OULUN YLIOPISTO

FACULTY OF TECHNOLOGY

DEVELOPING INFORMATION TRANSPARENCY BETWEEN SALES AND OPERATIONS

Riku Nyström

INDUSTRIAL ENGINEERING AND MANAGEMENT

Master's Thesis

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ABSTRACT
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Abstract

This thesis studies the information transparency in the sales and order-delivery process of the case company, focusing on the information flow between sales and other functions. The aim of the study is to identify the challenges related to information transparency in the order-delivery process of the case company and to find out how transparency can be improved, what the implementation of improvements requires and how the effects would be reflected in the order-delivery process. By developing the transparency of information and modifying the process accordingly, the aim is to facilitate the flow of information between different business functions, ensure the quality of information and shorten the process lead time.

The thesis was done in cooperation with a company operating in the manufacturing industry and utilizing Engineer-to-Order (ETO) production strategy. The main research method used in the study is a qualitative case study, for which data was collected from project-related meetings with case-company, e-mail discussions and by arranging semi-structured interviews for representatives of key business functions in the order-delivery process.

Based on the data collected from the case company and the results of the interviews, challenges related to information transparency were identified. Comparing these challenges with the findings from the literature, the aim was to create a solution by proposing to increase the features of the information systems already in use by the case company and to modify the order-delivery process accordingly. With small changes to the information systems and practices within the order-delivery process, it is possible to shorten response times and improve collaboration between different units. These changes increase the efficiency of entire order-delivery process and by shortening the average process lead time, they increase the case company's profit margin.

Typically for a qualitative case study, the results of the study cannot be directly generalized to other companies, as organizational structures, used information systems, operating environments, and order-delivery processes may differ significantly even for companies manufacturing similar products. However, some of the challenges related to information systems identified in the study are more common, so some of the related development proposals can be modified to be suitable for other organizations.

Additional Information

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Tiivistelmä

Tämä työ tutkii tilaus-toimitusprosessissa kulkevan tiedon läpinäkyvyyttä case-yrityksessä keskittyen myynnin ja muiden toimintojen väliseen tiedonkulkuun. Työn tavoitteena on tunnistaa tiedon läpinäkyvyyteen liittyvät haasteet case-yrityksen tilaus-toimitusprosessista ja selvittää, kuinka läpinäkyvyyttä voidaan parantaa, mitä parannuksien toteutus vaatii ja miten vaikutukset näkyisivät tilaus-toimitusprosessissa. Kehittämällä tiedon läpinäkyvyyttä ja muokkaamalla prosessia sen mukaiseksi, pyritään helpottamaan yksiköiden välistä tiedonkulkua, varmistamaan liikkuvan tiedon laatu ja nopeuttamaan prosessien läpimenoaikaa näiltä osin.

Työ on tehty yhteistyössä valmistavassa teollisuudessa toimivan Engineer-to-Order (ETO) -tuotantostrategiaa hyödyntävän yrityksen kanssa. Päätutkimusmenetelmänä työssä käytetään laadullista tapaustutkimusta, jota varten case-yrityksestä on kerätty dataa projektiin liittyvistä palavereista ja sähköpostikeskusteluista sekä järjestämällä tilaus-toimitusprosessin keskeisten liiketoimintayksiköiden edustajille puolistrukturoidut haastattelut.

Case-yrityksestä tutkimusta varten kerätyn datan ja haastattelujen tulosten perusteella tunnistettiin tiedon läpinäkyvyyteen liittyvät haasteet. Perehtymällä näihin kipukohtiin pyrittiin luomaan ratkaisu ehdottamalla jo case-yrityksen käytössä olevien tietojärjestelmien ominaisuuksien lisäämistä ja tilaus-toimitusprosessin muokkaamista näiden mukaan. Pienillä muutoksilla tilaus-toimitusprosessissa hyödynnettyihin tietojärjestelmiin ja toimintatapoihin on mahdollista nopeuttaa vasteaikoja ja parantaa yhteistyötä eri yksiköiden välillä. Nämä tehostavat koko tilaus-toimitusprosessia ja lyhentämällä keskimääräistä prosessin läpimenoaikaa, ne mahdollistavat case-yritykselle paremman voittomarginaalin.

Laadulliselle tapaustutkimukselle tyypillisesti tutkimuksen tuloksen eivät ole suoraan yleistettävissä muihin yrityksiin, sillä organisaatiorakenteet, käytetyt tietojärjestelmät, toimintaympäristöt ja tilaus-toimitusprosessit saattavat erota merkittävästi jopa vastaavia tuotteita valmistavilla yrityksillä. Osa tutkimuksessa tunnistetuista tietojärjestelmiin liittyvistä haasteista on yleisiä, jolloin myös osa näihin liittyvistä kehitysehdotuksista on muokattavissa muihinkin organisaatioihin.

Muita tietoja

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In Oulu, 12.05.2020 Riku Nyström

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ABBREVIATIONS AND DEFINITIONS

B2B	Business to business
B2C	Business to customer
CODP	Customer order decoupling point
CRM	Customer relationship management
EAI	Enterprise application integration
ERP	Enterprise resource planning
ETO	Engineer to order
MTO	Make to order
SCM	Supply chain management
SME	Small and medium-sized enterprise

1 INTRODUCTION

If you were asked in a job interview to sell a pen to the interviewer, you would probably at some level understand what kind of sales process is needed to sell a pen to another person, whether you are a good salesman or not. Instead, if someone asks you to sell their company-made production equipment to a factory that is a potential customer to them, understanding the needed sales process for this requires a much deeper understanding of that specific industry and technical sales. In manufacturing industry, sales units need information from multiple different functions in their company's supply chain in order to operate efficiently and that information should flow fluently in both ways between sales and operations.

The role of the sales personnel in technical business to business (B2B) sales differs quite significantly from traditional business to customer (B2C) sales (Oakes 1990). The sales process in industrial and technical sales cases is usually complex and unlike ordinary B2C sales process, it requires inputs from multiple stakeholders to successfully operate. Cross functional participation, external inputs to the process, measurement of the process and joint supply and demand planning are some of the key success factors to achieve efficient and profitable business in manufacturing industry (Lapide 2004).

Business environments have changed significantly over the last couple of decades. Competition has grown, markets have expanded, and customer expectations are higher than ever before. This has increased the pressure on companies to lower overall costs throughout the supply chain, shorten lead times and radically reduce inventory. Product portfolios are also expected to be broader, deliveries completed within agreed schedule, and quality of customer service and the products themselves should be higher than before (Umble et al. 2003).

1.1 Background of the study

The Case company of this study operates in manufacturing industry and is facing challenges between sales and production information flow. Currently it relies heavily on manual work and excel based solutions. In order to achieve more productive sales process and gain competitive advantage, integration of different information systems used through the whole supply chain would be highly beneficial.

In manufacturing industry, company processes depend heavily on customer needs and type of products, that are produced. Products of the case company are large physical products, that require time and precision to manufacture, but most importantly in many cases they need also new engineering before production of a new order can be started. Customer needs are highly specific for each product. Large size and high costs of products means that they cannot be manufactured for warehousing. Thus, the production can only start after a customer order is confirmed and required product design and engineering is performed.

Sales forecasts are often inaccurate and not comprehensive enough. This creates challenges for each business function to operate efficiently as everyone must wait for the order confirmation and then production planning must wait for potential engineering work to be done. A major problem here is that at this point, sales has already promised a fixed price, delivery schedule and specifications for the sold product that fits their estimated lead time and production costs. If all the needed engineering for ordered product has been done for some earlier order, this causes no major issues. However, in cases where additional engineering is needed, this causes problems to meet the agreed delivery schedule and to fit the original budget, eventually decreasing customer satisfaction and business profitability.

This research was completed as a part of Reboot IoT Factory project's grand challenge 1, the cognitive supply network. Reboot IoT Factory is a joint project with multiple research partners and major industrial operators, funded by Business Finland and the companies involved. Large manufacturing companies are providing their factory premises for innovation and development platforms, where they are in collaboration with research organizations and IoT solution providers developing proof-of-concepts to revolutionize the Finnish manufacturing industry. Successful proof-of-concepts that have a potential to increase competitiveness can be scaled up to other factories and possibly other companies as well after piloting in forerunner factories.

1.2 Research problem, objectives and scope

The purpose of this study is to identify the key challenges in sales and order-delivery process related to information transparency in the manufacturing industry. This research focuses mostly on the challenges of the case company, but they are often encountered in other similar business environments. Challenges in information transparency are present through supply chain from suppliers, all the way to end customers. However, implementing an information system between every supplier and customer is not an option in most cases. This would probably result as expensive and tiresome stakeholder selection process and eventually no money or time would be saved compared to more traditional ways. Information transparency between case company, suppliers and customers is equally as important as internal information transparency. However, it can be easier to start building it from inside out, so the scope of this study is limited to supply chain between procurement and sales. Efficient information flow through the supply chain from sales to procurement is not easy to accomplish, but it does have a serious potential for cost savings.

Case company has developed a new information system Prospect to project (P2P) to simplify their sales and bidding processes and cut the waste. The system is now in test-use and it is constantly generating new data. The next step is to find out how to make the most of the system. How to provide the right data to all business functions that need it and how to process it in a way, that all the needed information is provided in easily understandable format. Previous research and literature will be used to understand the potential best practices for improving information flow and data utilization in case company's current situation.

Research questions (RQs) of the study are as follows:

RQ1. How can information transparency be improved in supply chains?

The first research question is answered by providing a good theoretical foundation in literature review for improving information transparency in supply chains.

RQ2. What information requirements are related to sales and order-delivery processes in the case company?

The second research question is answered with interview results in the empirical part of the study.

RQ3. What are the current challenges and development needs related to sales and order-delivery processes in the case company?

The third research question is answered with collected data and results from the interviews in the end of empirical part of the study.

RQ4. How to improve the sales process and supply chain information transparency in the case company?

Last research question is answered through the recommendations made from combining the interview results and other case company data with findings from literature review.

Even though each supply chain is slightly different, and each organization has its own characteristics, many of the practices can be also scaled up for other organizations with some small modifications. Afterall, organizations that are trying to improve their sales processes or supply chain information transparency have common goals to cut the costs, shorten the lead time and improve customer satisfaction. Which one of these is the highest priority varies from case to case.

1.3 Research process

This is a qualitative case study that starts with literature review. The most important data collection method used in the study was semi-structured interviews with employees from the case company. Interviewed employees were selected from separate teams from different parts of the supply chain so that the current state analysis for the company could be as accurate and realistic as possible. In addition to literature and interviews, the study uses the existing data provided by the case company and some information may be exchanged between overlapping proof of concepts (PoC's) in Reboot IoT factory project.

The thesis starts with introduction part. The structure of the thesis, background of the study and research questions are introduced in first part which also clarifies the purpose for this study and how it is performed. The second part of the study is the literature review, where theoretical background is built to support the research by presenting relevant existing literature related to the topic. Literature review helps to thoroughly analyze the results of the study and come up with solid conclusions to improve the business of the case company. Employees from the case company's relevant units and teams were interviewed and the results of the interviews and data collection are presented and analyzed in third part of the study. The fourth part of the study consists of discussion, where the data obtained from the interviews is compared to the best practices found from previous research and literature. Limitations of the study are discussed and based on the findings, process- and information system improvements are suggested for the case company. In the conclusions, fifth part of the study, research questions are answered one by one and recommendations for further research are provided. The whole structure of the study is illustrated in Figure 1 below.

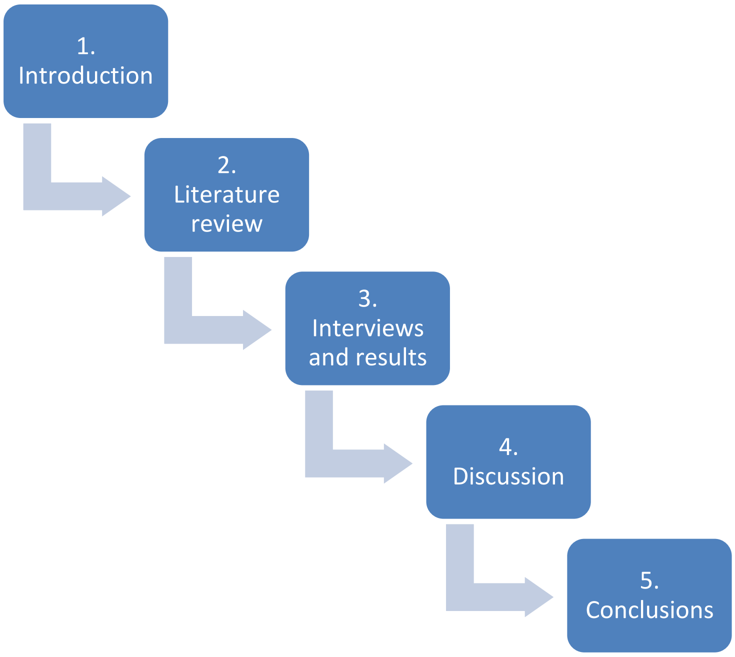


Figure 1. Structure of the thesis.

2 LITERATURE REVIEW

This chapter provides an overview of supply chains, supply chain management, different production strategies, and the processes involved in the supply chains. In addition to these, the flow of information between the different functions, information systems used in supply chains and how information transparency and efficiency of the processes can be improved by using these information systems will also be reviewed.

2.1 Supply chain management

2.1.1 Definition of supply chain management

Supply chain management has been around for thousands of years, but it has not been known with that name for longer than few decades. Virtually all larger successful projects in the history of mankind have required some level of supply chain management in order to make the project possible in the first place. Wars, building of something that has never been built before, or any other massive projects have a common fundamental need for supply chain management in a form or another (Christopher 2004).

To understand supply chain management (SCM) better, it is crucial to understand first, what supply chain means in today's world. Definition for supply chain by Mentzer et al. (2001) describes a supply chain as a group of three or more entities (organizations or individuals), who or which are directly linked to flows of products, services or information. This flow can move upstream or downstream in supply chain, but the chain is formed from "links". The first link in the start is supplier and after a number of links, depending on complexity of the supply chain it ends with a customer link.

It is important not to link SCM only to logistics as it covers multiple other areas of supply chain as well (Christopher 2004). Manufacturing, purchasing, distribution and sales all play significant role in SCM (Houlihan 1988). For companies in many industries, the ability to deliver flawless products to customers with shorter lead times and better reliability is essential requirement to even enter the highly competitive markets of today. To meet the demanding criteria, companies in manufacturing industry have to take a closer look at their supply chains and aim to seamless collaboration with their suppliers and distributors. (Mentzer et al. 2001). Monczka et al. (1998) described SCM as a concept, which aims to integrate and manage sourcing, controlling and flow of materials over all business units and multiple tiers of suppliers. Stevens (1989) encapsulates the main objectives of SCM as harmonizing the customer requirements with the flow of materials from suppliers to optimize efficiency and profitability without compromising the quality of products and customer satisfaction. Mentzer et al. (2001) emphasizes the importance of including all relevant business functions as part of the supply chain management and that the focus must stay on the goals of SCM. Supply chain management is described in Figure 2 below.

