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DEVELOPMENT OF THE NOTIFICATION AND RECLAMATION PROCESS IN A MARITIME SYSTEMS SUPPLIER

Tampere 27.5.2019
Examiner: Professor Janne Huiskonen
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ABSTRACT

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Circular economy pioneers have extended their operations from only manufacturing and selling products to new service models. The approach aims at a more stable source of revenue and value creation throughout the product lifecycle. This study discusses the process-oriented development of the service business from the perspective of the marine systems supplier. Thus, theoretical framework consists of information management, business process development and quality notification characteristics in the context of a maritime service business.

The studied process is part of the ABB Marine & Ports Propulsion Solutions quality management and concerns the notification process carried out by procurement team of propulsion service. The aim of this research is twofold. First, to identify and recognize problem areas in reclamation and complaint processes and second, to create development proposals based on the problems detected. In addition, the goal is to develop improvement measures in the form of more precise guidelines and accurate process descriptions.

The study is based on a general notion that the number of quality notifications made per year is too low. In addition, they are often made inadequately, and/or their lead time is remarkably long. Responses to these assumptions are sought by analyzing the history data of the enterprise resource planning software, conducting semi-structured interviews with process-related personnel and utilizing the knowledge learned by work experience of the author.

The case study revealed a wide range of challenges that are related to the supply chain, information management and prioritizing limited resources of the company. During the study, it was discovered that many challenges are related to the lack of systematical training, lack of monitoring of the reclamations and incomplete communication. As a result, development proposals and recommendations for their implementation were made.

TIIVISTELMÄ

Tekijä: Roope Kulmala
Työn nimi: Poikkeama- ja reklamaatioprosessin kehittäminen merenkulkujärjestelmiä toimittavassa yrityksessä

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Hakusanat: Reklamaatioprosessi, laatupoikkeama, prosessikehitys, palveluliiketoiminta, hankinta

Yritykset laajentavat toimintaansa yhä enemmissä määrin tuotteiden myynnistä ja valmistamisesta uusiin palvelumalleihin. Tämän toimintatavan avulla pyritään tasaisempaan liikevaihtoon ja arvonluomiseen koko tuotteen elinkaaren ajan. Tässä tutkimuksessa käsitellään palveluliiketoiminnan prosessilähtöistä kehittämistä merenkulkulaitteita toimittavan yrityksen näkökulmasta. Tutkimuksen teoreettinen viitekehys koostuu tiedonhallinnasta, liiketoimintaprosessin kehittämisestä ja laatupoikkeamien ominaisuuksista merenkulun palveluliiketoiminnan kontekstissa.

Tutkittava toiminta koskee ABB PS Servicen hankintaosaston laatupoikkeamaprosessia, joka on osa kohdeyrityksen laadunhallintajärjestelmää. Tutkimuksen tavoitteena on kartoittaa ja tunnistaa ongelmakohdat poikkeama- ja reklamointiprosesseissa, joissa servicen hankintatiimi on osallisena. Havaittujen ongelmien pohjalta tehdään toimintaa tehostavia ehdotuksia sekä luodaan täsmälliset ohjeet ja prosessikuvaukset toiminnan kehittämiseksi.

Tutkimusta edeltää yleinen käsitys siitä, että vuodessa tehtyjen laatupoikkeamien määrä on liian alhainen, poikkeamia tehdään huolimattomasti ja/tai niiden läpimenoaika on huomattavan pitkä. Ongelmakohtia kartoitetaan analysoimalla yrityksen toiminnanohjausjärjestelmän historiadataa, järjestämällä puolitrukturoituja teemahaastatteluita yrityksen henkilökunnan kanssa sekä hyödyntämällä työelämässä kartutettua kokemuspohjaista tietoa.

Tutkimus paljasti monenlaisia haasteita, jotka liittyvät servicen toimitusketjuun, tiedonhallintaan sekä rajallisten resurssien priorisointiin. Tutkimuksen aikana havaittiin, että suuri osa haasteista johtuu systemaattisen koulutuksen puutteesta, vaillinaisesta laatupoikkeamien seurannasta sekä riittämättömästä kommunikoinnista. Lopputuloksena esitettiin parannusehdotuksia ja luotiin entistä täsmällisemmät ohjeet prosessin läpiviemiselle.

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Roope Kulmala
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LIST OF ABBREVIATIONS

ABB GTC	ABB General Terms and Conditions
IoT	Internet of Things
ASEA	Allmänna Svenska Elektriska AB
BBC	Brown, Boveri & Cie
BI	Business Intelligence
BPM	Business Process Management
BPS	Business Process Standardization
CCRP	Customer Care Response Process
DS	Digital Solutions
ECM	Enterprise Content Management
ERP	Enterprise Resource Planning
ES	Electrical Solutions
GR	Goods Receipt
IMO	International Maritime Organization
ISM Code	International Safety Management Code
KPI	Key Performance Indicator
MRP	Material Resource Planning
MSC	Marine Service Center
NCR	Non-conformity report
OEM	Original engine manufacturers
PLM	Product Lifecycle Management
JIT	Just in time
PO	Purchase Order
PR	Purchasing Requisition
PS	Propulsion Solutions
PSS	Propulsion Solutions Services
R&D	Research and development
RFQ	Request for Quotation
SCM	Supply Chain Management
SCS	Supply control system

INTRODUCTION

1.1 Background

In a challenging and globalized market, companies are striving to improve their competitive advantage. Although complex manufacturing equipment have always needed maintenance and repair services, companies have only recently expanded their businesses strategically towards Product Service Systems (PSS). PSS are business models that provide an integrated delivery of products and services. Leading manufacturers are increasingly integrating products and services to generate increased revenues and achieve better customer satisfaction. (Raja et al, 2013)

Maritime industry presents inviting PSS offerings due to the capital-intensity and reasonably long life cycle of ships. Shipowners are central actors in the industry, with high degree of involvement throughout the whole lifecycle of the ship, from procurement and production to operation and recycling. Previous research illustrates that shipbuilding industry has formed several conglomerates and only a few big players dominate most of the production and sales, while the rest have little capacity to compete. This is due to the constant mergers and ongoing acquisitions in recent years. Previous studies are also showing that most of the maritime suppliers are dependent on a limited number of very important customers. As a result, customer satisfaction and continuous co-operation are particularly important in the maritime industry. The importance of maintaining customer relationships should be emphasized compared to the acquisition of new customers. (Pagoropoulos et al 2017 & Xu et al 2018, pp. 242-243)

Earlier research demonstrates that maritime companies can enhance their competitive advantage by selecting the right partners to form a strategic alliance. Organizations included in the maritime cluster is extremely diverse, while it consists of shipbuilding yards, ship design firms, producers of ship equipment, shipping companies, maritime insurance firms, ship brokers, and classification societies. On top of diversity, the industry is one of the heaviest regulated businesses in the world. PSS providers are facing severe challenges while delivering correct supplies to various ports around the world at the right time. The

supplier's capabilities and professionalism are significant elements for ship owners to evaluate in candidate assessment. (Hsu et al., 2016 & Solesvik et al., 2010)

Although the shipping industry is particularly sensitive to supply chain problems and equipment failures, the fact is that even the most intelligent companies get things wrong sometimes. When these problems occur, the performance of companies is put to the test. The main question is: How are the companies managing these problems and customer complaints? Research illustrates that on one hand, the complaints are seen as opportunities for development, when complaint management can lead to operational improvement and improved financial performance. On the other hand, complaints are often seen as necessary evil and complaint management is seen more like an expense than a potential source of profit. (Johnston, 2001 & Cook, 2012, pp. 1-9)

When companies are practicing business in deep collaboration, the added value of systematic complaint management must be recognized. In order to maintain the partnership and develop the business and products, it is extremely important to take all problems and notifications seriously. At best, complaint management is a process that consists of a standardized series of measures and actions to identify root causes, minimize the impact of the problems and restore the customer satisfaction. (Filip, 2013 & Cook, 2012, pp. 2) Similar topics are playing an important role also in the case company of this thesis, ABB Oy Marine & Ports.

1.2 Case Company

In 1988 Swedish general electric company ASEA (Allmänna Svenska Elektriska Aktiebolaget) and association of Swiss electrical engineering companies called BBC (Brown, Boveri & Cie) merged to form ABB (ASEA, Brown, Boveri). The new company had revenues of $17 billion and employed 160 000 people around the world. (ABB, 2013) Nowadays ABB is a global leader in power and automation technologies. The company is divided into four divisions that are presented in the figure 1. According to the annual report of the company 2017, the revenue was $34,3 billion with a net income of $2,2 billion. Operational EBITA $4,1 and EBITA margin 12,1 percent. Approximately 82% of the revenue

comes from products and the rest comes from services and other revenues. ABB operates in more than 100 countries and employs around 147 000 people. (ABB, 2017a)

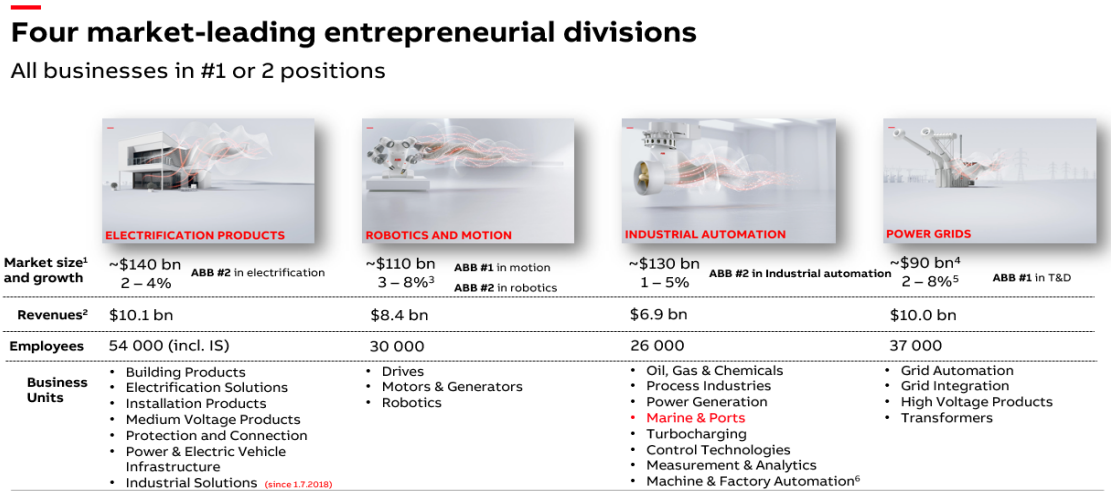


Figure 1. ABB Divisions (ABB, 2019a)

In Finland ABB is one of the biggest industrial employers while it operates in 20 different locations and employ 5300 people. Factory concentrations are located in Hamina, Vaasa, Porvoo and Helsinki where electrification and automation solutions for the marine industry are produced. In 2017 the revenue of ABB Oy was 2,3 billion euros. (ABB, 2019a)

1.2.1 ABB Business Unit Marine & Ports

Business unit Marine & Ports is part of the Industrial automation division. In 2018 its revenue was approximately 1 billion USD and it divided 50% to Marine vessels, 20% to Ports & 30% Services. ABB Marine & Ports has business in 26 different countries, six of which are hub units: China, Singapore, Finland, Norway, Sweden and United States. Company's typical scope of delivery consists of electric propulsion unit(s), automation and advisory products and power plants. Strategy has been to be complete provider from design to construction phase and finally support customer and provide services throughout the vessel life cycle. The main features of the business unit are illustrated in Figure 2.