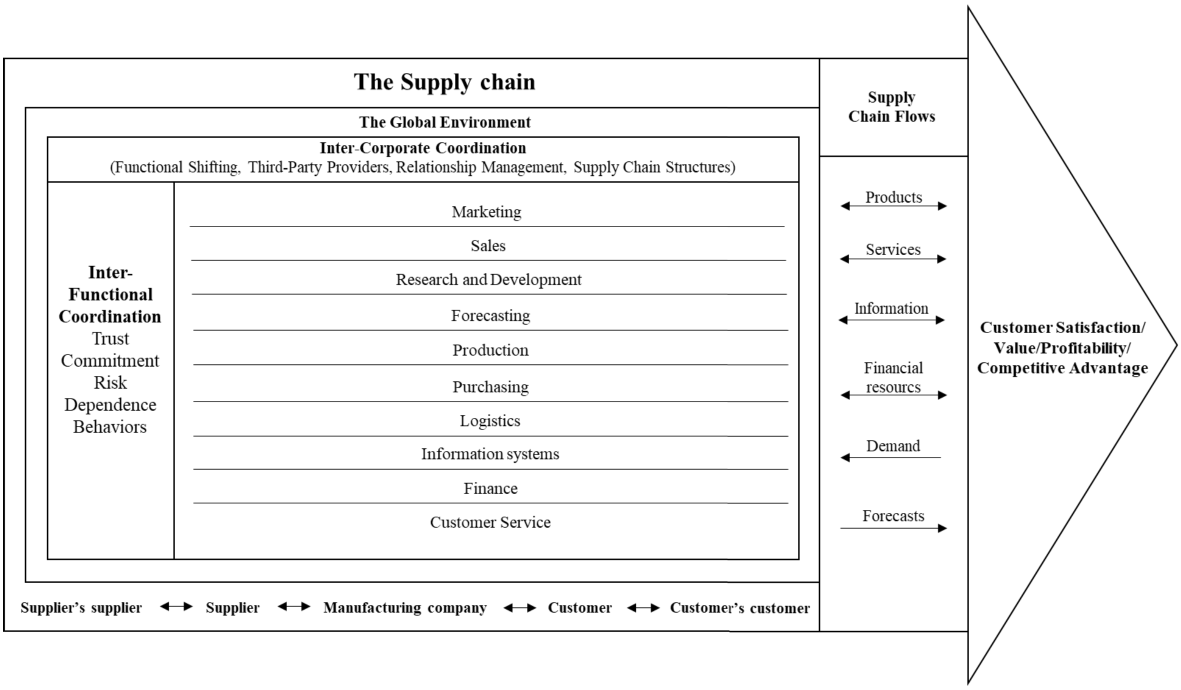


Figure 2. Supply chain management (modified from Mentzer et al. 2001)

2.1.2 Lean and agile supply chains

As the competition in markets is brutal, in many industries it means only few companies can be truly successful. To gain a good market share with competitive prices, and still be able to run a profitable business, companies are compelled to carefully design their supply chains. Volatile markets and customer demands force companies to improve their agility. Agile companies can answer to constantly changing customer demands quickly and being in right place at right time helps to build large customer base. However, keeping the business profitable at the same requires more than just will to answer the demand and this is where lean principles help. Combining lean and agile methods in supply chain design to create “leagile” smart and efficient supply chain helps companies to gain competitive advantage. Removing all non-value-adding steps (waste) in process through the whole supply chain can help companies to save large amounts of money, which allows them to have competitive pricing (Mason-Jones et al. 2000). Yet, it is important to keep in mind that the total value of the product to the customers is made up of several factors. As Johansson et al. (1993) proofed, it is impossible to increase the total value of a product with a move that improves one performance measure, but weakens another.

2.2 Information flow through supply chain

As said, in virtually all industries, competition has become so fierce that all companies must aim to optimize their supply chains in order to stay competitive. One of the largest issues in manufacturing industries is responding to changing customer demand. Every player through the whole supply chain has a common goal to meet the market demand. Unfortunately, in most supply chains, only the closest part of the customer knows the actual demand at that moment. As information moves manually through the entire supply chain, it generates a huge delay and distortion of current market demand (Mason-Jones and Towill 1997).

This distortion in supply chain information, caused by individual and mostly manually set orders between each member of the supply chain is known as bullwhip effect. If manufacturer only looks at the latest order information, it will probably result in amplified demand patterns, which will lead to increased manufacturing and warehousing expenses. And as the information goes upstream in supply chain, delivered demand data gets further from the actual market situation (Lee et al. 1997). The excess costs generated by distorted demand data can be enormous and that may have a huge impact on whole industries. As Fuller et al. (1993) revealed, almost one third of estimated $300 billion annual grocery sales consists of inventory. Huge amounts of products are caught somewhere between the end customer and first suppliers of supply chain.

Each supply chain generates enormous amount of data, that could be shared to other players in the chain. Examples of important demand-related information, that should be shared are point-of sales data, forecasts, existing firm orders, planned orders, and all inventory balances (Jonsson and Mattsson 2012). In many cases as the orders move upstream in supply chains, decisions are made based on the order information received from the closest player in supply chain. In more advanced models, the decisions are made based on combination of latest data from multiple sources. This can help the supply chain to adapt to demand fluctuation and avoid unnecessary production ramp ups and downs (Mason-Jones and Towill 1997).

As Mason-Jones and Towill (1997) stated, implementation of IT for data transfer through supply chain does bring success. The information should be managed so that it would flow through supply chain in real time but delivering the information in understandable format to right people is the key. In order to achieve efficient supply chain, it is crucial to look at the information as a strategic asset and make sure, that it flows through the supply chain with minimum delay and distortion.

For a company to gain competitive advantage, it is essential that the whole supply chain communicates efficiently. To maximize the competitive advantage the whole supply chain should operate seamlessly in real time and through the ability to quickly respond to customer demand changes, also customer loyalty can be attained. Losing that ability will most likely result in losing the loyal customers as well. If data is successfully delivered through the whole supply chain and real time information reaches right stakeholders in right format it will result in huge cost saving (Mason-Jones and Towill 1997). A study from Parente et al. (2002) also proofed, that quality of company internal relationship between the sales and production business units has a powerful impact on customer satisfaction, especially when it comes to engineer-to-order (ETO) products and companies.

2.3 Supply chain types based on production strategies

2.3.1 Engineer-to-order supply chains

The part of the process where customer orders arrive is called customer order decoupling point (CODP). CODP is the point, that separates supply chain to a part that responds straight to the customer and a part that uses forecast planning. In other words, all the products that are produced before CODP in supply chain are based on forecasts and the products that are made after CODP are produced based on customer orders. (Rudberg and Wikner 2004, Gosling and Naim 2009). Location of the decoupling point in supply chain determines a type for manufacturing environment. Hoekstra and Romme (1992) introduced a conceptual model of five logistic structures based on the place of decoupling point in the supply chain. This model was updated by Porter et al. (1999) to form shown in a list below.

- Make to Stock (MTS) – the decoupling point is located at finished products, the input of individual customers to product design is low and meeting customer needs requires producing a warehouse buffer.
- Assemble to Order (ATO) – the decoupling point is located in the assembly process, sub-assemblies or modules are manufactured according to forecasts and assembled after customer order is received.
- Make to Order (MTO) – the decoupling point is located at purchased goods, a list of products exist in catalogue and components can be purchased according to forecasts, but production starts after customer order.
- Engineer to Order (ETO) – the decoupling point is located at the design stage, products have high configurability and lots of modifications are made based on customer requests.
- Design to Order (DTO) – the decoupling point is located at the design stage, manufactured products are unique and they are designed to meet each individual customer's needs.

CODP is also the point in leagile supply chains, that roughly divides the planned lean processes that locate upstream in the chain from CODP and customer order related agile processes that are downstream from CODP (Mason-Jones et al. 2000). However, the list above does not mean, that each company is offering products from only one of these categories. For example, ETO sector includes a wide range of companies that design and manufacture a variety of products for multiple different purposes and many ETO companies which are producing capital goods, also produce MTO products, like spare parts as a side business.

In the definition of ETO supply chain, customer orders arrive in design stage of the production process. Thus, each individual product goes through the design phase and creates a pull in the supply chain. ETO supply chains are often linked to industries like construction or capital goods, where projects are usually large and complicated (Rudberg and Wikner 2004, Gosling and Naim 2009). ETO companies can be divided to four ideal types based on their core competencies and a few other selected characteristics, as illustrated in Table 1 (Hicks et al. 2001).

Table 1. Four ideal types of ETO companies (modified from Hicks et al. 2001)

	Type I	**Type II**	**Type III_1**	**Type III_2**
Definition	Vertically integrated	Design and assembly	Design and contract	Project management
Core competences	Design, manufacturing, assembly, project management	Design, assembly, project management	Design, project management, logistics	Project management, engineering expertise, logistics
Competitive advantage	Product and process knowledge; integration of internal processes	Systems integration; co-ordination of internal and external processes	Systems integration; co-ordination of internal and external processes	Reputation; engineering knowledge
Vertical integration	High	Medium	Low	Very low
Supplier relationships	Adversarial	Partnership	Partnership	Contractual
Environment	Stable	Uncertain	Dynamic	Dynamic
Type of risks	Capacity utilization, return on capital, under-recovery of overheads	Lack of manufacturing may undermine design capability. Sharing core knowledge with suppliers makes them potential competitors	Overall contractual risk capability and performance of suppliers	Loss of reputation

2.4 B2B sales process

B2B markets mostly consist of large and powerful customers, who are buying to drive their own organizational objectives. Selling in B2B markets in most cases includes working with professional negotiators from customer organizations and the sales process can last for months or even years as the deals are large and negotiations intense. Purchases are important for customer organizations' business so decisions must go through comprehensive judgement (Figure 3). Fortunately for sellers in B2B markets, this leads to more rational purchasing decisions, as the buyers must be able to justify them to others in their organizations. Products sold in B2B sales are often customized according to customer requirements and quality assurance, after-sales and additional technical services play a large role. In B2B markets customers value short delivery times, but most importantly reliable deliveries as their own operations may come to a halt if the delivery is not received within agreed schedule. This often raises the importance of delivery reliability over price of the product (Jobber and Lancaster 2009).

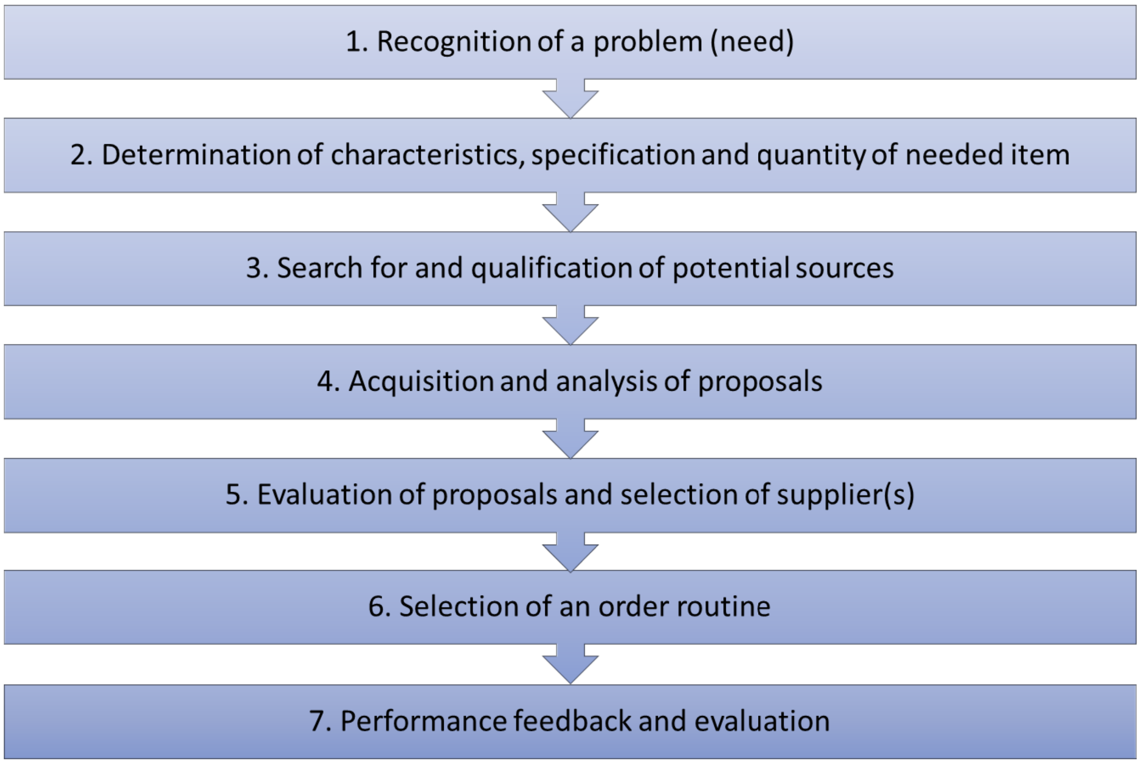


Figure 3. Organizational decision-making process (modified from Jobber and Lancaster 2009)

It has always been central for managers in B2B sales to keep the customer in mind at all times during the sales process (Paschen et al. 2020). As depending on industry sector, potential customers are limited in B2B markets and cost acquiring a new one can be tremendous, it is very important to value the customers and hold on to them (Jobber and Lancaster 2009). Challenges in acquiring a new customer vary a lot depending on the product or service that is being sold. According to Syam and Sharma (2018), sales processes vary significantly depending on the industry, the company, and especially the complexity of the product. When the product is complex technological solution that may be completely unfamiliar for buyers of the potential customers, lots of consultative selling is required so that the customers understand the product and the potential benefits it could provide to them. In the case of more traditional products or services, the customers already understand that they need a certain type of product (Viio 2011). In these cases, the buyers more generally go through the decision-making process described in Figure 3 above. Similar general steps for selling are described in the Figure 4 below.

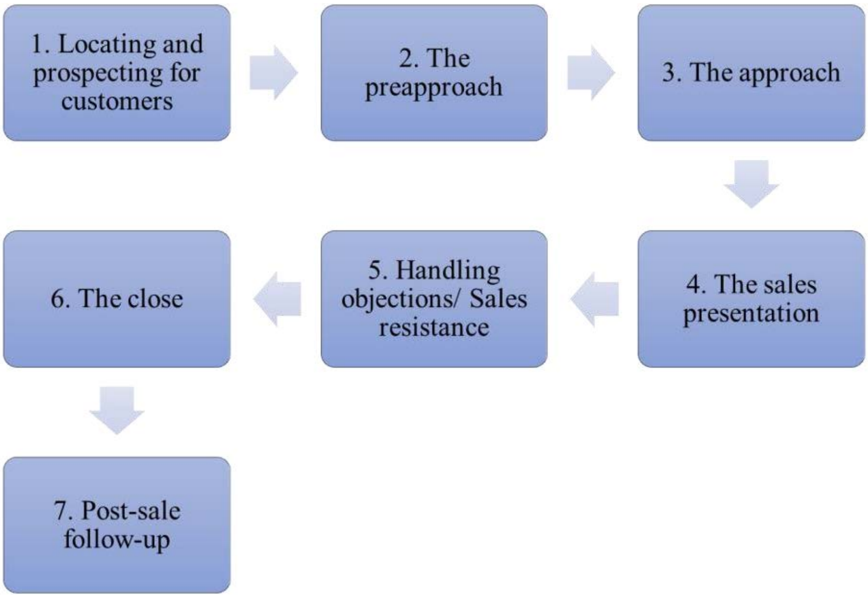


Figure 4. Seven steps of sales (modified from Dubinsky 1981)

Although in reality the sales processes vary significantly between different companies, the basic idea behind the sales process is the same. The seven steps of sales (Figure 4), introduced by Dubinsky (1981) each include several alternative techniques for performing the step. These depend on the product, company and multiple other factors, but still the basic idea stays the same. First the potential customer must be identified by sales (Step 1), they must gather specific information on that prospect (Step 2). Step 3, the approach includes the first contact from sales to prospect and the idea is to get the attention of the prospect and keep it. Step 4 is the basis of the sales activity where, the salesperson presents the product offering, and tries to convince, that prospect would benefit out of it. If the prospect does not agree to buy the product immediately, salesman must handle objections and still try convincing the prospect better in step 5. Closing the sales deal in step 6 means negotiating, finalizing the details of the transaction and trying to make the prospect sign the contract. Step 7 consists of different ways of convincing the customer, that the purchasing decision has been a right and, in some cases, providing trainings for customer organization about the purchased product or service.

With the development of technology and various information systems, B2B sales processes have also changed dramatically. Global, instant communication, enabled by the Internet and mobile phones, has transformed B2B sales, like all other areas of business as well. B2B salesmen travelling around the world have not been on their own for a long time (Paschen et al. 2020). According to Ingram (2004) the environment in B2B sales is again changing at a rapid pace. Customer preferences are changing constantly changing, and patterns may be difficult to perceive. The customer bases are more diverse and in order to succeed, internal and external collaboration has become essential for sales processes. Paschen et al. (2020) highlights how using emerging technologies like AI can enable companies to utilize huge amounts of data, that is available. As environment and customers are changing sales processes must also keep up with the change.

2.5 Order-delivery process

The order-delivery process refers to the company's internal process, where various stages of the process are implemented by different departments of the company. The process consists of guiding and executing work. Guiding work includes sales, order processing, procurement and financial management. Where executing work includes handling of the goods, transportation, production and executing payments (Sakki 2014). The order-delivery process is often a core process for the companies in manufacturing industry. It starts with customer order as an input and ends with the output as a final product which will be delivered to the customer and charged. Depending on type of the product, in some cases the order-delivery process continues even after invoicing in the form of possible after-sales services and customer feedback (Hannus 1993).

The order-delivery process in manufacturing industry is easy to understand, because great part of it consists of material flow. Procurement, manufacturing, testing, warehousing and delivery each form their own process and they can be described as a chain that forms one large process. The challenge, instead, is to ensure smooth flow through the entire chain (Laamanen 2001). According to Sakki (2014), in industrial and commercial companies, the logistical steps of the order-delivery process can typically be divided into inbound process, warehousing, and outbound process. The inbound process includes procurement activity, transportation of the procured products or materials, receiving the incoming goods, and the financial management of the procurement. The warehousing between the incoming and outgoing process causes a lot of work, in the order-delivery process, depending on the industry and also commits capital. The outgoing process, on the other hand, includes work steps related to customer service, shipping of goods and invoicing. The basic idea behind order-delivery process can be described with Figure 5 operations management below. The principle of the order-delivery process is always the same, internal functions, input resources and outputs can be different for each case.

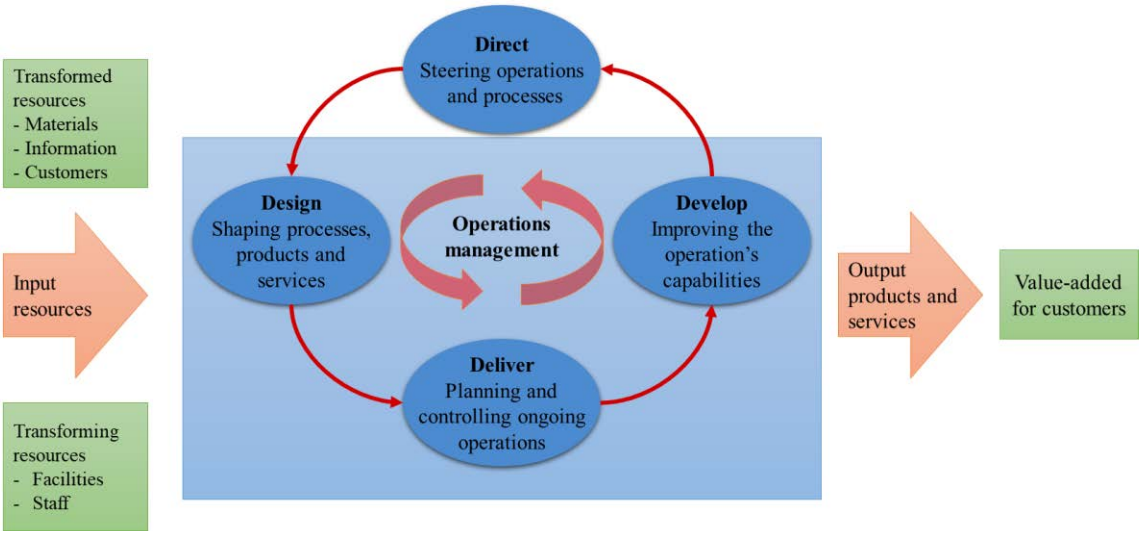


Figure 5. Operations management (modified from Slack et al. 2013)

The input resources of the process are transformed into group of products or services, which are the output. The purpose of process output is to create value for customers with the product or service delivered (Slack et al. 2013).

2.6 Data utilization

When information is shared through supply chain, the way of sharing the information efficiently and the information quality are important success factors for better performance. However, team is only as strong as its weakest member and in this context, it is often the efficient utilization of the information. Nonetheless, all the factors that have effect on willingness to use the shared information have to be considered as the information utilization will be inefficient if willingness to use it is low (Jonsson and Myrelid 2016).

As data and information are not the same thing, definition of the terms must be done in order to be able to utilize data efficiently. Data is values and symbols, computerized representations of models and attributes of entities. With pure data, no questions can be answered, but after processing it into information that becomes useful. Information is data with a meaning and based on information, people can gain understanding and use the information for decision-making. In order to make the most efficient use of the available data, it is therefore very important to ensure that all parties receive the data as information or at least can easily convert it into information themselves. A good way to turn data into information and ensure its better understandability is to use visualizations (Chen et al. 2009). Importance of understandability must be kept in mind, when moving information in supply chains. This can be also seen in the Figure 6 below.

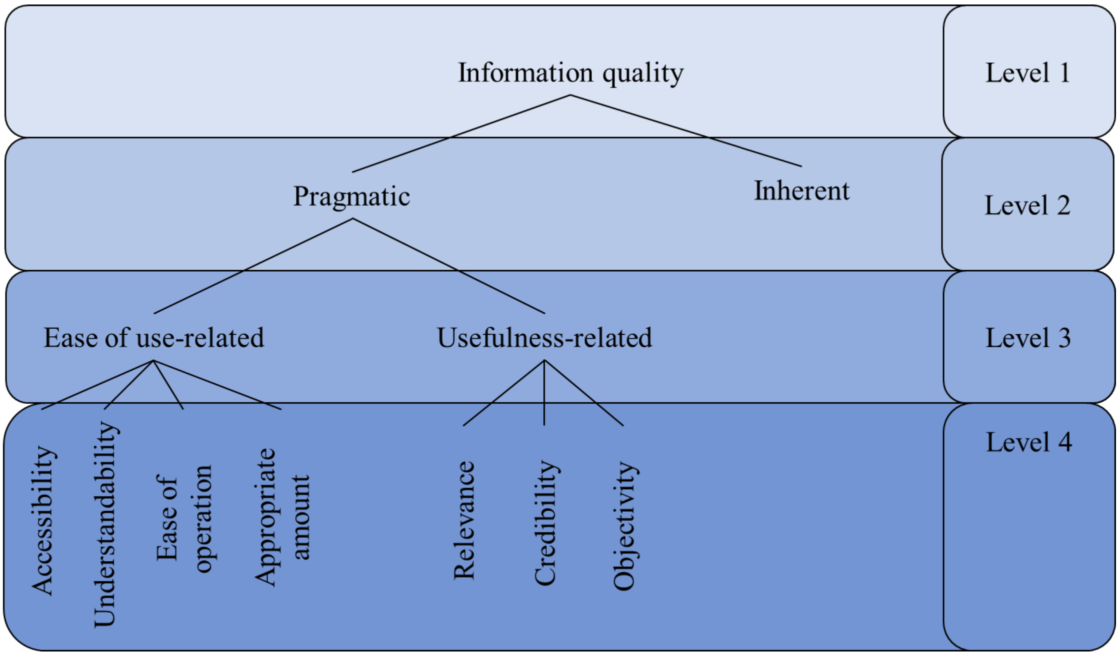


Figure 6. Levels and dimensions of pragmatic information quality (modified from Myrelid and Jonsson 2019)

2.7 Supply chain information systems

In order to remain competitive, companies need to constantly develop their own operating models and to be able to work more seamlessly with all of their stakeholders. It is essential for the smooth operation of business that suppliers, the distribution network and the customers get the information they need. In-house operations also need to be able to communicate accurately in terms of content and time (Umble et al. 2003). Information transparency and supply chain integration is essential for most businesses in order to succeed in their field. A significant part of those can be achieved by using right kind of information systems in right parts of the supply chain. Different parts of the supply chain have different kind of needs for information systems. This means that a business that could manage all the information through their supply chain with only one information system does not exist (Themistocleous et al. 2004). Some information systems used in supply chains are large modular systems like enterprise resource planning systems (Themistocleous et al. 2004), but most of the systems are a little less comprehensive and targeted for more specific needs in supply chains.

2.7.1 Enterprise resource planning

Enterprise resource planning (ERP) systems are enterprise information systems, which became more common during the 90's. ERP systems consist of multiple modules, that are meant to serve the needs of each business unit or function and that way they provide a large, integrated supply chain information system. In order to reach the full potential of ERP system, organizations implementing the system should replace most of their existing information systems with ERP modules. However, ERP systems are very heavy and complex systems, that require long and expensive implementations to work properly. High costs, inflexibility and in many cases lack of support for outside data, especially from systems that are taken into use after the ERP implementation prove, that ERP systems cannot handle all of the supply chain information (Themistocleous et al. 2004). This causes challenges for companies after the ERP implementation and in a study from Themistocleous et al. (2001), 72% of companies have faced major difficulties when customizing their ERP systems and 82% have been struggling with the integration of the ERP with their existing or new information systems.

2.7.2 Customer relationship management

Customer relationship management (CRM) system is an information system that supports customer management processes and provides needed information for customer relationship management. (Garrido-Moreno et al. 2010). According to Laudon and Laudon (2010) this information helps companies or organizations identify, attract, and retain their most profitable customers. Hendricks et al. (2007) states that CRM systems provide an environment that facilitates long-term customer relationship building. For sales organizations, information from the CRM systems can also help to increase sales. Other potential benefits include increased customer satisfaction, reduced marketing costs, more efficient marketing, and lower customer acquisition and retention costs. (Laudon and Laudon 2010).

2.7.3 Product data management

Product data management (PDM) system means a software environment that centrally manages information and files related to a company's products. The data stored in PDM systems is typically documents created or modified by a design program, such as CAD models, drawings, and calculation files, as well as documents linked to them, such as test reports, specifications, and part names or numbers. The PDM system also manages metadata associated with documents, such as information about who created the document, who last modified it, and what is the status of the document. Systems store information of different versions of documents and revisions. Product structure can be created for the managed product and create the hierarchy of different subassemblies in relation to the main assembly can be described and a parts list (BOM, Bill of material) can be produced on this basis. According to Mesihovic and Malmqvist (2000) the system may also have a built-in or integrated product configurator that can be used to manage very complex product variations.

2.7.4 Enterprise application integration

As there are almost as many options for information systems to use to handle supply chain data as there are supply chains, there must be links between different systems as well. Enterprise application integration (EAI) generally refers to activities that combine and convert the information in organization from system into another that needs it. The need for EAI is developed as amount of information in an organization grows and is being stored in different systems for different purposes. Increasing the amount of information leads to a situation where a single new system or process needs existing information that is spread over several information systems (Themistocleous et al. 2004).

2.8 Successful implementation of information systems

Information systems are supposed to help companies to gain competitive advantage, however that can only be achieved with successful implementation of information systems. Depending on type of the needed information system, their implementation projects can take lot of time and money (Gargeya et al. 2005). Implementation of a new software tool for couple employees without a need for integration with other systems does not require lot of resources, but company wide information systems require huge efforts for successful implementation. Research by Seethamraju (2015) shows that educating users, learning all the features of the new software and starting to use them have been identified as the key issues with new information systems.

To understand the challenges in software implementation more comprehensively, the implementation can be divided into parts. The initial implementation, where all the technical work for information system is done and system "go-live" is executed. This is the moment when the system is started using the first time in that environment. After go-live companies are facing a challenge how to get employees and possibly other stakeholders to use the system on a regular basis. From this moment onwards it is crucial for persons responsible for implementation project to have needed change management skills. The whole organization must have a clear understanding of how important it is to start using the system, starting from committed management (Seethamraju 2015). According to Gillooly (1998), up to 70 percent of ERP implementation projects are not fully completed after three years. Projects that long inevitably generate significant costs and they may cause a full failure of ERP implementation. In addition, this may cause situations where it is difficult to return to previous state with old information systems and processes, but it is not wise to proceed with the implementation like originally planned. This kind of dead end situation will probably generate even more costs as organizations often need to hire external consultants to get out of it (Gargeya et al. 2005). The critical success factors of ERP implementation are listed in the Table 2 below. Most of these success factors apply to other large information system implementations as well.

Table 2. Critical success factors in ERP implementation (modified from Fui-Hoon Nah et al. 2001)

Critical success factor	**Description**
ERP teamwork and composition	For the implementation of an ERP system, it is very important to form a team that includes the organization's top experts from different functions. The team should include in-house employees as well as consultants specializing in software implementation. The team must have sufficient business and technical expertise. It is very important that the ERP project is given high priority in their work and the total workload is considered reasonable. The team should be given clear incentives for successful implementation within the schedule and initial budget.

Top management support	The company’s top management needs to support the ERP project from start to finish. This also means defining the company’s strategic goals so that they support ERP implementation. As in the case of the ERP team, top management bonuses should be at least partially tied to the success of the project. In order to have sufficient resources for ERP implementation, top management must clearly align the project as the highest priority for the company.
Business plan and vision	It is important to create a clear business plan to guide the project throughout its life cycle. The business plan must show the strategic and concrete benefits, resources, costs, risks and timeline. These allow you to maintain a focus on the business benefits that the project aims to achieve. The goals and benefits of the project must be identified, and it must be possible to follow them. The change must be in line with the company’s future plans and needs.
Effective communication	Effective communication is a very critical part of the success in ERP implementation. Managing information, training, and expectations is important throughout the organization. Communication must include the composition of the teams assigned to the project as well as the status of the project as it progresses. Middle management must be able to convince employees of the importance of the entire project to the company.
Project management	Like any project, high-quality project management is essential in ERP implementations. The scope of the whole project must be defined and limited at the beginning. Clear milestones as well as a critical path to the project needs to be defined to support project management. In order to stay within budget and schedule, project milestones must also be reached on time. It is very important to closely monitor the progress, budget and success of the project from the beginning.
Project champion	The commitment of the project sponsor to implementation is important to engage the entire organization. The project should be sponsored by a high-level leader with the power to set common goals and approve future changes. The commitment of a high-level business leader facilitates change management across the organization.
Appropriate business and legacy systems	At the beginning of the project, it is important that the information needed for the ERP system is available. To create a functioning ERP system, existing business processes, organizational structure, culture, and existing IT infrastructure must be adapted to fit and support the new system.
Change management	Change management is crucial from the beginning of a project to the end of the entire system lifecycle. Changes in organizational structures and

program and culture	possible changes in culture require leadership. In order to avoid change resistance, the company should have common values and goals. All managers must be strongly committed to the use of the system, so that employees also prefer to use the new system and strive to achieve common goals. Change management also involves involving users in the design of the ERP system and new processes. To support this, users should be provided with the necessary training. The focus of the entire implementation project should be on staff training. Training and professional development of employees and management in terms of using the system and understanding its benefits is critical. Sufficient resources must be set aside for this at the beginning of the project. Employees and management must be able to understand, through the training provided, how the new system will change the company's processes. During implementation, support for use must be available at all times. Even after implementation, support for using the system must be easily accessible to users.
Business process reengineering (BPR) and minimum customization	The more widely an organization is implementing a new information system, the more likely it is required to modify existing business processes to be adapted to the new system. In ERP system implementations, this is inevitably ahead. Organizations should be prepared to modify their own processes as much as possible so that customization to the system itself can be kept to a minimum. Process development should take place iteratively with the system definition for maximum benefit.
Software development, testing and troubleshooting	Software development, testing, and troubleshooting are critical to the implementation of almost any system. The overall architecture of the ERP system should be defined before the implementation phase. This helps to avoid most laborious redefinitions in the later stages of the project. For all previously used information systems, a decision must be made whether to connect them to the new ERP system or to transfer the data from the old system to the new system entirely. To enable smooth integration, some legacy systems may need to be developed if existing solution is not available to create that interface. The organization acquiring the software should work seamlessly with software vendors and consultants to resolve any issues. Quick response, patience, perseverance, and problem-solving abilities are important qualities in the implementation of extensive software. There must be a clear plan for moving and pruning existing data. The right practices and tools are critical to success. Work steps should also be clearly documented.

Monitoring and evaluation of performance	The importance of project management is not only emphasized at the beginning. Continuous monitoring of targets and schedule throughout the implementation is very important to keep track of project progress as well as potential challenges. Achievements should be compared to the original goals. The monitoring should utilize the project team's understanding of the situation and the feedback provided by users. There must be clear evidence of meeting the goals and benefits of the system put in place. It is important for both management and employee motivation that the results of a large joint project are known and it can be seen that the resources used have not been wasted. In this way, management will continue to allocate resources to the project and employees will be more motivated to use the new system.

2.9 Theoretical synthesis

Using supply chain management, companies aim to optimize and control the flow of materials, information and money throughout their supply chain in order to achieve competitive advantage. Efficient communication between different functions plays a key role when organizations aim to streamline their processes utilizing lean principles and removing waste from supply chain processes. Rapid flow of information between functions is especially important in companies using ETO production strategy, as all functions must quickly react to customer orders.

Efficient information flow through the processes in supply chain can be achieved by using right information systems for managing and moving the information between functions efficiently and in understandable format. Well planned and executed implementation of integrated information systems for supply chain can lead to improvements in react times and the lead time of whole order-delivery process. Having successfully implemented, integrated information systems and processes through the supply chain enables a good level of information transparency and results as a strong competitive advantage, ultimately leading to better profitability for the company. This type of approach has also been proposed by Rai et al. (2006) and it is described in Figure 7 below.