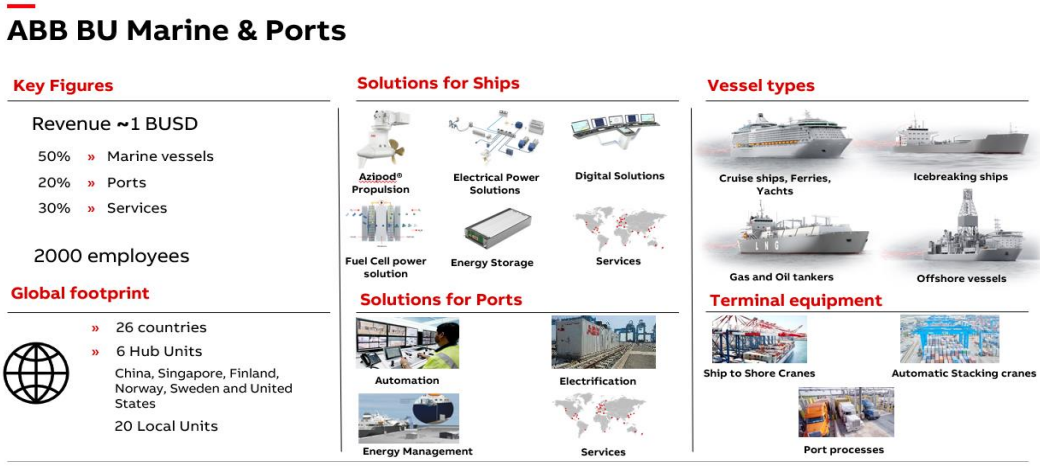


Figure 2. Business Unit Marine & Ports (ABB, 2019a)

The company has a strong belief that the next generation of ships will be electric, digital and connected, as the industry moves towards new energy sources and autonomous ship operations. (ABB, 2019a)

1.2.2 Propulsion Solutions and Marine services

As shown in Fig 2, the total offering of Marine & Ports consists a wide range of different solutions. This thesis focuses on Propulsion solutions and to be more exact, propulsion services. Azipod® propulsion is an electric propulsion system produced by ABB Group. It was developed in Finland 1990 and since then, ABB's Azipod® propulsion system has inspired naval architects to create more efficient and sustainable vessel designs. It has fixed pitch propeller and electric drive motor is in a submerged pod outside the hull of the ship. The propulsion family and their power range are shown in figure 3. (ABB, 2019a)

Azipod® gearless propulsion family

Power range 1…22MW truly available – with proven technology

	Azipod® D	Azipod® M	Azipod® XO	Azipod® XL	Azipod® ICE	Azipod® VI
Power (MW)	1.5 – 7.5	7 – 14.5	14 – 22	14 – 22	2 – 5	6 – 17
Cooling	Air + Sea	Air + Sea	Air	Air	Sea	Air
Motor type	PM or induction	PM	Synchronous	Synchronous	PM	Synchronous
Max ice class	PC 5	PC 6	PC 5		PC 3	PC2
Max BP thrust	130 t					

Figure 3. Azipod® propulsion family (ABB, 2019b)

The name comes from the fact that the unit is azimuthing, in other words steering around its vertical axis infinitely by 360°, and it is podded drive. This electrical propulsion unit can improve fuel efficiency by up to 20 percent and make ships much more maneuverable and simpler to operate than traditional shaft-driven propulsion systems. Although this gearless propulsion family has proved its excellence and efficiency the challenge is to make sure that customers are using them as designed. Like all other systems and machinery, propulsion units must be taken good care of. Quality and reliability are vital aspects in maritime industry because the safety of people and the environment cannot be risked. Creating technologically superior products in today's business environment is not enough to support the customer but with a range of functional services, the company can improve its competitiveness and customer satisfaction. As systems and components of a ship are aging, it becomes imperative that a life cycle management plan is in place to ensure that critical assets are supportable. (ABB 2019a)

ABB has devised a series of life cycle services that protect the operation of critical electrical plant and systems. The core of ABB Marine & Ports service has always been people and the way that company works together with customers. For many shipping companies, the implication of not managing their assets can be costly through operational downtime. Figure 4 illustrates the lifecycle of the ship. As technology evolves, the lifecycle of the ship can be extended by various modernization project in addition to day-today overhaul and large-scale docking projects. (ABB 2019c)

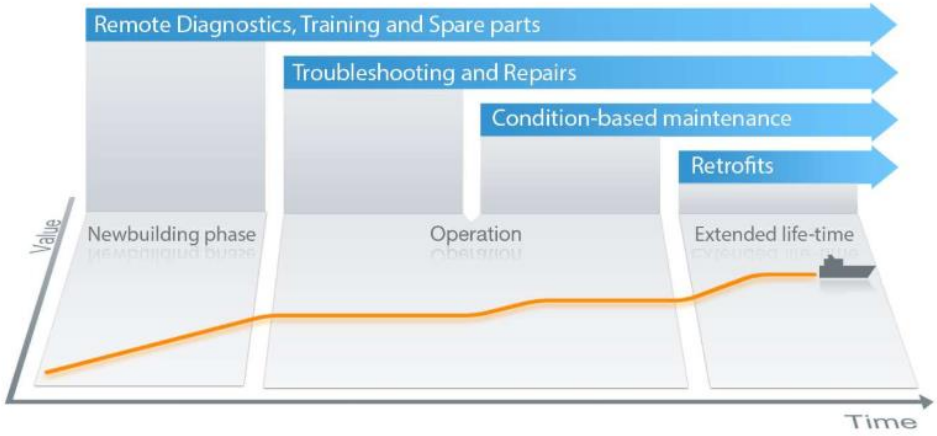


Figure 4. (ABB 2019b)

1.2.3 Propulsion solutions procurement and supply chain management

Depending on the type of the vessel, its life cycle is from 20 to 30 years. To ensure reliable operation, the vessel owner must take good care of it. Flawless propulsion system is one of the most critical factors for ships operation, so its condition must be monitored continually. As Original Equipment Manufacturer (OEM) ABB must carry out the maintenance program, supply spare parts and guidance to the customer and generally bear the responsibility for the equipment. (ABB, 2019b)

The department of propulsion solutions is divided to new building and propulsion service. New production and assembly facilities are located in Vuosaari and Hamina. The supply chain consists typical areas such as of procurement, warehousing, configuration and transportation. The characteristic of Azipod® production is that ABB Oy Marine & Ports is not manufacturing anything. Propulsion systems are assembled from materials that are produced by external suppliers according to the detailed instructions of ABB. New building is responsible for the procurement of all the materials needed to assemble new Azipod®-units. Propulsion service department is responsible for technical support, supplying spare parts and providing maintenance services. Also, through constantly evolving digital services, real-time condition monitoring has been made possible. (ABB, 2019b)

Previously, only one procurement team was responsible for meeting the material needs of both departments. Nowadays the responsibilities have been redistributed and both departments have their own category-responsible procurement engineers. Although parts and suppliers are the same, the supply chains differ from each other. While the new building orders all the materials for the Vuosaari production plant, the parts ordered by service organization are delivered all over the world to the end customers. (ABB, 2019b)

ABB Marine has a certain quality vision and requirement for its suppliers. In the first instance, vendors are assumed to support ABB Marine to achieve strategic goals while ABB is doing business in deep co-operation with the end-customers. Supplier collaboration is vital when the company is manufacturing this critical and quality superior products. In shipping business, the human- and environment safety comes always first. Thus, service business in maritime industry can be quite hectic while, in many cases, the manufacturers

are required to supply complex and detailed parts globally as fast as possible. The rush must be the biggest reason why faults occur, and costs increase. (ABB, 2019b)

1.3 The aim and scope of research

The aim of this research is to develop ABB's reclamation and complaint process in order to add value to the organization and its customers. The first stage is to identify and recognize problem areas in reclamation and complaint processes where the service procurement team is involved. After recognizing the problems, development proposals based on the flaws detected are created and finally developed in the form of precise guidelines and accurate process descriptions.

Purchasing engineers are primarily responsible for handling all notifications and other problems that are related to their own purchases. Thus, the notifications that are handled by new building procurement engineers are not part of the scope of this thesis. In addition, this study focuses on vendor-related notifications, so no attention will be paid for internal challenges.

The research questions are as follows.
1) What are the problem areas in reclamation and complaint processes in ABB Service organization?
2) What are the underlying reasons for these detected problems?
3) How the reclamation and complaint processes can be improved?

In order to get answers to the main research questions, the process is split into smaller parts and questions, like how the faults occur, who notices them and when and how will the procurement team take part to the process. It is vital to understand the details of the problem areas and finally create development suggestions. As tools of the development process, the current state is visualized, and all the related actions and systems are illustrated in chapter 3.

The general understanding is that ABB Service organization is bearing the responsibility for the faults and additional costs too often, while the causes remain unresolved. In many

cases the company would be entitled to claim credits from the vendors and even if this is not the case, clarifying the root cause of the problem could help to develop its business. One of the reasons for unused reclamation right may be the urge to secure customer satisfaction or maintain supplier cooperation. However, in the long run, this mode of operation is not sustainable, and problems tend to repeat themselves. Thus, in this study, the underlying reasons and patterns for the unused reclamation right is explored more deeply.

1.4 Structure of the thesis

The structure of this master's thesis consists of 7 main parts. Chapter 1 introduces the background, topic and case company of the thesis. In addition, the aim, scope and structure of the thesis is introduced. Chapter 2, relevant literature, presents five relevant topics and theories for this master's thesis. Successful complaint management includes a wide range of processes and actions within the organization. The common goal for advanced reclamation process is to develop the business and to fulfill the customers' needs. The process must be understood on a large scale and that is why the theory of process management plays a major role in this master's thesis.

Chapter 3, case ABB Reclamation process, concludes from presentation and the current state of the reclamation process in ABB. In this chapter, all process related systems, functions and actions are visualized and introduced. Although the reclamation process is planned to be similar for all company's business units and divisions, there are some detailed differences between them. Focus will be strictly on those claims and specific duties where service procurement team is involved.

Chapter 4, research methods, consists and presents the methods used for writing this thesis, preforming the research and analyzing the data. Chapter 5, research findings, presents the critical issues found in the current reclamation process. Earlier chapter 3 presents only the current situation of the reclamation process while this chapter focuses on finding the challenges or defects in the process. These issues may occur in the documents related to the process, in the current instructions or any other findings that were considered challenging during the research.

Chapter 6, Summary and Conclusions consists of all potential development suggestions that could improve the current reclamation process and might help achieving the goals. Consequently, this part summarizes the lessons learned within this development project and discusses the recommended steps for implementing the suggestions. In addition, suggestions for further research are presented.

2 REVIEW OF THE RELEVANT LITERATURE

In this thesis, theory section is divided in five different topics in order to understand the aspect and legislation, means of information management, the characteristics of supply chain management of service business, process management principles and finally the excellence of complaint management in the Maritime industry. Theoretical framework is quite extensive, and the basis of the theory is to understand why the supply chains in the maritime industry are so prone to errors and how can occurred problems be avoided. In addition, the discussion around international business agreements and process development creates their own challenges in the theory field. Figure 5 presents the main theoretical themes of the thesis and their linkage to the successful complaint management in the maritime sector.

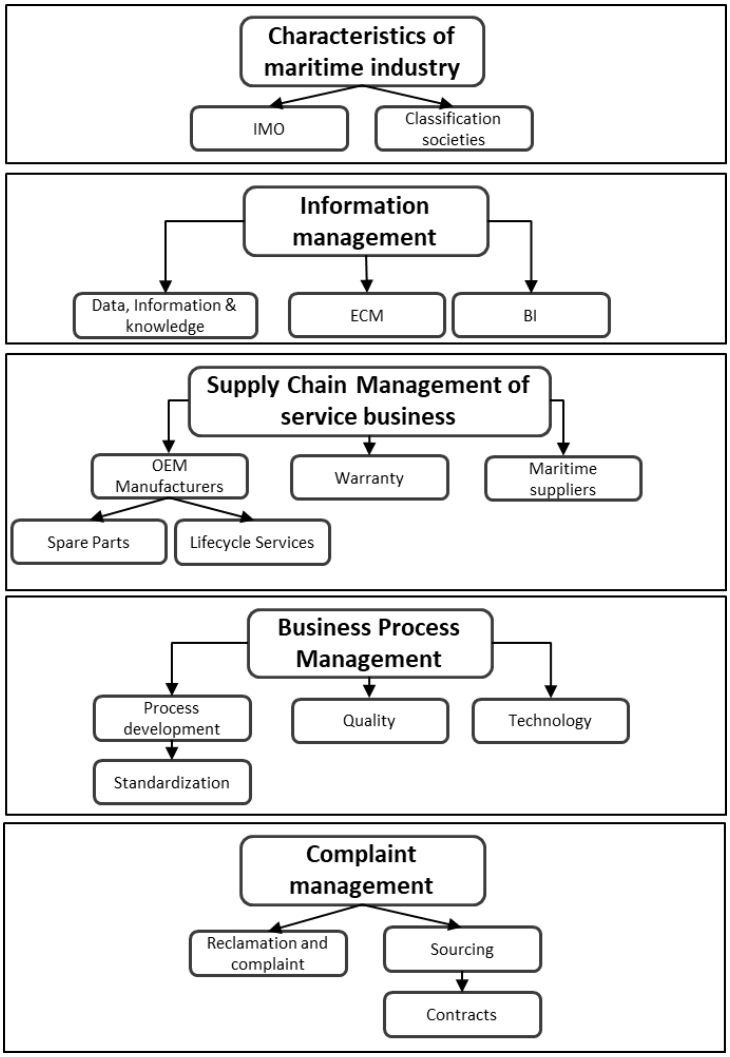


Figure 5. Structure of theoretical framework

2.1 Characteristics of maritime industry

Like with most manufacturing industries today, marine related products are heavily affected by rules and regulations. Since shipping is inherently international, it is necessary that shipping legislation is equal on matters such as standards of construction, crew competence and rules of navigation and pollution. If there weren't common worldwide rules, the alternative would be a collection of conflicting national regulations. The result would be commercial distortion and administrative confusion which could compromise the safety and efficiency of world trade. (International Chamber of Shipping, 2018)

Fortunately, it has always been recognized that developing international conventions, followed by all shipping countries, is the best way to improve safety at sea. In the mid-19th century onwards, several countries proposed that a permanent international body should be established for promoting maritime safety more effectively. As result of this International Maritime Organization (IMO) was founded in 1948. (World Maritime University, 2004)

Over the years, IMO has produced around 40 international conventions. National governments, which form the membership of IMO, are required to implement and enforce these international rules, and ensure that the ships, which are registered under their national flags, will comply. In addition, over 800 codes and recommendations have been developed for use by the 174 IMO member states. Unlike international Conventions, these codes and guidelines aren't mandatory. There are thousands of these non-mandatory instruments that will become mandatory after certain amount of member states, representing certain amount (for example 35%) of global tonnage, implements them into their own legislation. It is thus impossible to implement mandatory instruments without non-mandatory instruments and they do provide additional guidance and reference for the flag states. These recommendations are especially vital for those parties who have incorporated them in their national legislation. (World Maritime University, 2004)

2.1.1 Classification societies

The main responsibility for enforcing these IMO regulations, rests with the flag states. Flag states are the countries in which merchant ships are registered and they may be different to

the country in which they are owned. The relationship between maritime parties is shown more clearly in Figure 6. Flag states enforce IMO requirements through inspections of ships conducted by a network of international surveyors. Much of this work is delegated to bodies called classification societies. (International Chamber of Shipping, 2018)

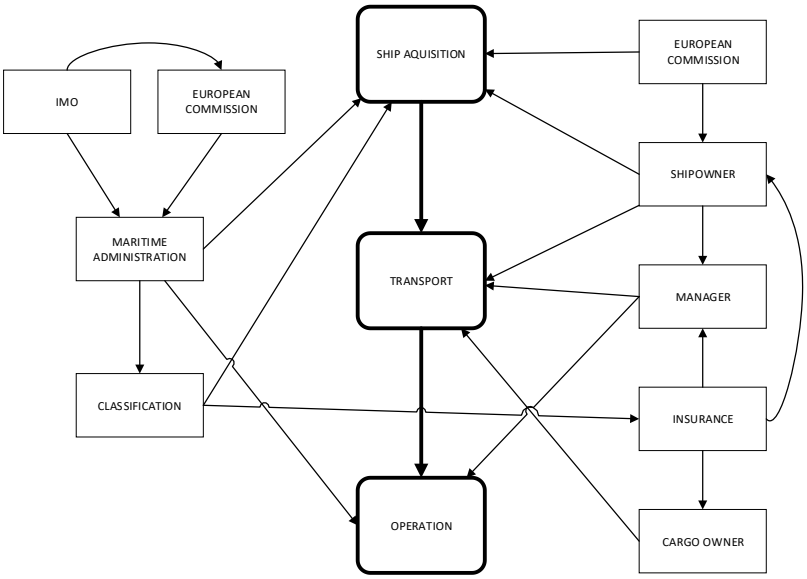


Figure 6. Relationship between maritime parties. (Kristiansen, 2005, edited by R. Kulmala)

Classification societies are independent and legal constitutions that are paid and hired by the owner of the to-be-classified vessel. They can broadly be defined as organizations, which classify and survey ships, according to their condition for insurance and other purposes. Thus, they are performing a vital function with respect to the marketability and insurability of vessels. While IMO develops and addresses a broad selection of detailed safety aspects, it has recognized classification societies' leading authority and expertise in ship's engineering, structural design, construction and maintenance standards. Besides the shipowner and purchaser, the principal maritime insurers, cargo interests, and charterers rely on their activities before providing financial coverage or hiring the vessel. (De Bruyne, 2014)

2.1.2 Ruling process

Although IMO is producing international conventions and guidelines, the rules and regulations are issued by multiple different parties. These rules are depending on the ship's flag

country, owner's decision, main region and mission. The basic ruling process hierarchy is presented in Figure 7. European Commission represents the corresponding organization based on the region. Kristiansen's simplified ruling process hierarchy figure is illustrated below. European Commission represents the corresponding organization based on the region.

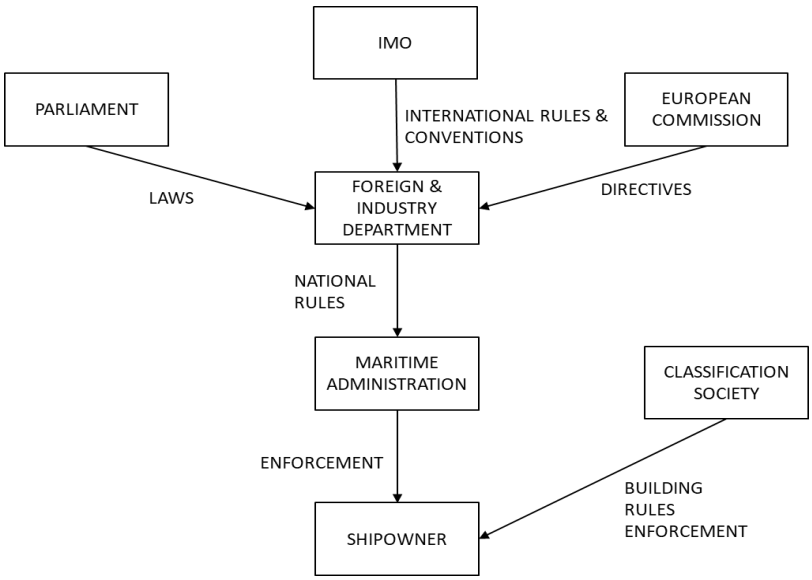


Figure 7. The structure and hierarchy of maritime regulation (Kristiansen, 2005)

Emerging technology and digitalization open opportunities to improve sea transport safety, energy efficiency and overall economy. Maritime law and IMO's conventions encourage companies for product development in order to ensure less pollution and safer environment. Unfortunately, slow regulation renewal is slowing down the rapid development and sometimes entails considerable costs for maritime suppliers. (Ahvenjärvi, 2018)

2.1.3 Maritime suppliers

Owners must expend money and provide all supplies that are required for repairs and consumption onboard to maintain seaworthiness of the ship. These supplies include spare parts, bunkers and lubricators and these expenditures can amount to over tens of thousands of dollars. Thus, an efficient supply chain system for the provision on supplies is one of the top priorities for ship owners.

The topic of supplier evaluation and selection has been discussed for many decades in various industries, but the subject is rarely researched in maritime supply chain management. While ships are vital assets for shipping companies, they must ensure that their equipment will pass various surveys and inspections conducted by Ship Classification. According to the request of International Safety Management Code (ISM Code), it is necessary for ship owners to possess a sound supply control system (SCS) and integrated planning maintenance system (PMS). The function of PMS is to ensure that maintenance and repair of ships are routinely performed and the aim for SCS is to consistently provide adequate maritime supplies. (Hsu & Al, 2016)

These maritime supplies must be delivered to various ports around the world at the right time, so ship owners must depend on professional maritime suppliers in order to effectively complete the entire logistics operation. The supplier's capabilities and professionalism are significant elements for ship owners to evaluate in candidate assessment. (Hsu & Al, 2016)

2.1.4 Lifecycle of the ship

Shipping industry is one of the heaviest regulated business and it is alive 24 hours a day, seven days a week. When the ship is not operating, it is only causing ongoing costs to the owners. When the idea of ordering a new ship is born, several steps and countless amount of people will follow. The building of a ship takes a great deal of organization and excellent management while shipbuilding remains a relatively highly skilled and labor-intensive process. (The Maritime Industry Knowledge Centre, 2013)

During the construction phase, there are companies involved from many different sectors and even when the vessel is ready, ships operation is complex and sophisticated process. Building and operating a modern-day cruise ship is a billion-dollar business. Ships life cycle is 20 to 30 years and operation require a large number of different services. (Fet, 1997)

The product-oriented life cycle is illustrated in Figure 8. This figure also indicates the time span for each main phase in the life cycle. A more detailed description of the activities in different phases is given on the right side in the figure. The approach to sustainable development of ships should aim to improve the environmental impact of the value chain, in

each phase in the life cycle. Better quality equipment and the careful maintenance alone, will reduce the negative environmental impact of ships. (Lindroos, 2015)

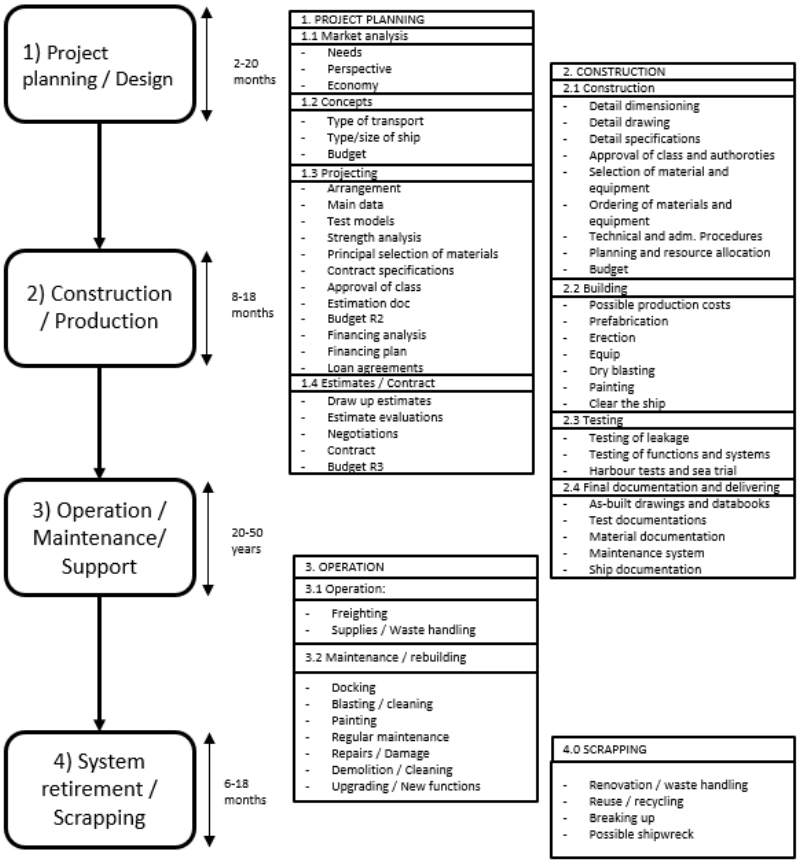


Figure 8. The life cycle of a ship described in four main phases (Fet, 1997. Edited by R. Kulmala)