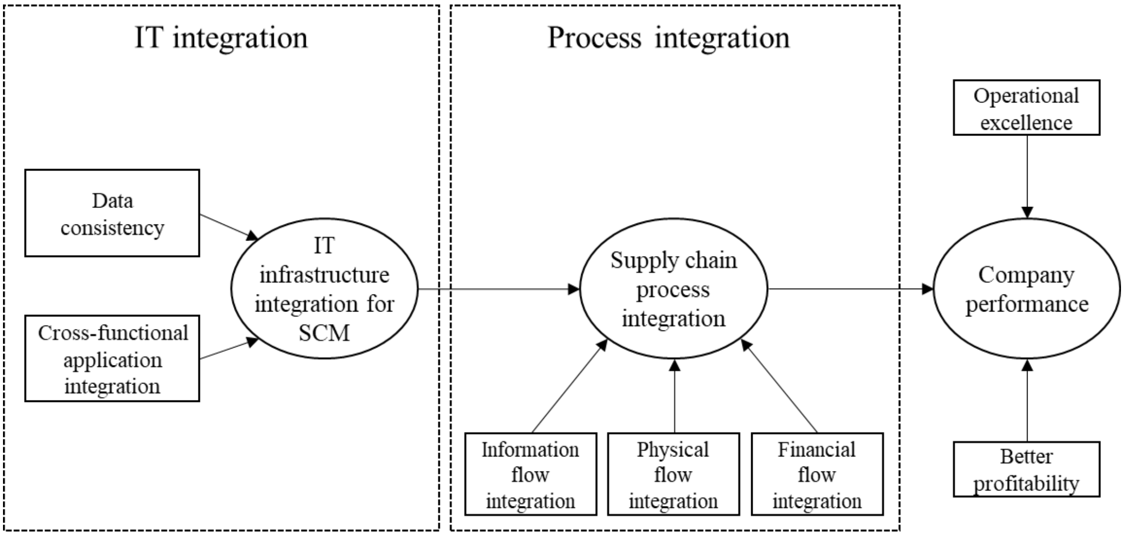


Figure 7. Supply chain integrations effect on company performance (modified from (Rai et al. 2006)

3 EMPIRICAL STUDY

3.1 Case company introduction

Case company of the study is a large global technology enterprise, which designs and delivers systems for positioning, surveying, navigation and automation to merchant vessels and offshore installations. The study focuses on their information systems and processes used in plant located in Finland, which manufactures marine thrusters. The case company has a large amount of old and new information systems in use. A lot of duplicate data is stored in several different information systems so finding the right information can be hard and there is no time to organize trainings for each system used by the employee.

Case company has recently implemented two new information systems and the aim of this study is to analyze best ways to utilize the data, that those systems provide and to find out how to improve general information transparency between different business functions of the company. Current state of the company's information systems is reviewed through interviews with different business functions and improvements are suggested for better efficiency and data transparency.

3.2 Research methodology

The empirical research of the thesis consists of semi-structured interviews, analyzing the information flow in case company's supply chain and building proposals for developing case company's existing information systems. The study was initiated by a literature review which sought to create good theoretical basis for information system development project for a company that uses ETO and MTO production strategies. This is a qualitative study and with gained knowledge from comprehensive background study about supply chains in manufacturing industry and information systems used in the sector, data is gathered from multiple semi-structured interviews held with the representatives of the case company. The interviews were conducted in February 2020 and based on the acquired data, development proposals were created in iterative interaction with the case company during March and April. One of the interviews was conducted remotely with Skype for business and the rest of them on-site at the case company's office premises located next to the factory.

Before the interviews, lots of data was collected from the meetings as well as email conversations related to the project, where the case company contact person and some other representatives of the case company were involved. This data included the case company's current information systems, how the systems are linked together, processes related to supply chain and what kind of challenges they have from the case company contact person's perspective. The organizational structure was also outlined, and what expectations the case company contact person had from the study. This information was used to shape the questions used in interviews and to form a better understanding of the current state of the case company, before validating that belief with the data and information gathered from the interviews.

The purpose of the interviews was to find out the current state of company's information systems, how they are linked together, which units use each system and what kind of information is needed and where. This was accomplished using a set of questions, which were used to create a frame for interview with each interviewee. Information systems used by each interviewed unit were modelled into a diagram, that illustrates the use of systems and dataflow between them. Duration of each interview was between 1 and 1.5 hours, depending heavily on how complex the diagram turned out with that interviewee. All the interviews were recorded, and notes were taken simultaneously. With the data from the interviews, a current state analysis about case company's information systems was created and it was compared to a "dream state" for case company's information system, which was modelled with case company contact person before the interviews. The aim is to eliminate waste in processes regarding the data handling in case company and streamline the dataflow and processes between different teams and functions through the supply chain.

Semi-structured interviews were organized for the employees from units, that were agreed together with the case company's contact person. The Case company contact person is working as a manager in sales support team and has been part of the Reboot IoT Factory -project from the start. The interviews were conducted for employees from product management and engineering, engineering to order, operational purchasing, sales support and production planning -teams. These business functions and teams were selected to be most important parts of the sales and order-delivery process, that operate within the Finnish factory's organization. Sales was not interviewed as it operates outside the factory organization and it was believed, that selected interviewees are capable to provide the needed information regarding the sales and order-delivery process. The role and place of these teams in the case company's organization is described and visualized in chapters 3.3 and 3.4.

The set of questions (Appendix 1), that forms the basis of the interview was created with case company to guide the conversation in the interviews. The goal of the interviews was to acquire needed information to form the understanding of current state of case company information systems. Question set was not fixed and could be modified between the interviews if necessary.

3.3 Overview of order-delivery process

The case company is manufacturer of heavy appliances for marine industry. On average, it takes months from a moment, when customer order is received for case company to design, manufacture and ship the finished product to the customer. As the products are physically large, require high manufacturing costs and in many cases highly customized to each customer, it would not be wise to produce them to stock. Using ETO manufacturing the case company can avoid most of the excess costs of warehousing, but on the other hand delivering products to customers is much slower. It would not be feasible to commit significant capital to the products in stock, thus other ways to shorten the product lead time should be reviewed to remain competitive.

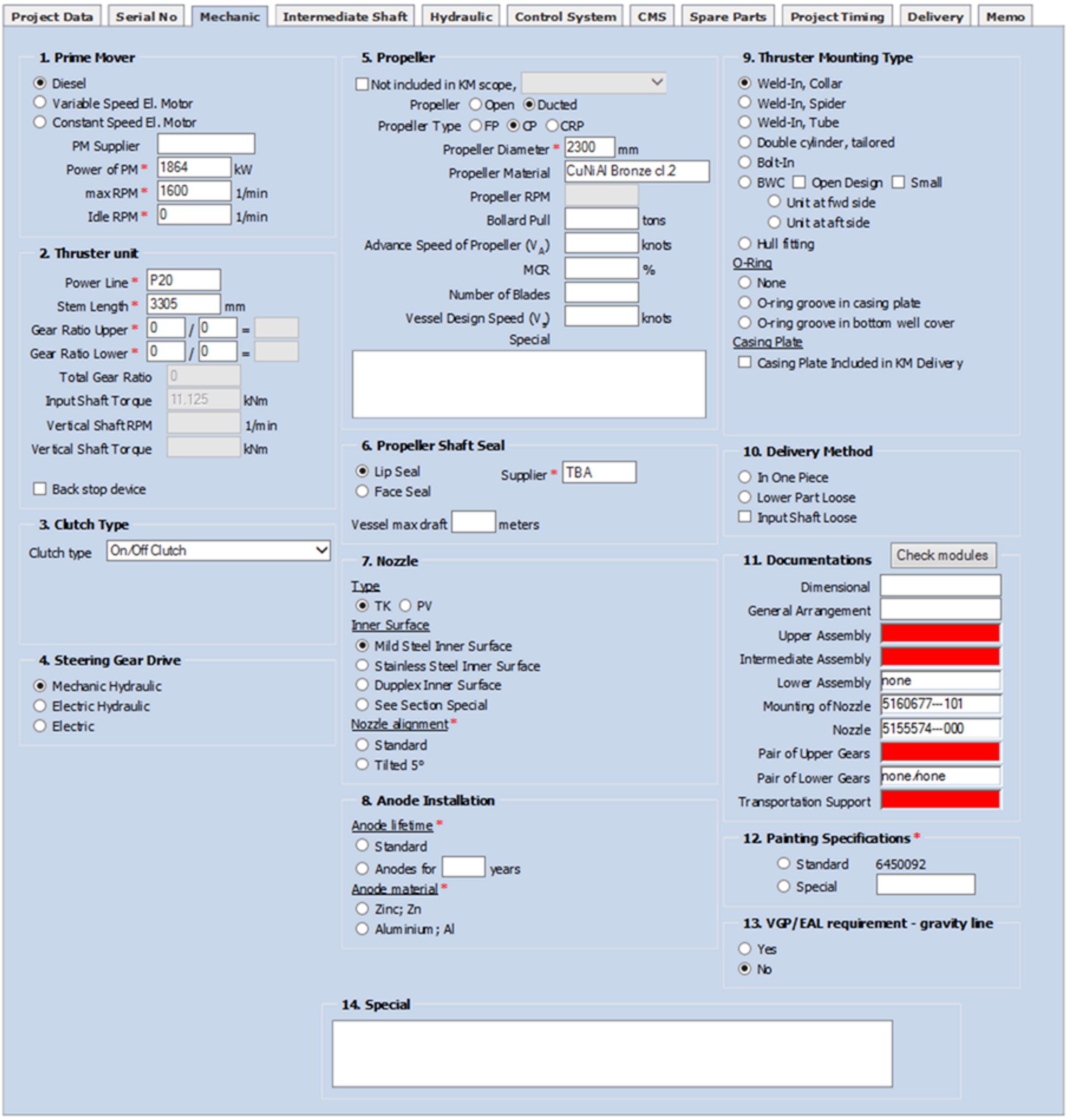
Having an engineering-to-order and manufacture-to-order production means that all the functions through the case company's supply chain require specific information about customer order from sales. Before receiving that information, they cannot proceed further with their work regarding that project. Engineering department needs the confirmation and technical specification of the ordered product, so that they can perform the possibly needed new engineering and designing work and then provide the documents to other functions. Procurement needs confirmation about sold products and included modules before they can order all the needed components and production needs confirmation and drawings so they can schedule the production in line with the schedule promised to the customer.

This transfer of needed information may take an unexpectedly long time with case company's existing information systems and processes. The situation is aggravated by the fact that information is often inadequate and has to be supplemented by return questions via email or telephone between different business functions. Missing information in technical specification of the product order can add a significant delay to the project as needed engineering work has to be postponed. That also adds excess pressure to the procurement as they must wait for the information and then rapidly place orders. At that point their supplier's delivery times could be too long to fit the schedule, so they may have to search for some of the components elsewhere and probably pay a higher price to receive the components faster.

3.3.1 Prospect to Project information system

The case company has recently implemented a new information system called Prospect to Project, or P2P. The basic idea of P2P is to streamline the sales process by providing needed data to right people in the supply chain. To users, P2P looks almost the same as its predecessor system (Picture 1) so it is easy to use for all employees who need it. However, the new P2P system has one major update, that has potential for significant time saving in the process. When the basic technical specifications of the prospect have been entered into the system, P2P should be able to retrieve the needed modules for the product from the case company's database. With the retrieved modules, P2P is able to form a technical specification document for the project, that earlier had to be manually assembled by the sales support team. For significant part of the products sold or offered to customer, the situation is that the modules are not yet available in the database as they have never been produced or designed before. This is also very valuable information, that P2P can provide as in these cases, a lot more engineering work is required compared to the projects that can be produced with the existing modules from database.

P2P was created to automate functions, reduce waste in the process, create more transparent overview and a common prospect interface with instant access for all the teams, that need the information. It also collects historical data, that has not been collected or used with earlier process and it may help to create more reliable forecasting with the information available. One of the most valuable features in P2P is the ability to verify in early stages of sales, if all the needed modules exist for that specific project. Without that information, in some cases unexpected need for engineering appeared after the contract for delivery was already made. When contract is signed, price for the product, technical specification, delivery time and budget for the project are all locked. When additional engineering work is added to the project after this point, it results as extended delivery time, probably higher price for components as they have to be purchased from distributors, that are closer than original suppliers and eventually lower margins for case company.



Picture 2. P2P user interface.

3.3.2 Organizational structure of the case company

The organizational structure of the case company is similar to many other companies in manufacturing industry with a twist of uniqueness from the specific needs of the business. The case company is part of a multinational company with plants and operation around the world, but this study is focusing mainly on operation of their plant in Finland. The organizational structure of the case company's Finnish part is visualized in the Figure 8 below. Country Managing Director is leading the whole organization and reporting to global management. On a upper level, the Finnish organization is divided to five units, which are listed below.

- Contract Management, ETO, Classification and Sales Support
- Supply Chain Operations
- Product management & Engineering
- Business development
- Strategic Purchasing

Each of these units has a designated director who is responsible for the operations of the unit, but Business development is managed by Country Managing Director. These upper level units include sub-units and teams related to that area of business, and most of them also have their own middle management, as can be seen from organizational sub-level organizational charts in Figures 9, 10 and 11.

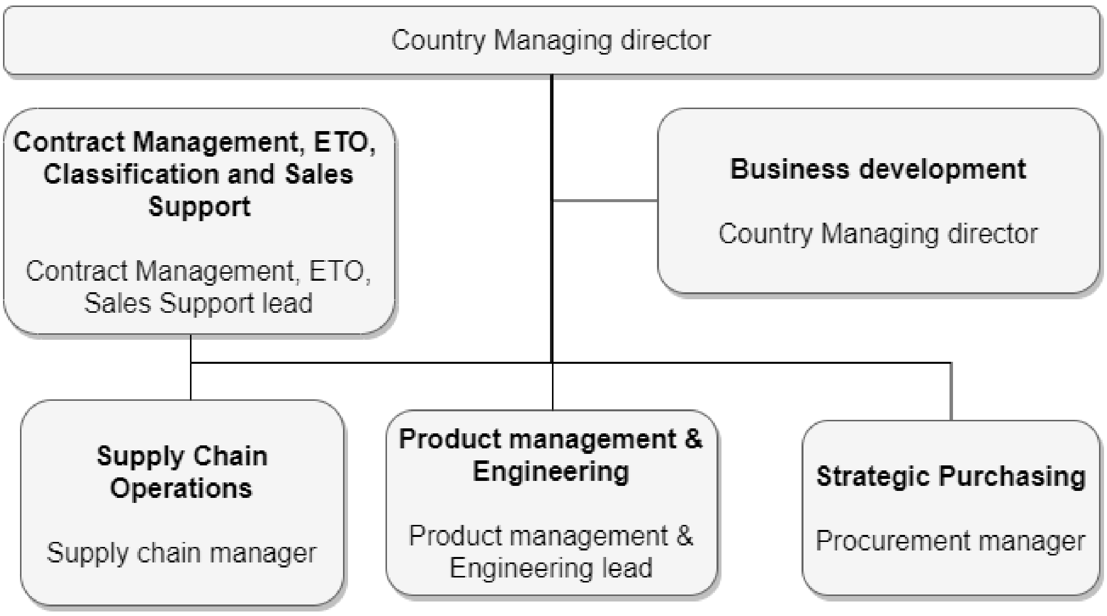


Figure 8. Upper level organization chart.

As this study focuses to information transparency in order-delivery process within the case company, interviewees were selected from limited number of units. The business processes are studied and developed to meet their needs in the best possible way with maximized efficiency and consistent quality. The business functions and teams, which are closely related to studied case company’s order-delivery process belong to different units in the upper level organization chart. The internal structure of these upper level units is pictured in the following figures. However, the organizational structure and hierarchy does not seem to play a major role in order-delivery process, so it is unnecessary to go through it in detailed level.