2.2 Information management

Motivated and professional staff is the core of profitable business. To maintain their competitiveness and improvement ability, the companies must pay attention to their key resource, information and its management. Our daily information environment consists of information that is in order and information that is unorganized. This information can be located on file-based systems for example a personal computer desktop, network storages or cloud-based storages. In business generally, this information may consist of offers, reports, project notes, or excel tables. In addition to these systems, the information is located in the database-based systems of the company, such as sales, enterprise resource planning, production or financial information systems. In these cases, the information is less often

considered as individual documents, but the information is retrieved and read in the form of data. Successful workflows require that file-based documents and database-data are easily found. In either case, the information should be in order if it is a supportive environment. There must be a common understanding of what is the right order.
(Lindén, 2015, pp.12-13)

Previous research, Melville, (2007) shows that the lack of structured Information Management system can generate productivity losses. These losses and weaken quality does not have to happen due to one large scale problem, but they can occur from many small streams as well. For example, if a staff member does not have the knowledge to make a decision based on information at hand, the process is likely to be delayed. If the same phenomenon repeats itself, it becomes a problem. (Melville, 2007 & Lindén, 2015)

2.2.1 Data, information and knowledge

While the field of Information Science is constantly changing, scientists are required to review its fundaments and definitions. The three concepts of data, information and knowledge are the basic building blocks of the field and they do differ from each other. Data means alphabetic or numeric signs and raw material of information. Without context data do not have any meaning. Information is data that is organized to produce meaning. It is facts and ideas that are communicated. And knowledge means enhanced information by a person's or a system's own experience. It is cognitive based, so it cannot be transferred from one another. Through information we are able to communicate about it. (Kock et al., 2006)

Business processes can be seen containing the product flow between different activities, suppliers and customers of the process. When manufacturer is creating a product from raw materials or assembling complex end products for a specific customer, the whole business and production consists of different processes that require employees with correct tools, data, information and knowledge. (Kock et al., 2006)

There are tools to gain better understanding of sharing information within organization. One example is information flow diagram, which assists user in understanding the entire

flow of information from beginning to end. It emphasizes the process of the flow rather than relation between data points. In addition, it shows the relationship between internal information flows within an organization and external information flows between organizations. Users can get a comprehensive picture on the steps that are involved within the process. (Business Online Learning, 2019) Figure 9 shows a simplified example of information flow during the procurement process.

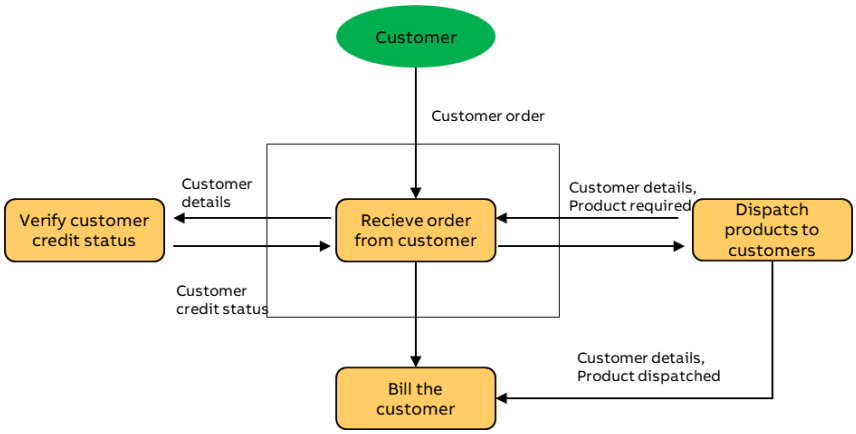


Figure 9. Information flow modeling (Integrated Modeling Method, 2019, edited by R, Kulmala)

2.2.2 Enterprise Content Management

Directors, managers and employees are combined by the fact that they all need information in their daily decision making. This information can be found through different channels but often by the individual himself. When the information comes from the own experience of an individual person, it is called knowledge. Even though experienced employees with large amount of knowledge are vital for maintaining businesses performance and competitiveness, it is quite problematic to transfer their knowledge to others. In addition to knowledge, business processes include enormous amounts of unstructured data and structured information, which must be available. (Business Online Learning, 2019)

The concept of enterprise content management (ECM) describes the strategy, methods, and the set of instruments that are used to collect, manage, save, store, and publish/unlock content related to these business or organizational processes. ECM covers also document management, digital asset management, Web content management, collaboration, and imaging. Companies must pay attention to their ECM because of the rapid growth of unstructured

information. Documents are less surveyable and different versions of documents occur. This results in inefficiency and unnecessary additional cost for redoing certain work. (Baan, 2013, p. 126)

2.2.3 Business Intelligence

Business managers used to gather and store massive amounts of data in the belief that they contain some valuable insight. Eventually they discovered that raw data is rarely of any benefit, and that the real value depends on an ability to analyze it. This need generated hundreds of Business Intelligence (BI) companies that specialized in providing software systems and services for extracting knowledge from raw data. Thus, the whole concept of BI was born. (Michalewicz et al., 1998)

The aim for BI is to make structured information available to the right people in the right way at the right time. The ability to make decisions based on this information is crucial. From a human perspective, BI means that a person is trained to make the right decisions and have the full support of management. Individual employee works to improve the organization and to achieve business goals set by management. BI supplies the necessary information. Figure 10 Baan's EIM triangle and the relations between concepts. (Michalewicz et al., 1998)

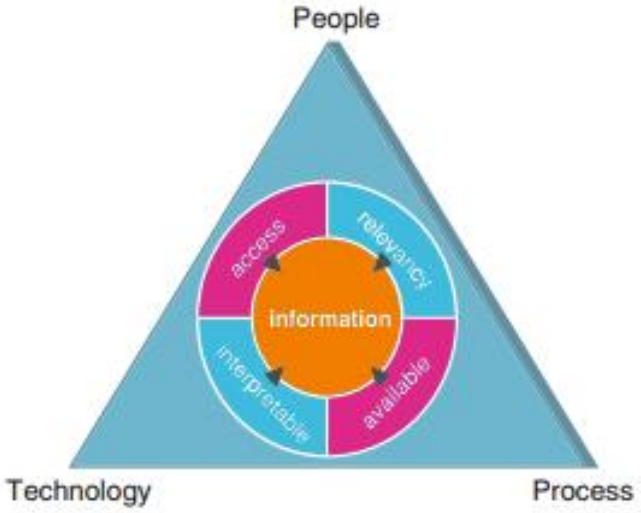


Figure 10. EIM Triangle (Baan, 2013, p. 50)

From a process perspective, BI means that business processes can be optimized by making decisions based on the numbers from the source systems or data warehouse architecture. This does not mean reverting back to stopwatch techniques to minimize lead times when only the error rate increases. Previous research is showing that the certain points in processes can be done much more efficiently by taking advantage of information in the process. (Baan, 2013)

Based on Gould & al (2013) in addition to business intelligence (BI) tools, also manufacturing-based transactional systems, such as enterprise resource planning (ERP) have been around already for decades. Online, cloud-based, software-as-a-service ERP systems are relatively new. First, the amount of data, that companies are collecting, is huge. Second, the exponential growth in the amount of data requires a new way of thinking. According to Costa & Al (2016) ERP systems are defined as comprehensive, packaged software solutions that seek to integrate the complete range of a business's processes and functions in order to present a holistic view of the business from a single information and IT architecture. Nowadays they are at the core of every firm. They can be customized to meet the needs of each company, and this integration can be continuously improved. (Gould & Al, 2013; Costa & Al. 2016)

2.3 Supply chain management of service business

Based on the book of Stadtler & Al, 2015, the term Supply Chain Management (SCM) has become an indispensable element of the management practices since its creation in 1982. Often, a supply chain consists of a number of production sites spread over several continents and coordinating material flows from raw materials to end products is a very complex task. In addition, customer requirements have increased significantly over the last few years. In response to increasingly individualized customer requirements, completely new level of organization and control over the entire value chain of the life cycle of products has been developed. This cycle begins at the product idea, covers the order placement and extends through to development and manufacturing, all the way to the product delivery for the end customer. In addition, it contains all final services and ends with recycling of materials. This is the vision for industry 4.0. (Stadtler & Al, 2015 & Thangaraj & Al, 2018)

Life cycle thinking has led to a change in business. Nowadays it is more and more common to sell a service instead of a product. This leads to increased producer responsibility but offers more ways for companies to create value, make profit and be more sustainable. (Turunen et Al., 2011)

2.3.1 The evolution of production and supply chains

The basis for the fourth industrial revolution is the availability of all relevant information in real time by connecting all instances involved in the value chain. The connection of people, things and systems creates dynamic, self-organizing, real-time optimized value-added connections within and across companies. Thus, production and supply chain evolution has gone a long way from water and steam powered machines via mass production to automation and Internet of Things (IoT). This development can be seen in Figure 11.

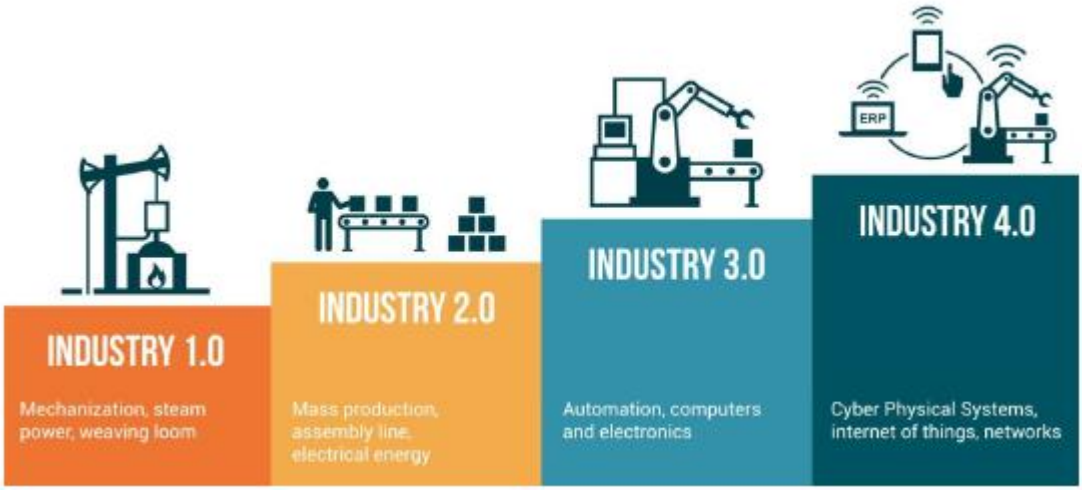


Figure 11. Industry 1.0 to 4.0 (Thangaraj & Al, 2018)

The key concept for optimizing production and supply chain is just-in-time (JIT). Nowadays, JIT is associated with efficiency, continuous improvement, quality, and optimal flow. Industrial Internet can be utilized in various different ways when companies are trying to produce customized products and services for just the right need, in the right time and just the right amount. With the help of various intelligent systems and software, unprofitable activities can be eliminated, and functions be better targeted to increase customer satisfaction and competitiveness of the company. (Rios-Mercado et al., 2010)

2.3.2 Servitization

There is even a new term developed to describe the phenomenon where companies, that are previously known as manufacturers, add services to their total offering. This term is called servitization. Modern day manufacturing companies are facing two different business goals: creating technologically superior products and making sure that customers are using them as designed. Researches have revealed that the process, where the product is transformed into service, is challenging. Companies are colliding with some obstacles when trying to change their strategic direction towards service business and one of the concerns is operational service management. Even though it is challenging for companies to add these services to their offering and create modern profitable business, there are groups of reasons to find a way. (Turunen et Al., 2011)

1) Economic reasons
- Services have higher margins than goods
- They provide a more stable source of revenue than products
- It's a new way to make profit in addition to a one-off transaction

2) Customer needs
- Customer organizations want to focus on their core competences
- Non-core functions, such as maintenance, are wanted to be outsourced to the provider of the capital equipment

3) The competitive advantage
- Services are difficult to imitate
- Less capital dependent
- Way for manufacturers to escape the typical problems of mature business (Turunen et Al., 2011)

When manufacturing firms are entering to the service business, the first steps have usually been the spare parts sales and repair and maintenance of products. On the first step the service portfolio is quite simple and easy to manage. After taking the first successful steps,

manufacturers are increasingly taking even further steps and creating more complicated and sophisticated solutions. This development means that the goal is not only to make profit but lengthen the lifespan of machines and equipment. Awareness of sustainability in business decisions has an increased importance for different stakeholders. To develop more sustainable solutions, which meet the needs of a society, is a key challenge in industries along the whole value chain. (Sonnemann et al., 2015, p. 31)

Industrial services can be categorized in various different ways. Common classification is based on the relationship to sales: Whether the service is offered before, during or after the sales event. Turunen et al., 2011, summarizes the categorization with a company example. In the Figure 12 service offerings are divided according the purpose of the service, the type of relationship with customers and the type of information required. Based on these factors offering forms three groups:

- Services supporting the product (SSP)
- Services supporting the customer's processes (SSCP)
- Services supporting the customer's business (SSCB)

	SSP	SSCP	SSCB
Purpose of the service	Enable the proper functioning of the product	Ensure the optimal usage of the product in its operational environment, minimize shutdown time of the plant	Enable the growth and success of customers' business
Type of relationship with customers	Transactional relationship	Performance partner	Strategic partner
Type of information required for the delivery	Basic information of the products and customers	Broader information of the products and customers as well as of production processes and operative environment	Broad information of customers' value chain and the ways in which different types of services may benefit it; information of customers' strategy
Examples of services in the category	On call repair, spare parts	Preventive maintenance, scheduled inspection, availability contracts, modernization	Consultancy, training, financial solutions, business optimization, integrated solutions
Examples of service providers in the category	Stannah group: after sale services (repair and maintenance of stair lifts)	Metso group: process optimization services (e.g. plant diagnostics and upgrades)	SKF group: engineering consultancy services (e.g. design optimization)

Figure 12. Categorization of industrial services (Turunen T. & Al, 2011)

While provision on supplies is one of the top priorities for ship owners, it is not a surprise that maritime systems suppliers aim to be strategic partners with shipping companies. They are usually aiming for continuous business partnership instead of one-time-transactions because supply chain requires a broad knowledge of the field.

2.3.3 Service business supply chains

When repairing equipment, there is often a requirement to replace defective components or parts. These replacement parts are commonly called service parts. Without adequate warehousing of these parts, construction equipment must be idled, power plants cannot function, computers cannot be repaired, and airliners will be grounded. The list of such commercial environments requiring service parts is seemingly unlimited. In other words, our technology-dependent world depends on the careful creation and distribution of service parts. (Muckstadt, 2005, p. 1)

It is recognized that there are many different types of these parts and that they perform many different functions. For example, to keep our cars operational, we can buy inexpensive parts, such as filters, and also very expensive parts, such as transmissions or engines. To ensure timely repair of our cars, extensive supply chain systems have been developed by car manufacturers and other companies. But how should these resupply systems be designed and operated? How many warehouses should there be? Which warehouses should resupply which other warehouses? Clearly, car parts differ in terms of their cost and demand rates. However, they also differ in terms of criticality. We can wait for certain parts but not for others: A car is often operable if it has a damaged interior trim part, but not if it has a faulty transmission. Thus, decisions concerning what parts to stock and what should be the locations of the stocks are important to the car-using public and to the providers of the parts. (Muckstadt, 2005, p. 1-4)

OEM refers to the manufacturer of the original equipment. For example, in automotive industry the vehicle’s original manufacturer makes OEM parts. Many automotive companies are using outside manufacturers for producing their original parts, so the concept of OEM does not mean that these parts are made by the car company. They are exactly same parts,

made in the same way, from the same tested materials, generally with the same machines that the vehicle was made with.

According to Thauer (2014): The managerial sources of corporate social responsibility, the component manufacturers can be either first, second or third tier suppliers to the OEM. First tier suppliers are often huge high-tech product suppliers such as Schaeffler or Robert Bosch AB. Second tier suppliers are usually medium-sized, and they do not deliver directly to the OEM but the first-tier suppliers. Third-tier suppliers are often small or medium-sized companies and their products are only car-specific to a certain degree. This division is illustrated in Figure 13.

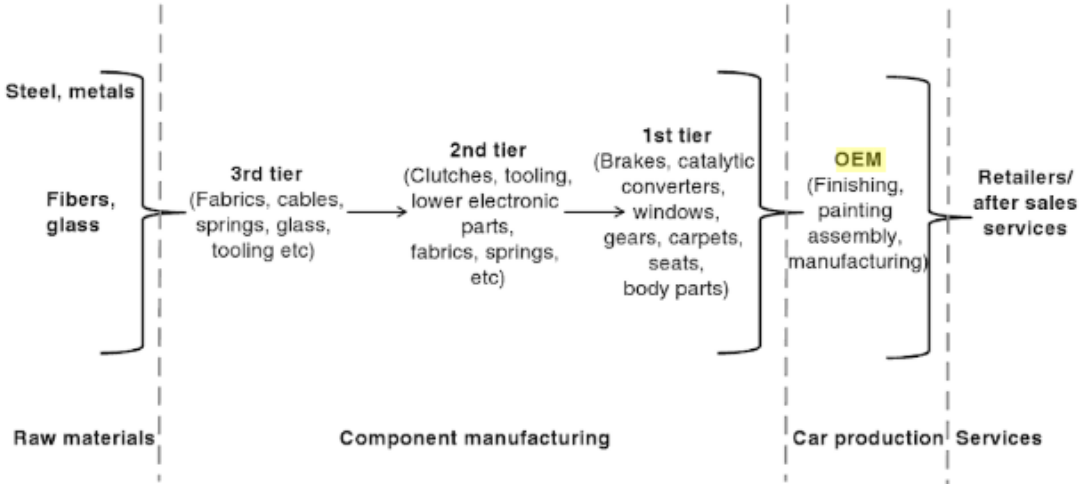


Figure 13. The Managerial Sources of Corporate Social Responsibility (Thauer, 2014)

The automotive industry is generally a high-skills, high investment and high-tech industry. The further down a company is in the supply chain, usually it has smaller operations and it relies less on skills, investments and technology.

2.3.4 Warranty

When customers are making the purchase decision, typically they are comparing characteristics of competing brands. Sometimes the decision is based solely of the product related characteristics such as price, quality, reliability, extra-features and so on. Post-sale factors take on added importance in product choice as well. Product warranty plays an increasingly important role in consumer and commercial transactions. (Rahman et al., 2015, pp. 1-4)

The use of word warranty is widespread, and it serves many purposes. According to Murthy and Blischke (2006), warranty means “Contractual agreement between the manufacturer and the buyer that requires the manufacturer to either rectify item failures or compensate the buyer for failures that occur within the warranty period after its sale.” In other words, warranty is only a term of contract and it serves as a promotional tool that allows manufacturer to raise its own products from competitors. When manufacturer is offering better warranty terms, it signals better product quality and greater assurance, and this leads to greater sales. Thus, warranty terms are often an important element of marketing strategy. (Murthy et al., 2006, p. 6)

The term warranty is often used as a generic term for any manufacturer related product responsibility. In legal terms, the concepts of warranty, guarantee or extended warranty mean different things and they should not be considered the same. Guarantee is defined to be a pledge or assurance of something in general. Warranty means a particular type of guarantee, usually written contract provided by a seller to a buyer. Another related concept is service contract or “extended warranty”. The difference between a warranty and a service contract is that the latter is entered into voluntarily and is purchased separately. The buyer may even have a choice of terms whereas the basic warranty is a part of the product purchase and is an integral part of the sale. (Delekta, 2013)

According to Rahman et al., 2015, the role of warranty is different to the customer/user, to the manufacturer/dealer, to under-writing insurer and to the public policy makers. To the manufacturer warranty plays protective role by limiting its liability in case of failure due to careless or improper use of product by the customer. It also plays the promotional role by signaling the quality of products to the consumers and finally, it acts as a powerful advertising tool for a manufacturer/dealer to compete effectively in the market. To the customer warranty plays both informative role by acting as indicators of the quality and reliability of the product and protective role by providing written insurance against early failures of an item due to manufacturing, design, or other quality assurance problem during the warranty period. (Rahman et al., 2015, pp. 4-8)

To the public policy maker warranty plays judicial role when making laws to see that warranty terms are fair and there are mechanisms to resolve conflicts originating from warranty claims. Currently most of the manufacturers or dealers pay a premium to insurers and insurance companies guarantee the costs incurred due to warranty service claims made by customers. Responsibility of the insurer is to check all claims and act according to the terms of the policy. Figure 14 illustrates the interaction between the parties related to the warranty offer. (Rahman, A. & Al. 2015 pp.4)

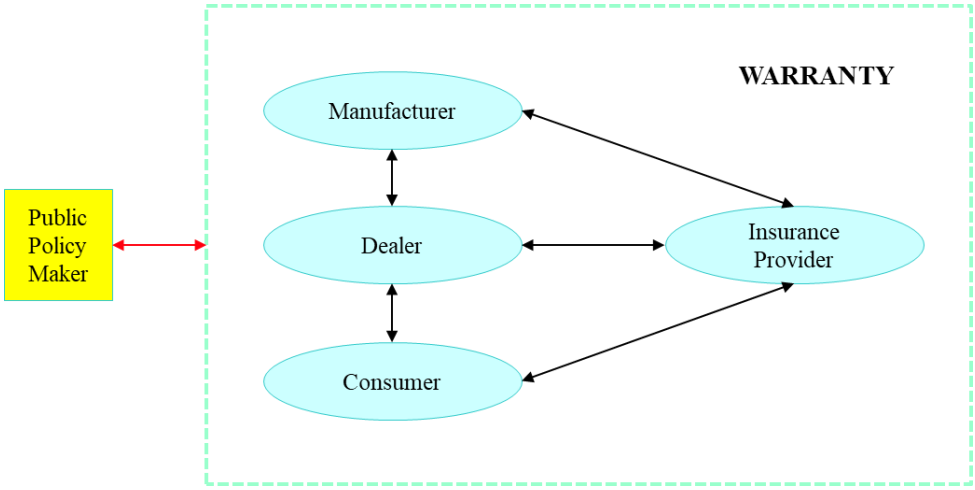


Figure 14. Interaction between parties associated with a warranty offer (Rahman, A. & Al. 2015 p.4, Edited by R. Kulmala)

2.4 Business process management

Business process has countless different definitions. Simply it means chains of events, decisions and other activities that are eventually adding value to the organization and its customers. Business process management (BPM) does not only mean improving the way how individual activities are performed, rather it is about managing the whole chains of processes. It is the science of overseeing how work is performed within an organization, to ensure the quality of the outcomes and understand the improvement opportunities. (Dumas et al., 2017)

BPM is one of those concepts that can be used differently in different contexts. Ideally, it is an approach that highlights understanding and optimizing business processes. It can also refer to a methodology for establishing a continuous process improvement lifecycle. These

methodologies are providing detailed and specific guidance how business teams can continuously improve business process chains. Nowadays there is a wide selection of different kind of software solutions for managing business processes and helping for execution of the improvement. Actually, these solutions act as only tools for successful business process management even though BPM sometimes refers only to the technology that is used. These tools are used for visualizing, mapping and documenting processes to aid communication, automate activities and optimizing the workforce. (BPM Resource center, 2012) In figure 15, the terminology related to the BPM is illustrated.