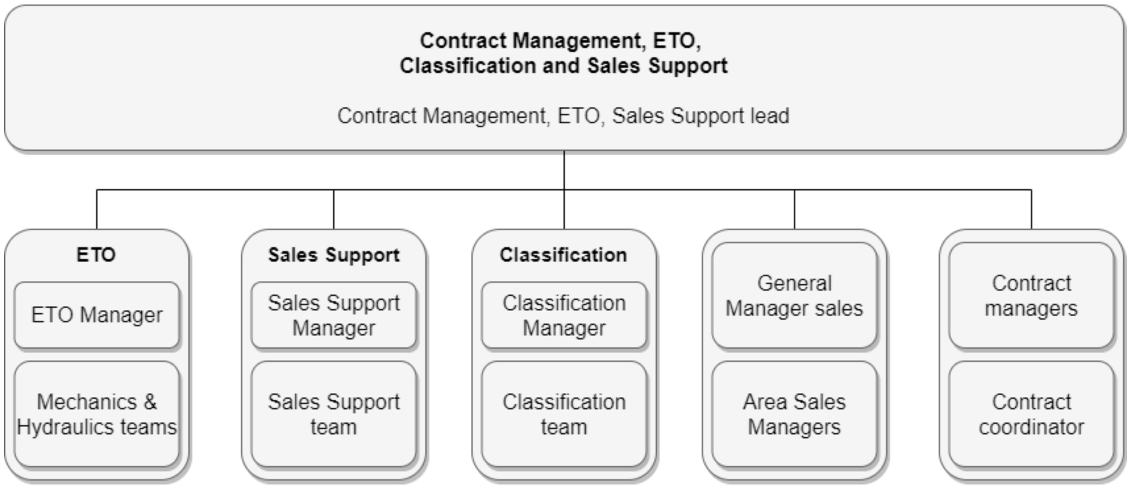


Figure 9. Contract management, ETO, Classification and Sales support organization chart.

Contract Management, ETO, Classification and Sales Support units include essential functions and teams for the studied process in this research. Sales support team is the main user of the P2P software and for the most part, they have been creating it in collaboration with the partner SME (Small and medium-sized enterprise). Case company contact person is the manager of sales support team and a member of sales support team was one of the interviewed case company employees. Engineering to Order Manager was also one of the interviewed employees and ETO has an important role in the studied order-delivery process in the case company. Even though sales teams and managers are part of the order-delivery process, sales representatives were not included in interviewed employees as the sales organization is scattered around the world. Critical information about the needs of the sales organization regarding the studied software was obtained through other interviews.

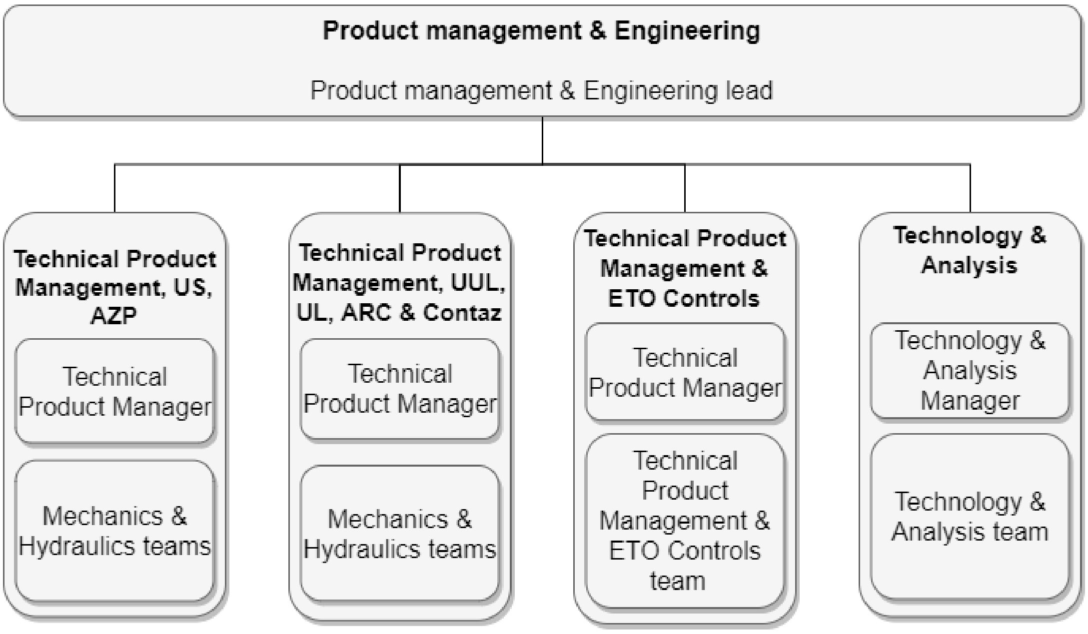


Figure 10. Product management & engineering organization chart.

Product management and engineering units consist of technical product management teams, managers and technology & analysis team. Each team's manager reports to product management & engineering lead. The unit is responsible for designing the modules and components needed for manufacturing the customer orders. These designs are then used by other units and teams like ETO, purchasing and manufacturing. Technical product manager from Technical product management, US, AZP was one of the interviewed case company employees.

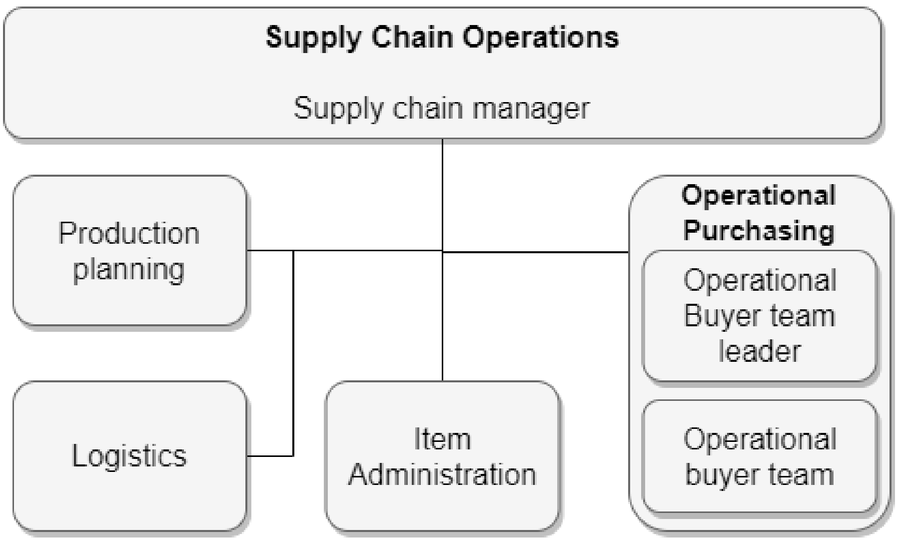


Figure 11. Supply chain operations organization chart.

Supply chain operations unit is led by supply chain manager and the unit includes essential players in order-delivery process. Operational buyer team leader, who is leading the operational purchasing was one of the interviewees. Operational buyer team leader reports both to Supply chain manager and to Procurement manager, who is leading the strategic purchasing unit. Another interviewed case company employee from the supply chain operations was Master scheduler from production planning. Both interviewees from supply chain operations both work in a key role in securing the case company's agreed customer delivery schedule.

3.3.3 Market situation

The market situation in the sector which case company is operating in has changed significantly in recent years. Customer demand has decreased over the years, creating more pressure to accept the potential orders. Manufacturers in the industry must be more flexible in their deliveries than before to meet the customer requirements. Delivery schedule is one thing that can create challenges, but flexibility also applies to other areas in delivery. Customers can insist for complex product configurations, which manufacturers have not produced earlier. Requests like this with a tight schedule, lower price and a need for additional engineering work, could have been passed by some manufacturers couple years ago. Now manufacturers must agree to strict customer requirements and produce those products with a lower profit margin.

Markets are expected to grow in close future, but current demand has put manufacturers into a situation, where it is even more important to optimize their processes and practices for more efficient and profitable business. It is extremely important to have good flow in information as well as material in order to remain competitive in this market situation. Using traditional lean principles in process improvement can help the companies to achieve that flow.

3.4 Analysis of order-delivery process information systems

The semi-structured interviews conducted for the study were arranged with the employees selected with the case company contact person. Information about the interviews is listed in Table 3 below. Focus of the conversation in the interviews was kept on topic with question set created for this study. The interviews started with asking the basic information about interviewees like name, role in the organization and the unit they work in. Most of the other questions in the question set were related to information systems used by the interviewee and the information transparency within the organization as well between other stakeholders involved in their regular work. If the P2P system had not come up earlier in the interview, the interviewees were informed about it. Finally, the interviewees were asked if there were any other comments on the information systems, information transparency or data transfer in the case company.

Table 3. Interviews.

Role of the interviewee	**Unit**	**Team**	**Interview date**	**Interview type**
Operational buyer team leader	Supply chain operations	Operational purchasing	06.02.2020	Skype
Technical product manager	Product management & engineering	Technical product management, US, AZP	17.02.2020	In person. Case company factory premises.
Engineer to order manager	Contract management, ETO, Classification and Sales support	ETO	17.02.2020	In person. Case company factory premises.
Master scheduler	Supply chain operations	Production planning	18.02.2020	In person. Case company factory premises.
Sales support engineer	Contract management, ETO, Classification and Sales support	Sales support	18.02.2020	In person. Case company factory premises.

During the interviews, a diagram representing the use of information systems by the team or unit of the interviewee was created. Based on these diagrams, the data about the information system usage is entered to tables in an easier-to-read and more comparable format. These information systems used by each unit of the case company are listed in following Tables 4, 5, 6, 7 and 8 under individual subchapter for each interview. The information system name is in the first column. The information to be retrieved and information to be entered into each system are specified in their own columns.

3.4.1 Operational purchasing

The role of operational purchasing team is essential for any company in manufacturing industry. Each component, part of electronics or hydraulics is ordered by purchasing and without them, it would not be possible to manufacture the products. From the material flow point of view, in manufacturing company, purchasing or procurement is the one who sends the purchase orders to suppliers, so that they can send the needed parts for production. On the order-delivery process point of view, operational purchasing is located more in the middle of the process. When sales receive a customer order, a technical specification of the ordered product is sent to product management and engineering so they can design the modules and parts needed for manufacturing that specifically ordered product. Only after this, procurement can purchase components from suppliers, as they know what is needed for the product. After this the production planning may schedule the production and when the product is ready it is shipped to the customer.

Already at the beginning of the interview it became very clear that the operational purchasing uses a significant number of different information systems in their regular work. During the interview, interviewee listed a total of 12 information systems, that their team uses in supply chain related work. Large amount of used information systems is directly linked to team's role in the order-delivery process. In order to perform their tasks, they need to obtain information from several different units. Many of the information systems they use are for information retrieval purposes only, and the team itself does not provide information to those systems. On top of all the listed information systems, lots of different Excel sheets are used to store and manage data related to operational purchasing teams work. Many of these Excels are also being used by other units. According to the interviewee, the operational purchasing unit regularly works together at least with strategic purchasing, supplier quality, product management and engineering, production planning, production, sales, warehouse and external logistics service provider.

The interviewee pointed out, that accessing these information systems is easy, but due to the large number of used systems, only some are provided with the proper training. This results in significant differences in user skills between different information systems, which often results in performing the tasks slower and with uncertainty. In addition to retrieving information from multiple information systems, the operational purchasing team has to often check various issues from other units or suppliers by phone or email. In many cases the manual information retrieval by email can create bottlenecks in process and result in expensive delays.

According to the interviewee, the process could be significantly streamlined by creating a functioning system for transferring critical project-specific product information between units, such as P2P system and a similar functioning system should also be available for enabling the flow of information between suppliers and the case company. Currently it is agreed, that operational purchasing should receive a sales forecast four times a year, but this may not always be the case. Also, the content of the sales forecasts does not bring concrete content to the forecasts sent to suppliers, as they are device- and device-size-specific. More accurate and frequent forecast from sales would benefit the whole supply chain and, in many cases, shorten the lead time of case company's products significantly.

Table 4. Information systems used by Operational purchasing.

Information system	**System use and retrieved information**	**Entered information**
ENA	Part lists and other documents for projects. Works also as a B2B portal for some suppliers.	Read only, but data regarding orders moves both ways between ENA and Baan.
MDM	Used in planning department. Data from Team center and mapper goes through MDM to Baan.	Logistics templates.
Planner	Tool for planning unit. Data comes from Baan. State of project delivery can be checked from Planner. What has been bought, what is still needed and what items are arriving late. Thruster supply chain retrieves a spreadsheet from Planner for risk analysis every morning.	Read only.
Baan	ERP. Project/Production controlling system. Main tool for planning/production/procurement to plan and handle material flow.	ERP. Main tool for planning/production/procurement to plan and handle material flow.

Mapper	Old ERP. Old order/item data and some BOM's/project related date still available here.	Read only.
ECM	Baan's document storage. Same data available about products than in ENA, Team center and Mapper.	Read only.
Item data control (IDC)	Tool for strategic purchasing. Item names are imported from Baan for pricing.	
Cognos	Web-based reporting system, that uses data from Baan for creating reports.	Read only.
P2P	Not in use yet.	
DHL portal	DHL transportation tracking and Power BI for visualization of data in the system.	
Team Center	Newer information system used by Product design. Product drawings and part lists.	Read only.
Logisticar	New system for warehouse controlling. Gives suggestions for procurement based on history data. Batch sizes, safety stock, what to buy and when etc.	Read only.

3.4.2 Product management and engineering

The second interview was held simultaneously with product management and engineering unit and Engineering to order team, as their work in the process is very similar and takes place at the same stage of the process. Also, the information systems, that both interviewees teams use in their work are the same with few exceptions. Interviewed technical product manager is leading the Technical product management, US AZP teams and reports to Product management and engineering lead. Role of the product management and engineering teams is to design new modules and parts for ordered products, that have not been manufactured before. Based on this data, engineering to order can create project specific drawings and part/item lists, that purchasing can use to order the components needed for production to manufacture that specifically ordered product.

Compared to operational purchasing, these teams have a few less information systems in regular use. Project folders and quotation folders are listed as used information systems, but actually they are folder structures located in the case company's internal network, where project-specific information is stored. Many of the information systems listed in Table 5 and Table 6 can also be found in the operational purchasing unit’s Table 4, but operational purchasing mostly uses them only for information retrieval when the engineering departments create and edit the data for those systems. Large amount of used information systems is partly explained by the fact, that there is lots of duplicate data across different information systems. This is because new information systems have been implemented into the case company from time to time, but new systems have not always met the needs of some units. As a result, the old information systems are still partially in use in parallel with new information systems and the same information is therefore stored in multiple systems. Good example of this kind of case is Mapper, Automanager and Team center. The systems have been implemented at different times, but partly they store the same data. Mapper was originally ERP-system used by the case company, but after Baan was implemented almost a decade ago, the features in Mapper have been cut down and it is now only used for product data management. Despite all the duplicate data, not all information is available everywhere, interviewees emphasize that information is spread over several places and finding the needed information from all the available information systems can occasionally slow down the process.

Like the operational purchasing, product management and engineering must regularly confirm or ask for more information manually from other units as well as suppliers. Teams collaborate throughout the supply chain from supplier to case company sales units. Engineering must often ask for further information from sales or project managers if it is not available in project- or quotation folders. From suppliers the engineering unit asks for information related to technical specifications on a weekly basis.

Table 5. Information systems used by Product management and engineering.

Information system	**System use and retrieved information**	**Entered information**
Mapper	Older product data management system. Part of company’s old ERP. Has been burning platform for couple years. Same data should be available in Team center.	

Team center	New product data management system. Product drawings, part lists, descriptions and instructions.	Product drawings, part lists, descriptions and instructions.
Project folders	All the documents related to the project number in same folder, that can be found from company web-drive.	Drawings, calculations and models related to the project.
Quotation folders	All the documents related to the quotation number in same folder, that can be found from company web-drive.	Read only for the engineering teams.
P2P	Technical specifications for prospects and projects.	Needed modules for project.
ENA	Product drawings and part lists. Some external stakeholders use ENA, but most of the product engineering employees use Mapper.	ENA retrieves part of the data from Mapper and drawings are entered by engineering.
Automanager	Product data management tool. Drawings and instructions.	Drawings and instructions, however new instruction are mostly entered into Team center.

3.4.3 Engineer to order

The second interview was held simultaneously with product management and engineering unit and Engineer to order team, as their work in the process is very similar, takes place at the same stage of the order-delivery process and the information systems they use are mostly the same. The role of the interviewee from engineer to order team was Engineer to order manager.

Engineer to order team's role in the case company is to create the project specific drawings and part lists according to technical specifications and the modules designed by product management and engineering. Using the drawings and part or item lists created by ETO, purchasing and production can perform their work. If a very similar product has been produced earlier by the case company, needed modules are probably available and ETO does not have to wait for product management and engineering to finish the modules.

Compared to the product management and engineering, ETO has a couple more information systems in use. In addition to the information systems used by product management and engineering, ETO uses Baan and Baan project flow. Baan is the case company ERP system and Baan project flow is a monitoring interface for ERP data. In addition to these systems, some of the information systems used by both units are used for different purposes or one unit may use one system for more purposes than the other unit. Similar differences are also seen between the purchasing unit and engineering units in the use of information systems, which are listed in the tables of all these units. As can be seen from both engineering unit's tables Table 5 and Table 6, the information systems used are mainly related to product drawings, technical specifications and other product data that are essential to their work.

In the end of the interview the interviewee pointed out a concrete challenge in the case company related to data transfer. Data transfer can be also seen as part of or as an enabler of information transparency. It turned out that the case company does not have any agreed course of action or tool for transferring large data files within the organization. The need to transfer larger files is much rarer than of those that move conveniently in the information systems created for them or as an e-mail attachment. The fact that there is no pre-determined way to perform a task can slow down the work and, above all, can lead to unnecessary security risks if employees decide to transfer files, for example through external services, not validated by the company.

Table 6. Information systems used by Engineer to order.

Information system	**System use and retrieved information**	**Entered information**
Mapper	Older product data management system. Part of company's old ERP. Has been burning platform for couple years. Same data should be available in Team center.	
Team center	New product data management system. Product drawings and part lists and descriptions.	Product drawings and part lists and descriptions.
Project folders	All the documents related to the project number in same folder, that can be found from company web-drive.	Drawings, calculations and models related to the project.

Quotation folders	All the documents related to the quotation number in same folder, that can be found from company web-drive.	Read only for the engineering teams.
P2P	Technical specifications for projects.	Read only for ETO team.
ENA	Product drawings and part lists. Some external stakeholders use ENA, but most of the product engineering employees use Mapper.	ENA retrieves part of the data from Mapper and drawings are entered by engineering.
Automanager	Product data management tool. Drawings and instructions.	Drawings and instructions.
Baan	ETO enters to Baan the dates, that product or module designs are scheduled to be ready.	
Baan project flow (Intra)	Information system for following the project design schedules. Gives automatic notifications for design team via email about new revisions for project.	Read only.

3.4.4 Production planning

The interview with production planning or supply chain planning as interviewee called it, was held with Master scheduler of the case company. Production planning is responsible for scheduling the production so, that it would operate efficiently, the customer order deadlines would be met, and products delivered on time. As production planning is located closer to the end of the order-delivery process, they must wait for information and confirmations from other units before they can do the scheduling of each project. This reflects directly to information systems that they use, and as can be seen from Table 7 below, many of the systems in production planning's use are used only for retrieving information. In addition to the information systems listed in the table below, production planning uses several different Excel tables in its work, such as the production schedule list.

The interviewee feels, that accessing the information systems and retrieving the needed information has developed over the years. Lots of improvements have been made according to user needs. All the employees in production planning have access to the information systems, that they need, but like in other units, the interviewee says, that production planning as well has to contact other units by email or phone about any changes in information. The interviewee also thinks that information may be moving too much in different formats. Often something important is missing. Also in the production planning interview, the interviewee's perception is that their unit is located in quite middle of the organization.

Table 7. Information systems used by Production planning.

Information system	**System use and retrieved information**	**Entered information**
Cognos	Reporting software. Supply chain planning can get tailored reports from Baan data through Cognos.	Read only -system and the data comes to Cognos from Baan once a day (at night).
Baan	ERP system used by the plant.	ERP system used by the plant.
Intra	Intranet build by local IT-department.	Intra retrieves data from Cognos and Planner daily reports and some information is entered manually.
Quotation folders	Pricings, specifications, drawings and lots of excel sheets related to each project in their own folders.	Read only for Supply chain planning.
Project folders	Pricings, specifications, drawings and lots of excel sheets related to each prospect in their own folders.	Read only for Supply chain planning.
Planner	Planning software, that read data from Baan. Planner can be used to track the arrival of needed material and allocation to projects. Reports from this data are also available form planner.	Planner reads the data from Baan, so it is read only -system for end users.
CRM	CRM is not yet used by Supply chain planning unit, but probably will be in future.	

3.4.5 Sales support

The sales support team plays a very central role in this study. The case company contact person who has been involved since the beginning of the research and even earlier in Reboot IoT Factory project, is the sales support manager. The sales support team also played a central role in developing the current P2P system in collaboration with Finnish SME and other stakeholders involved in the project. The interviewees role from sales support team was sales support engineer. However, a lot of data about sales support team and generally the operation of the case company has been collected through meetings and email conversations with sales support manager, prior and after the sales support engineer's interview. Role of the sales support team in the case company is to work between sales and other units in supply chain. Sales support team creates the technical specification for each project and creates the first price estimate for sales.

Like all the other interviewed units, sales support has also a wide range of information systems in use. Most of the systems are already familiar from the tables above, but again the use cases are different for some of them. Compared to some of the interviewed units, sales support team enters and modifies data to quite many information systems. According to the interviewee, all the sales support team members have access to the systems listed in the Table 8, but access rights vary from system to system within the team. Some team members have rights for read only and some can also edit the data in certain systems.

Interviewee thinks, that most of the needed data is quite easily available in the information systems they use, but the structure of project folders is a bit challenging. But like all the other interviewed units, sales support also needs to regularly contact other units by email or phone to get more information or confirmations about the projects. In most cases this means asking sales or engineering some clarifying questions and less frequently in direct contact with customers or with suppliers in some cases. Most of the interviewees have also agreed, that in many cases, questions are asked within teams as well. However, most of the teams work in their own office areas, so it is easy to ask anything from others in the team.

When the interviewee was asked does manual information retrieval from other units or within their own unit slow down the unit's business, unlike in other interviews he gave more specific answer. The interviewee thinks, that activities are slowed down by the fact that many salesmen around the world do not have access to the information systems used at the case company's factory in Finland. The interviewee also mentioned, that it would be very important to have all the existing information stored in the information systems. In particular, potential sales cases often lack up-to-date information and latest information is only available by asking the employees in sales who are dealing directly with that specific case. Regularly updating this information to CRM could save significant time and effort.

Table 8. Information systems used by Sales support.

Information system	System use and retrieved information	Entered information
Mapper	Some of the Sales support team members use Mapper to find part lists.	Read only for Sales support team.
Team center	Another option for finding drawings and other documents about projects. Most of the Sales support team members prefer to use other systems.	Read only.
ENA	Pricing is done with ENA by Sales support team. Part lists, drawings and some pricing information about older projects can be also retrieved from ENA. Data comes from Mapper.	Pricing is done by Sales support with ENA.
Cognos	Through Cognos, Sales support team can run a project Handover report, which indicates the starting point of the project.	Read only system and data comes to Cognos from Baan once a day (at night).
Baan	Information about old projects, that Sales support team needs can be found from Baan. For example, what were the actual costs for project or logistics.	When a deal is confirmed, Sales support team enters the project to Baan.
P2P	Technical specifications can be crosschecked from other prospects or projects now and in the future, Sales support team can get technical specification for the thruster directly through the P2P system.	Technical specification about prospects are entered to P2P by Sales support team.
Reference search tool (Referenssihaku)	All the projects, including modules used in the projects that have been delivered can be found here. Reference search tool has more flexible search functions than Baan.	Read only.

CRM	Information about sales opportunities like who is the customer ship type. If sales keep the information up to date in CRM, more reliable sales forecast is also available from CRM.	Sales support team sometimes creates the sales cases to CRM and in earlier version they also entered the pricing number.
Project folders	Pricings, specifications, drawings and lots of excel sheets related to each project in their own folders.	Pricings, specifications, drawings and lots of excel sheets related to each project in their own folders.
Quotation folders	Pricings, specifications, drawings and lots of excel sheets related to each prospect in their own folders.	Pricings, specifications, drawings and lots of excel sheets related to each prospect in their own folders.
Automanager	Main dimensional drawings for each product can be found from Automanager and it is needed for every quotation.	Read only for sales support team.

3.4.6 Current state of request for quotation to quotation process

The current sales process of the case company involves various functions besides sales including sales support, product management and engineering, ETO and purchasing, which were all interviewed. Information about the operation and needs of sales and customers were obtained from case company contact person and the interviews. All the information systems visible in the described process were discussed during the interviews. The request for quotation to quotation process is part of the sales and order-delivery process, where the exchange of information between different functions is very intensive. The process described in this chapter and visualized in the Figure 12 below, does not apply to all case company sales cases, but it illustrates the flow of information in most cases. However, as the interviews revealed, almost all units are in contact with several other units and ask for more information about the projects if necessary. This process description was created based on information gathered prior to the interviews combined with the information from interviews.

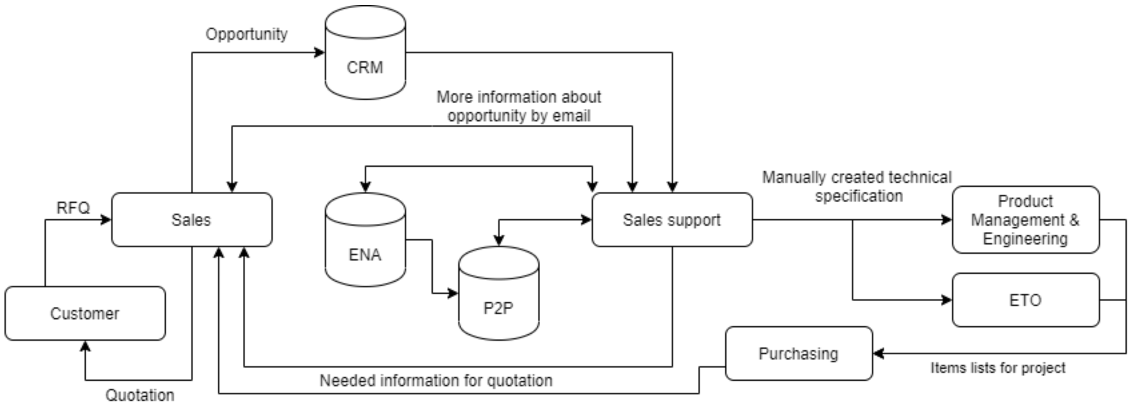


Figure 32. Current request for quotation to quotation process.

The sales process normally starts with a signal from potential customer, that they would like to buy a case company's product. This request for quotation (RFQ) should provide enough information for the case company to prepare an offer for the customer, including price and schedule for delivering a product, that fulfills the customer needs. Sales enters some information about the prospect to CRM and sends additional information to Sales support team. Currently the information entered into CRM system varies a lot from case to case, and it is not yet possible to get a comprehensive picture of a potential customer order based on information in CRM. Sales support team enters the needed information of the prospect to ENA, which provides them the preliminary price estimate. As P2P is not yet fully implemented and still lacks some of the features, sales support team has to create the technical specification of the product manually and send it to Product management & engineering and ETO, who provide the item lists for purchasing. Purchasing and sales support provide the needed information for creating quotation to sales, including the price estimate and schedule for delivery. Sales combines all this information and sends a proposal to the potential customer.

The case company describes the status of prospects in the sales pipeline with seven stages of sale. At the beginning of the scale, the stages indicate the probability of winning the sale and the last stages indicate the actual won or lost sales. The sales determine the probability of winning the sale based on their own estimate. However, in reality this information is usually not updated to any information system in real time or even regularly, so it is very challenging for other units to assess what kind of orders can be expected in the near future. Uncertainty about upcoming sales creates challenges, especially for the operation of purchasing unit and production planning.

3.5 Current challenges related to information transparency

The case company has challenges and room for improvement in several areas of their operations. This is a statement, that applies virtually to every company in any industry. However, the message is important to understand and accept it so that the areas, which need to be developed can be located from company's operations and right kind of development measures can be started. As this study focuses on information transparency in sales and order-delivery process of the case company, the challenges discussed will be related to these themes.

3.5.1 Large number of information systems used by the company

Virtually every interviewee felt that there is a lot of information systems in use. In addition to the information systems that were mainly discussed in the interviews and listed in the tables above, the case company employees use lot of different Excel spreadsheets and software tools needed in their daily work, like communication- or product design software. These information systems have been introduced along the history of the case company's Finnish factory, so some of them are tens of years old and some were introduced a few months ago. During this time, the business and its environment have changed, the case company's processes have changed and the units' needs for information systems have changed. Some information systems have been introduced completely new to meet certain needs of case company operations and some have been introduced to replace an old information system performing the same task. It can also be a combination of the two, in which case the new information system is also suitable for use for which the previous system was not used at all.

In some cases, part of the employees feel that the new information system is not as suitable for the task they are performing in their job as the previous information system. Sometimes, due to an insufficiently made requirements specification or the limitations of the system vendor, some needed tasks cannot be performed at all by the new information system. This results in the old information systems being left in place, either in part or in full, alongside the new information systems in order to perform those tasks. The use of two or more information systems, partly used for the same purpose, results in the same data being stored in several places. Multiple similar information systems and the duplicate data in them easily slows down processes and increase operational costs and uncertainty, due to the maintenance need for larger number of information systems and increased need of user trainings for the systems.

Based on the interviews, at least some of the information systems and software used by the case company have been invested too little in the software implementation phase or otherwise the implementation phase has been insufficient. A lack of planning or invested resources in software implementation often leads to a situation, where the utilization of that software is much lower than planned and users may not understand or agree to switch from the old information system to the new one.

3.5.2 Information transparency in order-delivery process

Despite the large number of information systems used, almost all units have to regularly request or verify project-related information from other units by phone or email. This manual retrieval of information from person to person between units or teams easily slows down processes and may create serious bottlenecks in the process. Information must be retrieved manually from other units within the case company, but also from suppliers and in some cases directly from the customer.

One factor that clearly increases the manual information retrieval is that sales unit is organizationally separate from the Finnish plant's units. Although this makes sense for the company's operations, as a result most employees in sales do not have access to the information systems used at the Finnish plant. Since virtually all of the case company’s products are manufactured directly from a customer order, it would be very important to have all available information about sales and upcoming customer orders to other units as quickly as possible. A new CRM system was recently implemented by the case company, but most salesmen do not enter all the necessary information into it.

However, the information does not flow in only one direction between the sales and the factory organization. Salesmen need information from the factory's information systems in their work as well. The pricing, delivery schedule and the technical features of the product are all essential parts of the offer, that sales sends to the customer and these all depend on the functions of the factory. Even before a formal offer is sent, the sales must be able to give preliminary estimates of the price of the product, delivery schedule and whether the case company is even able to manufacture the product in question. The transparency of information should therefore be at a better level in the order-delivery process to both directions. If most of the information that a unit needs is not available on-demand, it will inevitably slow down the process.

3.5.3 Short- and medium-term sales forecasts

Poor information transparency between sales and factory units makes it significantly more difficult to plan future operations. Engineering, purchasing and production planning all must allocate their resources according to customer orders in order to meet the agreed delivery schedule. If after the officialization of a sale, it is noticed that the case company will have to do more engineering work to produce the ordered product than it was included in calculations for the offer, the project will almost inevitably be delayed and the costs will probably also increase. A good forecast of future sales would significantly reduce these unexpected situations.

As the interviews showed, the quarterly forecast provided by sales unit is not very specific, so the purchasing entity is not able to use it directly in the forecasts they send to suppliers. The accuracy and usability of the forecast is further impaired by the fact that it has sometimes not been delivered on time, or at all. For shorter-term visibility of future sales, the case company uses seven stages of sale to describe the status of a prospect. In theory, this should inform other units of the probability and current situation of the potential sale, so that they can prepare for that kind of projects in the near future. In reality however, this information is only a personal conjecture from a sales employee and that information is not updated regularly into any information systems, where it would be directly available to other units when needed. The same problem applies also to other data related to prospects, which should be available to other units.

The fact that sales unit keeps information about potential customers and the customer orders only to themselves does not benefit anyone and may easily lead to unexpected challenges in operations. Any information that could potentially help to prevent excess surprises, should be available to other units within order-delivery process as well. The creation of forecasts can always be taken further, and more sophisticated systems can be created to obtain more accurate forecasts. However, it is vital for the usability of forecasts that the information is available at the right time in the right place and in a form that is as easy to use as possible.

3.6 Summary of the findings

Based on the interviews, email discussions, and material received from the case company, the following can be stated. There are a lot of information systems in use, some of them are decades old and some of them have been implemented more recently. Some of the old information systems are still used alongside the new ones, as some individual units need the features from the old ones, and as a result, a lot of duplicate data is stored in many of the systems in use. Based on the interviews, the number of information systems and the duplicate data can be partly explained by insufficient investments of resources in the implementation of new information systems. In many cases, this leads to a lower utilization rate of the new system and to large differences in levels of user expertise. Hence, some users still prefer to use the old information system and in the long run, this becomes expensive as it slows down processes and the system maintenance costs accumulate.