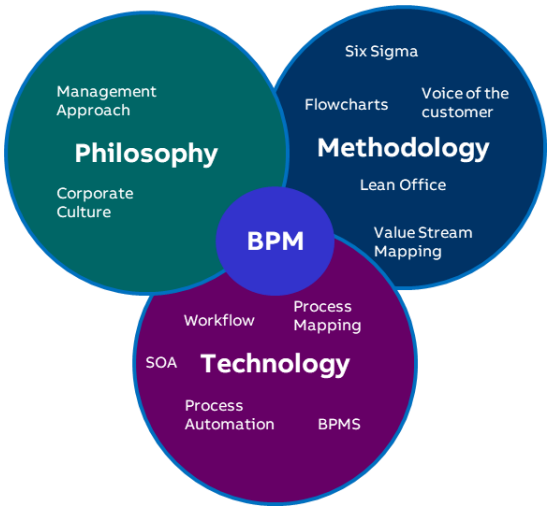


Figure 15. What is Business Process Management (BPM Resource center, 2012, edited by R. Kulmala)

2.4.1 Process development and standardization

BPM's aim is always process development. If the organization is not able to improve or develop their business, it is certain that a competitor or a new actor in the market segment will, and the company loses its value in the eyes of the customer. To improve businesses competitiveness, companies must be constantly monitoring and defining their processes, configuring measurements to track their performance and implement the improvements. By systematic BPM, different organizations can practice business more cost effectively, meet faster the changing demands of the market and create more value to the customer. (BPM Resource center, 2012)

Savolainen et al., (1997) are presenting that business process development revolves around the three following questions:

- Where are we? To analyze the current situation, it is needed to gather facts, views and opinions about the business process performance and structure. To be able to develop any business process, they must be able to be measured.
- Where we would like to be? To be able to answer this question a new target state must be created. By combining current state problems, customer needs and future visions it is possible to create realistic understanding of the target. In other words, creative synthesis is needed to be able to answer this question.
- How to get there? In process management, it is intended to create and follow a long-term strategy by achieving defined milestones. The facts and boundary conditions must be analyzed before creating the final target state. (Savolainen et al., 1997, pp. 18-22)

By developing only point-to-point technologies, the overall result is not developing. Research shows that it is worth to invest specifically in the cooperation between parts in the whole supply chain. This is one of the reasons, why process management has become a popular management philosophy. Extended enterprise is a concept, which means an entity formed by the company, its subcontractors and customers. (Savolainen et al., 1997)

As a more detailed concept within the BPM-philosophy, Business process standardization (BPS) is an often-discussed approach. By using standard parts and standard operating procedures for process activities, it is possible to remove operator's discretion, obscurity, and opportunities for making mistakes. While process standardization enables decreased flow times and inventories, it helps companies for achieving cost savings and increase in profits due higher efficiency. (Schäfermeyer et al., 2012)

Although successful BPM and BPS offer convincing benefits, diversity allows different kinds of customers to be served in different or more dedicated ways. In addition, the design and implementation of improvements and processes often requires significant efforts in terms of time, money and other resources. Organizations are struggling with rising complexity of business processes such as customer-tailored products or services, increasing number of value chain partners, global sourcing, procurement and distribution. Schäfermeyer et al. (2012) are stating that a simple business process can be highly stand-

ardized with low effort and the results can be significant. More complex the process goes; more effort is needed for standardization and the result gets lower.

2.4.2 Quality management

Quality Management means controlling all actions and tasks needed to maintain the desired top level of excellence. This includes the three basic functions: planning, control and improvement. In general, quality management focuses on long-term goals through the implementation of short-term initiatives. (Barone, 2019 & Kristiansen 2005, p 469)

There are several different methodologies and technologies, which can be used as quality management tools. One of the most popular concepts is Lean whereby the focus lies on streamlining the flow of a process by finding and eliminating non-value-added activities and waste. The key is that if organization manages to kill off no-value activity, it is possible to do things faster and more cost effectively. (BPM Resource center, 2012)

One other popular philosophy is quality management methodology Six Sigma, by Motorola. It is oriented on quality and defect reduction. The basic idea is that process errors must be measurable before it can be systematically developed. In practice, Six Sigma is used to measure the number of faults and systematically determine how they can be removed. These two development methods can be combined to form Lean Six Sigma. When this combination is done properly and applied consistently, it can be considered an integrated approach for changing the corporate culture. Misunderstood quality costs money and the requirements of customers are to be met completely and profitably. (John et al., 2008) Lean six sigma is a very comprehensive ideology and its correct application requires a considerable amount of work and understanding. Although these methods have been found to be very effective, process development does not have to follow a particular ideology assiduously. (Smetkowska et al., 2017)

One extremely important concept within BPM and Lean Six Sigma is Continuous improvement. The concept means that organization and individuals should strive for an ideal state of perfection, even though we know that such a state is not achievable. It is important that everyday work is wanted to be developed and the improvement starts from each indi-

vidual employee. Among many different tools, which may be considered as methods of continuous improvement, the main one is DMAIC. It is the acronym from the words Define-Measure-Analyze-Improve-Control, illustrated in Figure 16. It is a cycle that is integral part of Lean Six Sigma process, but it can be implemented as a standalone quality improving process as well. (Smetkowska et al., 2017)

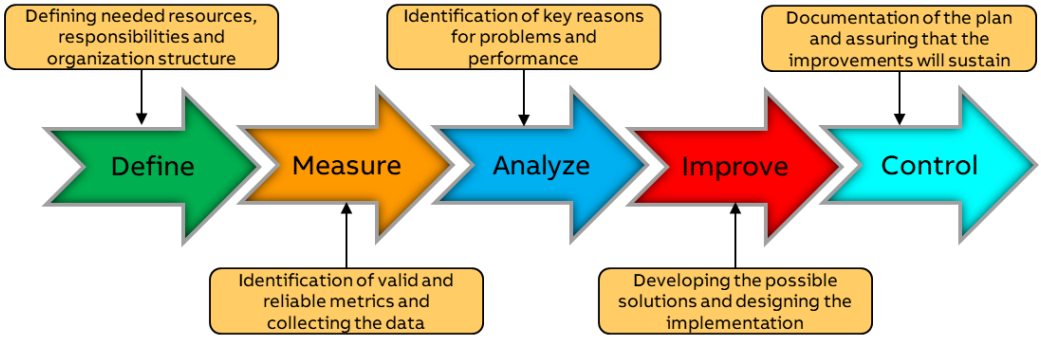


Figure 16. DMAIC Roadmap (Rastogi, 2017, edited by R. Kulmala)

An important way to sustain the development is to visualize, instruct and automate the new operation. There are number of specialized tools for this and their use should be as simple as possible. Certain tools can be utilized at each DMAIC-phase. Sharp et al. (2009) represent a way to create logical process charts. Creating a swim lane diagram does not require a lot of training and understanding, but it is relatively easy to use. However, one should understand the basics of drawing the chart as it must be clear and easy to understand. The ultimate goal of describing a process is to create a single, complete process map, where the entire procedure is graphically illustrated. Figure 17 shows the wrong and correct ways to draw the chart.

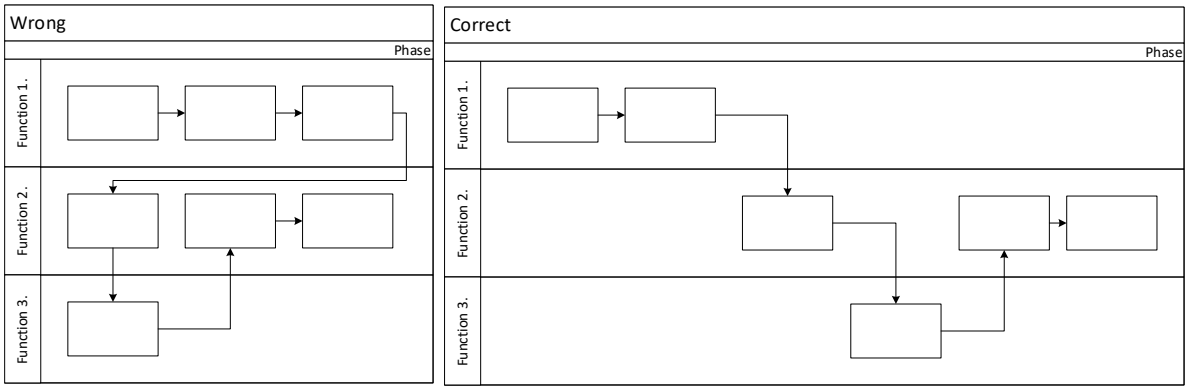


Figure: 17. From left to right and simple symbols (Sharp et al., 2009, p. 204)

2.4.3 Interaction and people management

To keep pace with changing environment and requirements of the customer, companies must be able to change and evolve. They have to find a way to be better than competitors by offering short lead times and minimizing the costs to offer better prices for the customers. At the same time, the companies are facing a major challenge to create good work environment for their employees in order to get them involved to improvement processes. Unfortunately, research shows that in many cases employees are not willing to engage in the company development. (Dorota et al., 2017)

It is important to engage all the personnel in the process of continuous improvement on their own work stands. Employees know what kind problems exists and are able to propose the improvements appropriately. These improvements can concern the work organization, process performance, hazard protection, used tools, ways to avoid possible failures or any other useful topics. It is only the matter of an adequate motivation system to encourage employees to propose improvements. In many cases, managers do not want employees to do anything apart from doing their tasks properly, because development is perceived as exclusive right of managers, not workers. (Dorota et al., 2017 & Anad et al., 2009)

In order to ensure the employees' involvement in continuous improvement, the companies are building different kinds of incentive systems based on the employees' needs and expectations. Researches are showing that if the employees have an opportunity to contribute in the development of safe work procedures, they are more likely to follow them after the implementation. Additionally, they encourage other employees to do the same. One of the most successful way to motivate employees is respect. Personnel need to be meaningful and trusted, seen as individuals and be trained and educated. (Dorota & Al. 2017 & Anad et al., 2009)

2.5 Complaint management

While some organizations are doing their absolutely best to meet the customers' continually rising expectations and rapidly changing demands, others are failing to deliver. Even though customers have not always been so forthcoming in expressing their dissatisfaction, today they are more vocal and informed of their rights. Flow of information is incredibly

fast while Internet and digitalization has played their part in shaping customers' views. (Cook, 2012)

Manufacturing business is nowadays very customer-oriented. The dominant thrust behind the philosophy is the supply of the right items, in the right quantities, with the right quality, in the right place only at the right time. The concept JIT acts as the ideal state of perfection that should be every organizations aim. While companies need to strive for this, another important factor is the ability to learn from the mistakes that have occurred. If the customer is disappointed, the company should do its best to restore the confidence quickly and efficiently. (Rios-Mercado et al., 2010 p. 262; Cook, 2012)