The case company's order-delivery process is slowed down a lot by the organizational detachment of sales unit from the Finnish factory's organization. As an organizational model, this is not a bad solution for the nature of the business, but the processes, information systems and agreed practices should be adapted accordingly to facilitate good level of information transparency between the sales and other units. Low level of information transparency is reflected in the case company's operations directly in terms of inefficient processes, slower response times and lower profit margins. All of this is often reflected to customers as well in form of slower deliveries and in some cases, changed schedules can also affect the quality of deliveries. A weaker customer experience and a lower profit margin can be a very bad combination in the long run.

The key challenges based on the information gathered from interviews and, meetings and email conversations with case company are listed in Table 9 below with their impact on sales and order-delivery process of the case company. These challenges and how to overcome them, will be discussed in more detail in the following chapters 4 and 5.

Table 9. The key challenges and their impact on case company's operations.

Challenge	Impacts on case company's operations
Large number of used information systems	• Duplicated data in multiple information systems • Significantly varying levels of user skills → Some information can be hard to find, even though it would be available
Manual retrieval of information from other units and external stakeholders	• Person-to-person information requests easily result as latency in the process • Information is provided in several different formats, which makes it harder to utilize → Longer process lead times and weaker overall understanding of the situation throughout the supply chain
Inaccurate sales forecasts	• Challenging to communicate with suppliers, what kind of components could be needed in future • Engineering is not able to allocate their resources in advance • Long term production planning is unreliable → Delivery schedules are hard to predict, and efficient resource allocation is challenging through the whole supply chain
Insufficient implementation of new information systems	• Easily leads to excess information systems when users do not know how to use new systems properly or prefer to use the old systems to which they are accustomed → Lower utilization of each information system and increased maintenance costs

4 DISCUSSION

Based on the information gathered for the study and results of the interviews, case company's current sales and order-delivery process is well suited to its operating environment, but with some improvements related to information transparency, efficiency of the process can be increased significantly. The identified key issues in sales and order-delivery process are all somehow related to information transfer between different units and teams within the company. Currently all interviewed employees felt, that they need a large number of information systems in their team's operation. Having too many information systems in use, may feel confusing and some information could be hard to find. Most of the used systems are needed and it would not make the tasks more simplified, if some systems were integrated. However, some of the currently used information systems are old and the same features, that are used would be available in newer systems as well.

Some of the interviewees felt, that manual information retrieval from other units slows their team's operation only little bit and others felt, that it has bigger effect. Nevertheless, all information that must be manually retrieved by email or telephone, from person to another, creates additional steps to process and in many cases can result as excess delay. According to lean principles, if some steps in the process are not adding value to end customer, they are waste and should be removed. Transfer of the information between different units is essential to the process, but if that information could be available on demand from suitable information system, it would eliminate the risk of forming a bottleneck in this part of the process. According to the interviews, it seems that most of the challenges and possible delays in sales and order-delivery process, are related to transferring information between sales and other units within the process. This is logical, as sales unit is geographically and organizationally apart from the other units in the process. Many of the employees in sales do not have access to information systems used in Finnish factory and in some cases, operating in different time zones may cause critical delays in response time. In these situations, it would often help if there would be an access to a common information system where the needed information could be retrieved when it is needed, whether the other party is currently available or not. Common practices must also be agreed so, that all the needed information is stored in that system as soon as possible.

Even if specific information systems or databases had been agreed to use as a tool for information transfers between sales and other units, if the information is not stored there immediately by providing unit when it is available, the systems will not increase the information transparency. To avoid such situations, the solution could be to agree, that the information system in question is the primary location for storing this information. If it is necessary to store that information in another information system, automatic retrieval of information between the systems to another might be worth the investment. Similar challenges are also faced in information transparency between case company and external stakeholders. However, the focus of this study is in the sales and order-delivery process, which is limited to case company's internal functions from sales to purchasing.

The purpose of the sales forecasts is to make it easier for other units to prepare for future customer deliveries and to help with the initial allocation of resources according to probable scenarios. Creating long term sales forecasts is not easy and needs analyzing markets and customers with all the data available. But like traditional weather forecasts, sales forecasts become more inaccurate the longer the future is projected. Hence, accurate resource allocations and component orders cannot be made for several years based on forecasts alone. If the order backlog is full for several years, the situation is of course different because the information is already at least almost certain. Short- and medium-term sales forecasts are often much more useful to other units. Forecast as a concept can be difficult to define precisely, but in theory all the information provided by the sales unit about potential deals before the customer order is confirmed, is part of the sales forecast. The closer the confirmation of a customer order is, the more important it becomes that information about the prospect is available. Therefore, it should be considered that information about already confirmed customer orders as well as prospects in the sales pipeline should be easily available to other units when they need it.

The interviews revealed a problem in constantly sending critical prospect or project information via email. The same information moves in several different formats and this makes it difficult to utilize the data in other units. In particular, the technical specifications range from very comprehensive to very short versions. This could be avoided in some cases by using agreed information systems for moving information between units. When the information is stored in an agreed information system, content requirements can be defined in the system. In this way, all the necessary information is delivered to other units who need it and the format of the information is always the same.

4.1 Recommendations

Based on the issues identified in the study, case company's information transparency in sales and order-delivery process could be improved by small changes in used information systems and related practices. By developing the information systems and the process accordingly, it is possible increase the efficiency and improve collaboration throughout the case company's sales and order delivery process (Fui-Hoon Nah et al. 2001). In practice, achieving these process improvements would require following three steps.

1. The P2P information system must be developed further according to section 4.1.1. P2P should be able to provide reliable on demand information about prospects and projects to units described in the Figure 8.
2. CRM system must be connected to the P2P system with an interface, which enables automatic updating of information in P2P.
3. The sales and order-delivery process must be adapted to these changes and all employees involved in the changes must be comprehensively trained on how the systems should be used in the future and why it is important.

Further developing the recently implemented P2P information system and creating a functional interface between them would allow P2P to act as a link for critical project related information between sales, engineering and purchasing units. These changes in information systems and processes speed up the transfer of information between units and develop certainty in both the availability and quality of information.

4.1.1 Development of P2P information system

The current version of Prospect to project or P2P system has already been implemented in the case company. The biggest improvement over the previous system is the ability of P2P to check from a database managed by the case company whether the modules required for the manufacturing the product in question have already been designed. To check the modules, P2P needs basic technical information about the project like physical information of thruster, propeller or thruster mounting type, that customer has requested. The database including the module information is updated by sales support team. With P2P, the information about the modules is obtained much faster, as earlier the module check had to be done manually. Based on this information, the case-company can estimate the project schedule and provide more detailed estimates to the customers as well. If the required modules are found in the database, P2P is also able to use them to create technical specifications for that product, previously created manually by the sales support unit. Technical specification is needed by engineering to create the project specific drawings for purchasing and production.

This current version of the P2P system can be called P2P 1.0. Compared to the previous system, P2P brings significant improvements and saves a lot of manual work from sales support team. That time saved can be reallocated on operational development and other less manual steps. However, by developing the system and its use from now on, more benefits can be achieved and the information transparency in the sales and order-delivery process can be improved.

4.1.2 P2P 2.0

Currently, P2P is only operated by the sales support team. It is true that the system saves the most time specifically from the work of the sales support team, but the data provided by P2P benefits several units through the order-delivery process. It would therefore be wise for the information transparency that this data could also be used directly by other units. The needed input data for P2P comes from customers through sales to sales support team. After P2P has done the module check, the system will tell if those modules have been designed before. If all modules cannot be found in the database, information of the missing modules should be provided to the product management and engineering unit with current status of that sale. If the sale is in its early stages, product management and engineering can do some initial preparations for designing the module, but if the deal seems very certain or the order has already been placed, the product design work should start as soon as possible. Information about this should also be made directly available to ETO and the operational purchasing so that they can rationally plan their future work based on confirmed or potential customer orders. If one or more modules required to manufacture products are not found from the database, information must also go back to the sales team, so that they can use it in their offer calculations and in other communication with the customer.

If module check indicates that all modules required to manufacture the product already exist, the information should again be passed on to all the above units except product management and engineering as they don’t have to design the modules for that project. On this basis, the case company’s sales cases can be divided into two categories, cases where new engineering work is required (Figure 13) and standard cases for which the necessary modules already exist and no longer need to be designed by the product management and engineering unit (Figure 14).

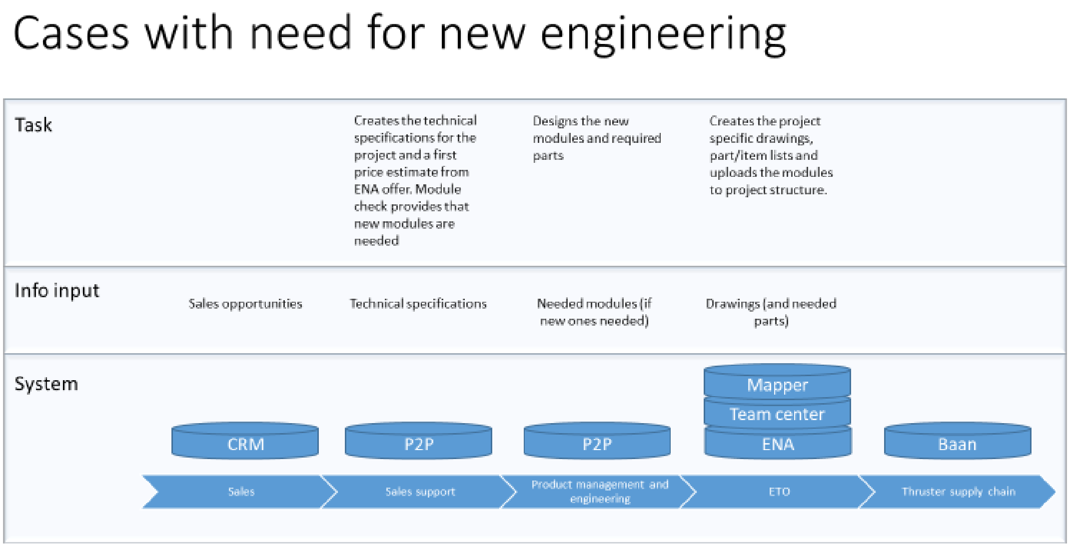


Figure 13. Sales cases with need for new engineering work.

The main difference between P2P 2.0 and 1.0, then, is that information flows seamlessly to the units that need it and it is presented in a format that is easy to understand and utilize in that unit's work. The flow of information from P2P can be implemented in several different ways, but it is important that it is automatically available to anyone who needs it in their work (Jonsson and Myrelid 2016). One way would be to create automatically sent messages from P2P to selected units, which would contain the data they need in a format that serves them best. There are multiple similar options and this information could also be sent to one of the information systems already used by these units from which they could follow the situation. However, creating new system interfaces from P2P to multiple other information systems is unlikely to be a smart or cost-effective way to accomplish this.

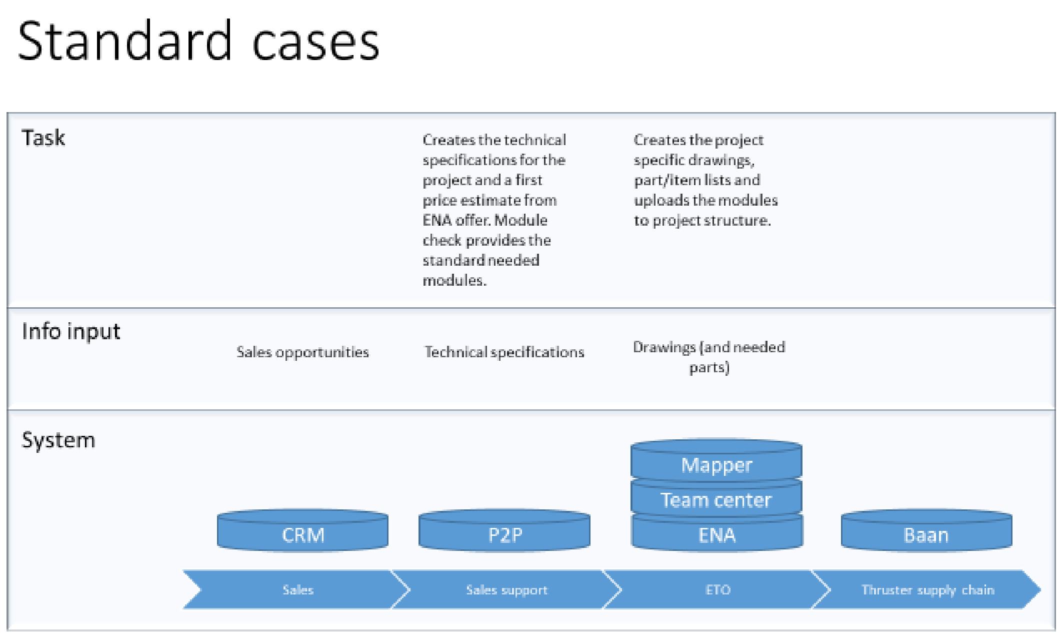


Figure 14. Standard sales cases.

Probably smarter and user-friendly solution would be to use P2P data to build a separate tracking interface for each unit, containing the information that is most relevant to them and automatically presented in the format that works best for them. This could include a dashboard overview of the current situation and more detailed information they need in a separately agreed format. Such user interface could be built as a part of P2P system or as a stand-alone system built with visualization tool, which would be capable of retrieving the necessary data from P2P in real time.

Sales teams could also directly use P2P themselves and enter the necessary information for module check, but entering the technical features of the product, required for P2P also requires the user to have sufficient technical understanding of the products. Not all sales team members have this, so incorrect information would be easily entered into the system or some of the required information would be left blank, which would result in no modules found, even if the modules for product in question would actually exist in the database. Hence, in order for sales teams to directly use P2P, some additional modifications should be made to the system.

4.1.3 P2P 3.0

A clear factor limiting the utilization of a P2P system is the technical understanding of the products produced by the case company that it requires from users. As pointed out at the end of the previous chapter, sales teams could directly use P2P in their work, leaving out the middleman in the process. However, the need for technical expertise makes this significantly more difficult.

In the P2P user interface, the product information is entered into fields reserved for that specific information in the system (Picture 1). Currently however, a technical understanding of products is required as incorrect values can also be entered in the fields, even accidentally. If false information is entered, P2P will not give any error message, but the needed modules cannot be found in the module check. Some of the information categories to be filled in the system already have drop-down menus or check boxes that make it easier to fill out the form. Free-text fields, on the other hand, do not utilize any preset values or define the limit values within which the entered value should be. Also, in the current version of P2P, the separate fields in the system are not linked to each other so that the value entered in one field or selected check box in another information category would affect the options in the other. Transforming P2P system into a dynamic product configurator would allow it to be used even without wider technical knowledge of the company products. In practice, this would mean that the information system would guide the user to fill in all the necessary fields with appropriate values.

Guiding the user to fill in the data could mean, for example, visually highlighting different fields and information categories for the user in an order in which it would be wise to enter the data into the system. After entering the data into one information category, the system would highlight the next one in order. The values entered into the system would also affect other fields to be filled and available check boxes, as they set the limits for actual product as well. For example, the maximum rounds per minute of motor entered into the system would set limit values for the size of the propeller. There are several similar connections between the data entered into the system, but in the current version of P2P, the user must understand these connections himself, if an exact list containing all this information has not already been provided for the project in question. Even in this situation, the necessary information must be found from a long document full of technical information.

Adding the features listed above to the P2P system would allow the sales teams to check the availability of modules independently at least in part of the sales cases. This would speed up processes and release the resources of sales support team to be used in more complex cases. As explained in the previous chapter about P2P 2.0, in this case as well the information would flow directly to all units that need it, but sales support team would not play an equally big role in the process for all sales cases as earlier. With these features, P2P would allow all units to receive the information they need faster than before and it would significantly improve the case company’s response time to the customer in some cases.

4.1.4 P2P 4.0

At the point where the customer is informed that the case company is able to produce and deliver the device they are requesting and a preliminary schedule estimate for delivery is provided, much remains to be done before a formal offer for the product can be created and sent to the customer. Currently the initial price estimates for the products are obtained from the ENA information system. However, these estimates are based on rough upper-level calculations created based on previous deliveries. When the sales support team provides a preliminary price estimate to the sales team based on data from ENA, it is very difficult for the case company at this stage to estimate the actual cost of manufacturing the product to the company. Therefore, it is also challenging to estimate the profit margin for the project. The deal may be closed at the initially announced price estimate, but the modules and detailed part-lists for that project may indicate after sealing the contract, that the costs will be higher than estimated. If there are challenges in terms of schedules or component availability and the purchasing unit must buy some of the components from more expensive suppliers, the project's profit margin will eventually decrease significantly.

By refining the P2P system little further, it would be possible to turn it into a comprehensive sales configurator and pricing tool. This would mean that sales teams would be able to define challenging product configurations directly at the customer or in cooperation with the customer already in the early stages of sales. This would allow sales teams to use P2P completely autonomously in some deals and the required information would flow seamlessly through the system between sales and other functions. A system with these features would significantly improve the information transparency throughout the sales and order-delivery process. Especially with customer orders for which the needed modules have been designed earlier and they are found in the module check by P2P, the process lead time would be significantly decreased.

4.1.5 Additional suggestions for P2P

As markets and the whole industry have changed a lot in recent years and are very likely to continue to do so, industry players should also consider questioning and developing old familiar and safe practices. Bold, industry disrupting changes in company's operating practices can help to achieve a significant competitive advantage and a greater market share if implemented correctly and at the right time. Traditionally, the technical sales of the manufacturing industry has required a great deal of expertise from sales teams and a large proportion of the deals that have taken place are behind long negotiations. It is rare in manufacturing industry for there to be a different information flow channel between a manufacturing company and potential customers than the company's website and sales unit or customer support team.

Today, however, we live in an information age. Owning data and being able to utilize it can take companies very far (Paschen et al. 2020). Currently, the world's largest and most influential companies are the ones who greatest amounts of data and have the ability to utilize it in their business or turn the data itself into business. Case company sales unit needs more prospects to make sales pipeline in order to they can eventually close more deals. The case company's potential customers on the other hand need the information which companies are able to deliver the devices they need, on what schedule, and at what price. In theory, all this information is available from later, more advanced versions of P2P. This would also allow the creation of a separate interface for potential customers, through which representatives of customer companies would be able to tentatively determine if a case company would be able to deliver the product they need, that would meet their requirements for delivery schedule and budget. In addition to the features of P2P 4.0, the estimated cost of production should be converted to an estimated selling price by adding the profit margin which the case company seeks. An easy-to-use customer-friendly user interface based on P2P under the case company brand could be built on their website.

Previous development suggestions regarding the features and use of P2P in this study are intended to develop the information transparency within the case company in the sales and order-delivery process. The next step would be to improve the transparency of information throughout the whole supply chain from suppliers to the customer. Making information flow provided by P2P available to potential customers, would significantly improve the information transparency between the case company and the customers. For customer companies, the benefit of having this information available would be clear and it would make their initial procurement process easier. From the case company, this would be a show of confidence in client companies and a new way of operating in the industry. However, this would also allow case company to collect valuable data from potential customers.

Potential customers could be required to create credentials or leave contact information in the system, after which they would be able to use the online user interface for customers of the P2P system. The system would store the contact information of the users and the related technical data entered into the system. This would give the case company useful information about potential customers, their contact information and information about what kind of device that customer is interested in. It would be a good idea to attach a "request a quote" button to the interface, which would allow the user to directly ask the case company's sales team to create a quote based on the information they enter. Even if this request is not sent by the customer, the sales team of the case company would get a good hint from the potential customer based on the data stored in the system. Implementing these features could mean gaining information about future projects of potential customers that are not yet known by competitors that may in some situations provide a competitive advantage, or at least more time to prepare for them. The potential customer contact information stored in the P2P system could also be utilized in the marketing of the case company, making it easier to target it correctly. P2P with user interface for potential customers and other suggested features from this chapter, can be called P2P X.

4.1.6 Implementation of new features to P2P information system

Table 10. Key features in different versions of P2P information system.

P2P version	**New key features in the version**
P2P	- The system can check, if the case company has all the needed modules for manufacturing a product, based on basic technical information from potential customer - Technical specification of a product can be created automatically through P2P

P2P 2.0	- Enables seamless information flow through sales and order-delivery process by providing the needed information instantly and automatically for each unit.
P2P 3.0	- Works as a dynamic product configurator. - Guides the user to fill in the information of a product correctly and sets limit values for other fields and drop-down menus based on data entered into the system. - Enables the use of P2P with a more limited technical understanding of case company's products and makes it available to all sales teams.
P2P 4.0	- Dynamic product configurator and pricing tool. - Can automatically provide all the information sales teams needs to give potential customer a preliminary estimate of project schedule and price of the product if module check finds all the modules.
P2P X	- Makes the product configurator available to customers and potential customers. - Collects valuable data of users like contact information and what kind of products the user is interested in. - Collected data can be used by case company sales and marketing departments. - New way to operate in the industry developing information transparency between thruster manufacturer and customers.

Starting an information system development project or even taking the initiative in it can sometimes be challenging. However, utilizing the listed development proposals in P2P information system and the case company's sales and order-delivery process would significantly improve the information transparency and efficiency of the process, which would very likely make it a profitable investment in the long run. The proposals do not contain precise instructions related to the technical implementation of the development project. They were created with combining the findings from literature, authors previous experience and data collected from the case company for the study. Proposals are preliminary and require more detailed internal review by the case company before implementation.

Information system and process development project can be planned to be implemented as one larger project from P2P 1.0 to P2P 4.0 at one go, or in stages like the versions listed in Table 10 with multiple smaller projects implemented step by step. However, if case company prefers to proceed cautiously and develop the system gradually, it must be carefully considered how the gradual and all at the same time implementations differ and which will eventually become more expensive. Initiating and implementing an information system development project may take time, and in a large global company, securing the funding and general permission to proceed with the project can easily take a long time. Financially, multiple individual projects will probably become more expensive than one carefully planned larger project, which leads to same outcome as those individual projects would. When introducing new information systems, it is crucial to get all employees to use the system for which it is intended to (Fui-Hoon Nah et al. 2001). Motivating the sales teams to follow a modified new process is much easier if implementing the change successfully has clear benefits for them as well. Successful implementation of change requires that all parties understand why the change must be done and what are the benefits from it to the organization. Change management can become more challenging if there are constantly new development projects starting after the previous ones as it can lead to decreased motivation of employees to committing to the change. If the more advanced versions of the P2P system and related process are implemented in a few years or later in the future, the lack of benefits from the latest versions may become much more expensive with lost potential gain than it would if the development project was done entirely at once. If the project plans are made or have already been partly made for the development of P2P system in the current operating environment, things may have changed so much in a few years that planning the project then must be started almost from scratch.

For an information system and process development project like this, it can be very challenging to find the necessary expertise within a manufacturing company and even more challenging to be able to release company’s staff from their normal tasks so they could use enough hours to manage the project. If sufficient resources are not allocated to the implementation of the project, there is a much higher probability of failing to implement the change. Therefore, in such situations, it should be determined which external solution provider would be able to deliver the project with a required knowledge ensuring the quality, but at a competitive price. Finding a competent company to implement the project among Finnish SMEs would also support the goals of the Reboot

IoT Factory project. The logical choice for SME to manage the implementation could be SME 1, which has already implemented the first phase of the P2P information system in cooperation with the case company and on whose server the database for module data used by the P2P is located. However, it should be first determined whether the SME 1 is willing and capable to deliver the development project and whether they can make changes to the software but also help to implement and deploy process changes in the if the necessary expertise and resources are not available within the case company. If the SME 1 can deliver the necessary changes to the software but they are unable to help with the implementation project within the case company, the expertise needed for that must be acquired from somewhere else. In any case, other companies must be also considered for the project implementation and select the contractor on the basis of a comprehensive comparison of offers.

4.1.7 Adapting the request for quotation to quotation process to changes

No matter how much information systems and tools are modified and perfected, their features would not be properly exploited if required changes to related processes were not made to support those improvements (Gargeya et al. 2005). In order to take full advantage of the P2P information system development proposals given in previous chapters, changes should be made to the case company's request for quotation to quotation, that the information would flow according to Figure 15 below.

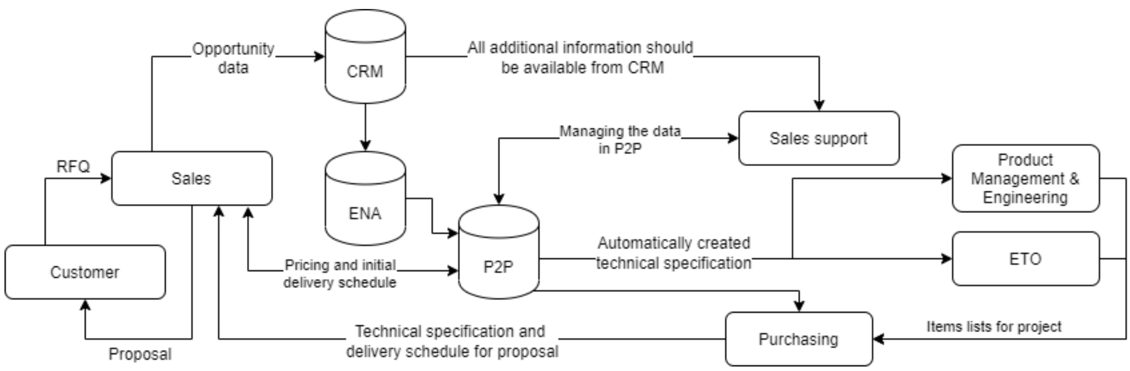


Figure 15. Improved request for quotation to quotation process.

The purpose of this study was to identify the key challenges in sales and order-delivery process related to information transparency. By looking at the challenges identified from the process, suggestions listed in the previous chapters for developing a P2P information system were created. Modifying P2P information system according to the development proposals would enable a significantly smoother flow of information throughout the sales and order-delivery process. Better information transparency in the organization is shown in improved request for quotation to quotation process described in Figure 15 above, with P2P being directly connected to all the functions which belong in the process and manual movement of information between units is now automatic from P2P to most functions.

When the sales team receives the necessary technical information from the customer about the device they want, they enter it into the P2P information system. P2P performs a module check and based on the results, it sends information about a potential future project automatically to product management and engineering, ETO, and purchasing. If the modules are found, P2P will return the module-based price calculation and the initial delivery schedule for that specific product to the sales team. If the modules are not found from the database, the sales team will also be informed directly by P2P, so they know they cannot promise the customer faster delivery time than case company is able to provide and a more accurate price estimate will be obtained once the necessary modules have been created by product management and engineering, and the module search is performed again. Even after these improvements, some information needs to be sent manually from one unit to another, but especially for customer orders for which the required modules can already be found in the case company's database, the process is considerably faster. Large portion of the critical information of the process flows automatically from the P2P information system to the units that need it, and latest update of current situation is available when needed without waiting for someone to respond to an email inquiry. Benefits of the different versions of P2P from sales support team’s point of view are demonstrated in the Table 11 below.

Table 11. Benefits for sales support team by P2P versions.

	P2P	P2P 2.0	P2P 3.0	P2P 4.0
Time used for standard prospect by sales support	●	●	◒	-
Time used for unique prospect by sales support	●	●	◒	◒
Time available for reallocation in sales support	-	-	◕	●
Increased project costs from cases with late information changes	●	-	-	-
Time needed to respond to customer inquiry	●	●	◒	◔

The Table 11 above provides estimates of how a successfully implemented P2P information system would benefit the sales support team by each version of the system. It can be seen from the table that later versions 3.0 and 4.0 of P2P have a potential of saving a significant amount of sales support team's work hours per year that can be reallocated by doing most of the work on standard prospects automatically. Standard prospects refer to sales cases where P2P is able to find all the modules needed to make a product from the case company database. Unique prospects, on the other hand, refers to sales cases where products have not been manufactured before by the case company, and P2P cannot find all the necessary modules directly from the database, but product management and engineering must design them. It can also be seen from the table that the request for quotation from potential customers can be answered much faster with later versions of P2P. Although the overall benefits are greater with P2P 3.0 and 4.0, it can be noted that the better flow of information between different units enabled by P2P 2.0, would also help the case company avoid unpleasant surprises after already signing the customer contract, which would keep project costs in line with original plans.

4.2 Managerial implications

This study proposes that developing new features to the P2P information system and adapting the process accordingly would improve the information transparency between sales and other functions in the case company. However, when planning an information system development project, it is important for management not to underestimate the resources required for the project and to invest what is really needed. A failed information system development project easily becomes significantly more expensive than a slightly overdelivered one when new features are not exploited due to a failed technical implementation or inadequate change management.

Good change management and otherwise adequate resources needed for success should also be considered in similar future projects by the case company. Successful change management is mostly based on a good plan and constant communication with all stakeholders in the project. Good communication and clear agreed practices are also important in the day-to-day business. The interviews revealed uncertainty about how larger files should be sent to a coworker within the company, another unit, or to company external stakeholders. If there are no clear instructions for data transfer, the accidental use of insecure tool for file transfer could, in the worst-case lead to serious information leaks.

4.3 Limitations of the study

The challenge of case study is always to generalize the results out of the context of the study. The results of this study apply to the case company's sales and order-delivery process and the company's information systems in their current state, but even manufacturing companies operating in exactly the same field may find it challenging to take advantage of development proposals of the study. Large part of the proposals are strictly related to the P2P information system used by the case company and to related process. However, findings related on change management in information system development projects answer to more common issues and are not tied to context of this study or even specific industry.

The case company contact person with whom the project was originally agreed and who has been the main contact to the case company through the project is the sales support manager. Although the information transparency and related challenges has been discussed throughout the case company's sales and order-delivery process, great part of the reflection has focused on the work done by the sales support team and the P2P information system, which has only been used by them.

5 CONCLUSIONS

5.1 Contribution of the study

This thesis is a single case study that investigated the information transparency between sales and other functions in the case company and the challenges associated with it. The research process consists of literature review, interviews and data collection, results, discussion and conclusions. The study focused on developing information transparency between case company sales and other functions, which would lead to a shorter process lead times, avoidance of unpleasant surprising changes in the middle of the process, and a better profit margin for the products delivered by case company. Based on the interviews and collected data from the case company, it seems like that the main challenges are related to the features, utilization or implementation of information systems. These themes are clearly linked together, and the proposed changes developed through the findings of the study aim to improve the case company's performance in these areas. This is achieved by adding critical features to an existing P2P information system and modifying the sales and order-delivery process so that the changes in the process and in information systems are mutually supportive and allow for a more efficient process flow.

In projects for the development and implementation of information systems, both large and small, it must be borne in mind that a well-designed project is half-done and that a poorly implemented one is likely to be more expensive than not implementing the whole project at all. If a new or upgraded information system is not used correctly or as widely in the organization as intended, the achieved benefits of the system may be less than the actual cost of the project. On the other hand, if processes are not continuously improved when operating a highly competitive market, important competitive advantage may be lost, or competitors may get too far ahead in development.

5.2 Recommendations for further research

Before proceeding further with developing P2P information system according to the development proposals in this study, the functionality of the proposals should be further validated from the different functions of the case company. In particular, if the latest proposed version of P2P, P2P X which includes a user interface for potential customers, is to be implemented, it will require a more comprehensive requirement definition and the involvement of a wider team in the design before the development project itself begins. Extensive research for similar new practices at the customer interface of the manufacturing industry would be an important step in improving the transparency of information throughout the supply chain. Utilizing the data from these studies, the supplier interface should also be included studied with same manner.

In order to achieve better generalizability, similar case studies should be performed in other companies in the manufacturing industry, preferring the ones that use ETO production strategy as well. Comparing the results with other similar cases would improve the reliability of the results and would the identified challenges relate mostly to same themes or does the industry sector or organizational structure play such a major role that the challenges identified change completely if they change. The reliability of the results could be even further improved if all or part of the similar case studies were completed without this study and its results being available. This could avoid unconscious biases and overly prescriptive research- or interview questions.

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APPENDICES

Appendix 1. Interview questions.

Reboot IoT Factory

Data transparency PoC, Questions for the interviews

1. Basic information of the interviewee
   a. Name/names
   b. Role(s) in the organization
   c. Business unit/team
2. What information systems do you use in your business unit (Draw a diagram with interviewee)
   a. Do all employees in your business unit have access to these systems if they need any information from them?
3. What sales-related information systems do you use in your unit's work?
4. What information do you retrieve from each information system?
   a. Is this information easily available and clearly presented according to your needs?
5. What information do you enter into each information system?
6. Does information transfer automatically from system to another?
   a. If yes, what information and which information systems?
7. Do you often need to ask for information by email or phone?
   a. Within your own business unit
   b. Within the company
   c. From external stakeholders
8. Do you use Excel spreadsheets to store or process data?
   a. What data is stored in the Excels?
9. Which business units you work, or have regular contact with?
10. Does manual retrieval of information between business units or within your own unit slow down the operation of the business unit you work in?
11. Do you feel that this information could also be available directly from the company's existing or new information system?
    a. Why yes/no?
12. Are you aware of the new Prospect to Project (P2P) information system?
13. Any other comments regarding the company's information systems / data transfer or information transparency?