Companies that do not manage customer dissatisfaction well, do not only risk the existing customers but are driving off potential ones as well. In the 21st century, companies must be more focused on the need to deliver an excellent customer experience. While customer feedback or complaints are some of the best improvement opportunities, some companies are still viewing them as an unnecessary evil. The concept of complaint management describes planning, realization and control of all measures taken to deal with customer complaints. (Cook, 2012)

2.5.1 Complaint, reclamation and notification

According to international standards program for complaints, called ISO 10002:2004, a definition for a complaint is: "Complaint is an expression of dissatisfaction made to an organization related to its products, or the complaint-handling process itself, where a response or resolution is explicitly or implicitly expected." In other words, complaints are made to point out a subjectively perceived fault or flawed behavior of the company (ISO, 2004)

The definition of reclamation is: The process of claiming something back or reasserting a right. It is a notice of breach of contract, it must be made without delay after the breach has been noticed and always in writing. (ABB 2019d)

Quality notification is a process that is carried out in ERP system. It describes a business object's nonconformance with a quality requirement and contains a request to take appropriate action. It also helps to handle customer complaints for defective products, defective products produced in-house and defective materials supplied by a vendor. (SAP Help Portal, 2019)

Complaint management covers the processing of the complaint to deal with the legal aspects of the purchase. According to S. Cook (2012) immediate actions and the root cause analysis is required to reveal the reason of the customers' dissatisfaction. Poor complaint handling is estimated to result between 5 and 15 per cent lower revenues and corresponding reductions in profits. (Cook 2012, p.13). On the other hand, studies show that, depending on the industry, 54 to 70 per cent of customers who register a complaint will do business with the organization again if their complaint has been resolved on time. The figure goes up to a spectacular 95 per cent if the customer feels that the complaint was resolved fairly and quickly. (Cook, 2012, p. 14)

There are many different methods for handling the complaint fairly and quickly. As an example, the automotive industry in Germany has agreed on a common method to deal with complaints and to communicate these to the suppliers. This method is called 8 disciplines - Report and it is a standardized procedure to handle complaints and their corrective action plans. This method is illustrated in figure 18. Within this method, the filed complaint is sent to the supplier, who sets up a team to deal with the complaint. (Behrens et al., 2007, p. 93)

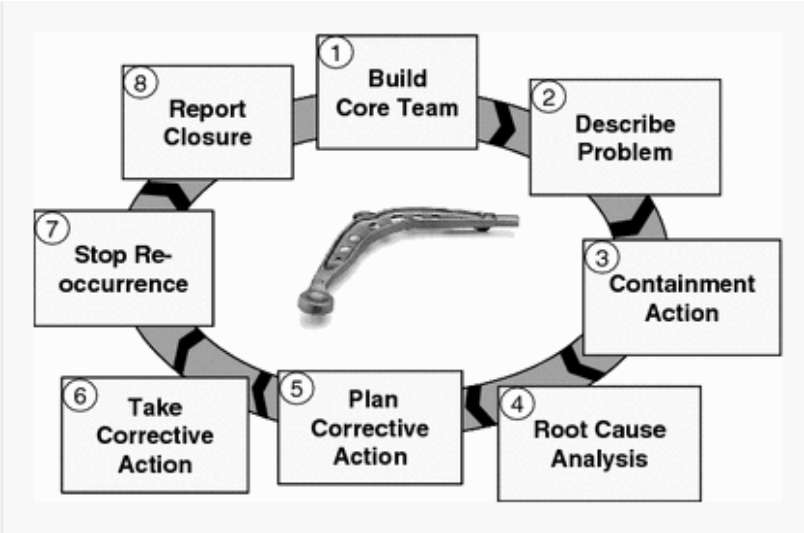


Figure 18. Complaint management system cycle using the 8D-Method (Behrens et al., 2007, p. 93)

At a stage one, the cross-functional core team is built, and it should include the responsible process owner, a member from quality assurance and others involved in the containment, analysis, correction and prevention of the problem. At the next stages, the team describes the problem with the words of the supplier, thus clarifying the fault description handed in by the customer. At the same time, the person in charge starts the root cause analysis. (Behrens et al., 2007, p. 93-95)

Discipline five includes the definition and verification of all possible corrective actions to address the root cause of the problem. The next step is the actual implementation of the planned long-term corrective actions and the seventh discipline contains the preventive actions to avoid a reoccurrence of a similar fault. An important aspect of this discipline is the standardization and deployment of corrective actions or process improvements to all products that may possibly be subjected to the same issue. The report closure is the last step of the 8D-method and includes the complementing of the team for the successful corrective actions taken. (Behrens et al., 2007, p. 93-95)

In modern day manufacturing business, the supply chain can be quite long and complicated. While the root-cause-analysis is performed, the supplier of the supplier (prior-supplier) might found responsible for causing the initial error. Depending on the quality of the rela-

tion between supplier and prior-suppliers this responsibility can be determined with or without the cooperation of the prior-supplier. After this, the prior-supplier is contacted to inform him of the results of the analysis and to invite him to solve the problem cooperatively. In figure 19 the flow of material and information is shown in more detail. (Behrens et al., 2007, p. 91-95)

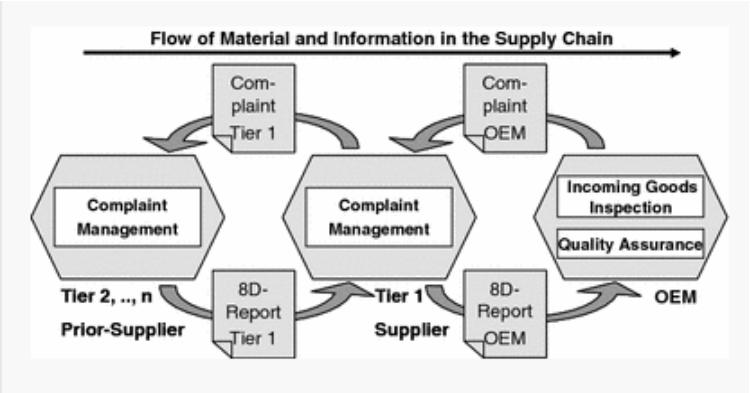


Figure 19. Handover of information in the complaint management (Behrens & Al, 2007, p 93)

2.5.2 Sourcing and contracts

Even the most sophisticated techniques and cutting-edge supply chains, the possibility of faults cannot be completely removed. The fault can be found in vendor's performance or the prior-supplier may be found responsible for causing the fault. Sometimes it is debatable whether the product is faulty at all, even if the customer is claiming so. Legally, the delivery is incorrect only if it is not in accordance with the contract or it is restricted by provisions of mandatory law. For these reasons, an engineer may often include a quality error in another way than a lawyer. The product can be totally unusable and useless but in contract terms it is still contractual and thus flawless. Identifying the error and using sanctions require knowledge of the contract and the law. (Lindefelt, 2017)

Organizations are using different kind of sourcing contracts according to the type of the partnership. These contracts and sourcing channels are mainly designed to create shared value within the whole supply chain. When a sales contract is signed between the seller and the customer, several sections must be agreed. The supply of the goods includes a lot

of things to decide, such as delivery and reception, transport contract, cost allocation, risk transfer, export and import clearance, delivery- and other documents, packaging, inspection and information and other formalities. These obligations may be agreed upon separately by the parties, or they may use a delivery clause that defines the division of responsibilities between the parties. (Logistiikanmaailma 2019a; 2019b)

These contacts can be only one-off contracts, framework agreements, project contracts, year contracts or wider partnership contracts. Based on the LOGINET release 1997, the annual agreement sets the basis for supplier co-operation. The annual agreement defines the basic rules of the game, which significantly reduces the order-specific negotiation of delivery terms and prices. Due to the annual contract, the delivery time of the supply chain is shortened because the price for the items has been specified and the delivery time before the customer company receives the order from its end customer. If the customer company and the supplier do not have a valid annual contract, the parties will have to negotiate separately on price and delivery times, which will cause extra costs and extend the lead time in the supply chain. (Jahnukainen et al., 1997, p. 41-45)

Companies have been making annual contracts with their suppliers for years. The key features of the agreements are the price, the quality and the delivery time of the items. Item prices can be tied to an agreed index if, for example, the cost of raw materials strongly affects their manufacturing costs. The purpose of annual contracts is also to reduce unnecessary bureaucracy during the delivery process. (Jahnukainen et al., 1997, p. 41-66)

Sourcing contracts do not only reduce bureaucracy and shorten the lead times in the supply chain, but they protect both, seller and supplier. In order to protect the purchases and relationship with the supplier, the sourcing contract must be strong and durable. Without official contracts, suppliers have no penalties for not delivering on their promises. Figure 20 shows ten bullet points that each sourcing contract should contain.

Figure 20. Contents of Sourcing Contract (Ask Idea Sourcing, 2017. Edited by R. Kulmala)

3 CASE ABB MARINE - RECLAMATION & NOTIFICATION PROCESS

This chapter focuses on illustrating the current state of the reclamation process in the case company. In order to comprehensively describe the process, it is vital to understand the events and information flow preceding the non-conformities in the supply chain. Due to this reason, the practices related to procurement process and enterprise information management are also presented in addition to only illustrating the reclamation process. These practices consist of all the relevant systems regarding the day-to-day operations of purchasing engineer, existing operational instructions and their location and information sharing within and outside the company. These functions are the basis for the chapter 3.3, which focuses solely on the reclamation process of the company.

The department in question is ABB Marine & Ports Propulsion Solutions, referred as “the department” and the team in question is Service Procurement team, referred as “the team”. Due to the same product configuration, two procurement teams, new building and service, are illustrated and some benchmarking between teams is carried out. The emphasis is on service procurement and the characteristics of the service supply chain.

General guides, instructions and previous studies were utilized to provide the descriptions. However, no research findings are meant to be presented, nor problematic aspects addressed. Based on this introductory information of this chapter, the findings of the research will be presented in chapter 5. The structure of the chapter 3 and the linking of the relevant topics is shown in more detail in the Figure 21.

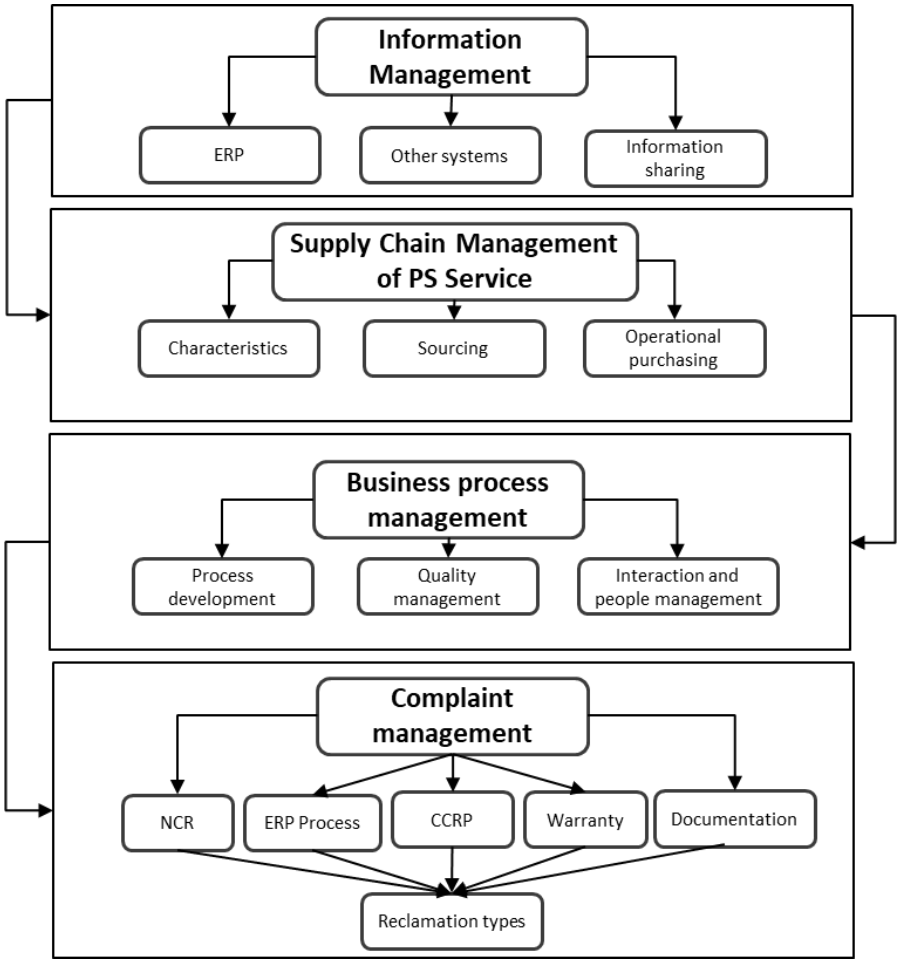


Figure 21. Practices related to the notification and reclamation processes

3.1 Information management and storage networks

The case company is using different software for business process integration and product lifecycle management. In addition, variety of storage solutions and different applications are utilized for project related information and companywide instructions. The most common information and document handling systems are presented in this chapter.

3.1.1 ERP

The main interface for day-to-day operations of the department is Enterprise Resource Planning (ERP) software. It is an information system that integrates various functions, such as production, distribution, inventory management and project management. All this data is stored in the same database, making it easy to share it real-time between different teams or even different businesses. Procurement transactions, PO history, creation of quality notifications and many other activities are handled in ERP, where the creation and exchange of

documents has been standardized. The documents sent to the vendors will therefore always look the same and will automatically contain all the necessary additional information. All Purchase Orders (PO's) and quality notifications created by the ERP-software are stored in the system. In addition to the documentation, one of the best features of ERP is history data utilizing. The same ERP-system has been in use for about ten years, so the ABB personnel can review the entire purchase history for this period.

3.1.2 Other systems

Azipod® Propulsion system is a complex configuration that is assembled from tens of thousands of different parts. To manage all these parts, referred as materials, company is using Product Lifecycle Management (PLM) software. It is an information management system that can integrate extended enterprise information. With PLM it is possible to manage product related documents from manufacturing to maintenance and finally to disposal. All the technical drawings and parts lists are controlled in the PLM.

Each ABB-material has their own unique code created by PLM. Based on the code, all different materials can be distinguished and identified. This coding also enables protection to the OEM spare parts business. In addition, new materials are constantly added, and the existing ones updated with new specifications. The core suppliers have integrated these codes into their own systems and are thus able to identify the products to be purchased. Furthermore, the software contains additional information, such as own material codes of the supplier.

ERP and PLM systems are integrated with each other, when the systems are able to utilize each other's information. Thus, purchasing history data can be retrieved from the ERP with only a material code. PLM software is not meant only for designers and IT-engineers, but it is a vital tool for the procurement as well. As it is the responsibility of purchasing engineer to purchase several hundred different materials, it is not possible to know all the details of them by heart. By utilizing the PLM system in day-to-day operations, the work of the purchasing engineer is enhanced.

Daily work of purchasing engineer consists several different functions. Hence, many different guidelines and instructions have been created and they can be found in many different places. One common location is local server that refers to the internal network storage. The server is a common location and procurement team members are using it mainly for tracking delayed purchases. It is not used as an official end storage for documents because anyone can save and delete almost anything at any time. Also updated vessels data list is stored in local server, when purchasing engineers can utilize it daily.

Another daily database is SharePoint. Propulsion product supply chain department maintains a large share of work-related documents here as the usage is easy and does not require additional permissions. For example, instructions for complaint handling, presentations for suppliers, the introductory material for the new employees and various other presentations are also located in SharePoint.

There are also various different locations for storing other order documentation. For example, surface treatment and painting instructions are stored in enterprise content management software (ECM), quality guidelines and some process descriptions are maintained in IMS-portal, some general information such as invoice handling instructions is stored in company intra-website and supplier-related contracts and agreements are officially stored in ProSupply+ application.

3.1.3 Information sharing

Almost all interaction within the company and between purchasing engineer and supplier is done via email. In addition, most of the PRs and related conversation are forwarded via email while it is a familiar and direct way of handling communication and between several different people. Purchasing engineers are also able to use their personal email for forwarding and storing documents into the ERP system. For example, order confirmations are stored in the ERP, behind related PO, so other team members can also see them when necessary.

Every purchaser and purchasing engineer have their own computer, personal email account and mobile phone. The faster information sharing can be handled over a phone call or with

Skype. Some meetings and trainings are also arranged with Skype when unnecessary travel can be reduced. Both procurement teams and sourcing are located in the same open office facilities making information sharing easy.

3.2 Supply chain management – Propulsion Solutions Service

The mission for the strategic supply chain management (SCM) of the case company is to enhance supplier relationships, develop a sustainable supply chain and ensure the highest quality standards. Competitive advantage can be gained by reducing total delivered cost, optimizing the supply chain to ensure on-time deliveries and pursuit to the best quality in the field. The challenge is to develop sustainable and reliable products for the demanding marine environment, while successfully meeting the specific requirements of the shipping industry. In addition, the stock-related capital should be minimized while still ensuring availability and being able to prepare for unexpected problems. (ABB, 2017b)

As illustrated in chapter 1.2, case company and the department in question has a variety of solutions and offerings for maritime industry. Typical scope of delivery for a ship consists of automation and advisory products, power plants and propulsion. All of these separate deliveries are serviced and maintained by their own dedicated organization. Due to the wide offering, ABB has founded a global service network supporting its customers. Usually the customer has been assigned a specific Marine Service Center (MSC) whom they should primarily contact and from where their needs are delegated to the right organization. In case the needs of the customer are related to the Azipod® propulsion unit, their query is directed to Spare Parts team from where it is forwarded to purchasing. The flow of information and the movement of materials is shown in Figure 22 at a very general level.

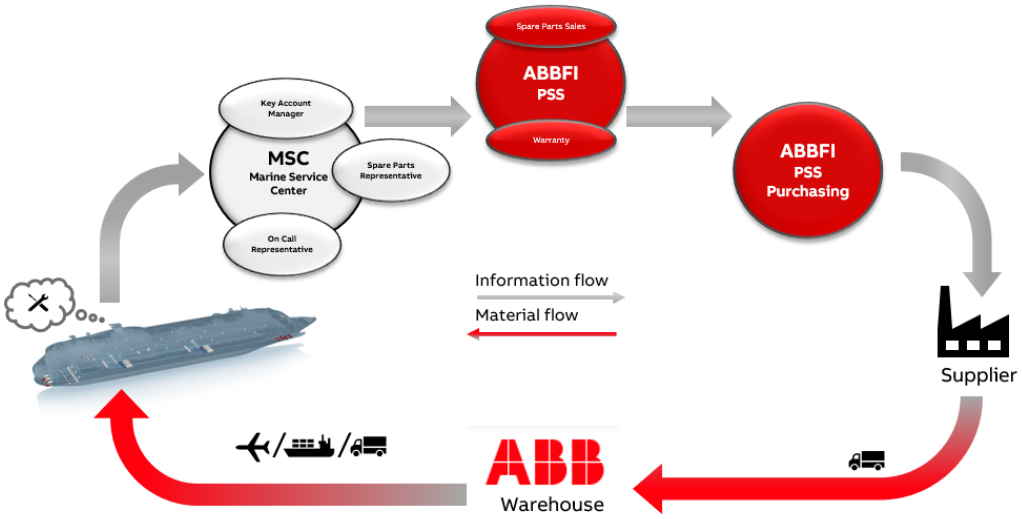


Figure 22. Flow of information and materials

3.2.1 Characteristics of operation

Slightly depending on the sector, the most important operating time for ships is summer and winter. Thus, the maintenance breaks are desired to be kept between seasons in spring and autumn. Docking a modern ship is a massive project, involving not only ship and shipyard personnel, but also numerous contractors and equipment dealers. The planning is always started more than a year in advance in order to prepare for material needs and scheduling. The delivery time for large components may be several months, so as an OEM, the department personnel work closely with the docking project personnel to prepare on time.

If the docking project is delayed due to the lack of right material, the costs can be multiple times higher than the material itself. The effects of delays can be reflected in the following projects as well, making it difficult to estimate the costs incurred. If something critical occurs to the propulsion unit during the operation, for example grounding or difficult technical failure, unintended docking may be the only option to fix the problem. Their costs are usually extremely high and unplanned projects are very vulnerable to other problems as well. Therefore, in maritime sector, it is extremely important to invest in preventive maintenance instead of corrective and the company must be able to prepare for unexpected problems. However, maintaining emergency stocks can be very challenging and expensive. During the operation of the ship, the maintenance operations of propulsion unit are quite

limited. For wider maintenance operations, the ship has to be taken out of operation and usually placed in the dry dock. The maintenance and spare part usage for Azipod® are described in Figure 22 in more detail.

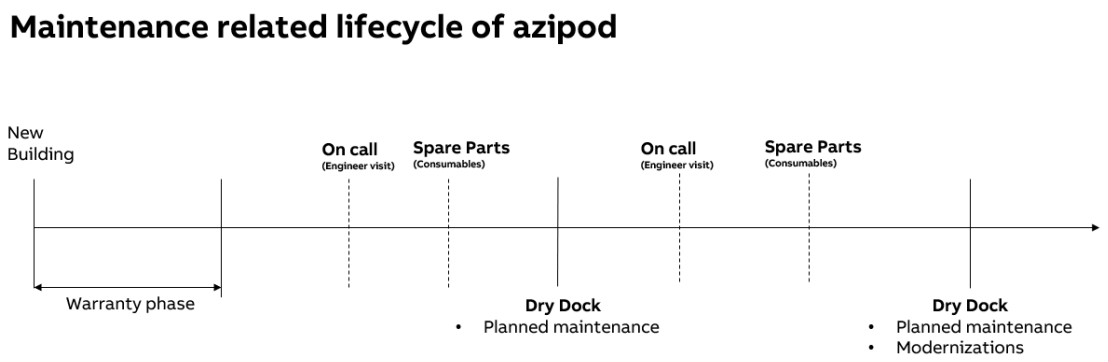


Figure 23. Maintenance related lifecycle

Besides investing to preventive maintenance and ongoing development of the maintenance plan, ABB has created the possibility to perform real-time condition monitoring. Thus, the condition monitoring is not only carried out in the shipyards when existing propulsion systems are providing real-time information for R&D's use at all times as well. The first units have been in use for over twenty years and they have been maintained, updated and modernized several times. As seen in Figure 22, the maintenance can be divided into day-to-day operations carried out by personnel of the ship, on-call visits taken by an ABB-authorized service engineer(s) and larger planned dry-docking projects and modernizations, when existing parts and materials are replaced by updated ones. (ABB, 2019b & ABB, 2019e)

All materials and assemblies related to the propulsion system are designed by ABB personnel, even though external suppliers are used for manufacturing basically all of them. Thus, all development activities are based on cooperation with the suppliers. For this reason, all challenges and problems should be communicated to them as effectively as possible. These parts, referred as materials, vary from simple bolts and nuts to expensive and complicated appliances and units. Therefore, it is necessary to maintain partnership with several different suppliers and constantly develop the supply chain of the department. The parties involved in the procurement process are illustrated in the Figure 23.

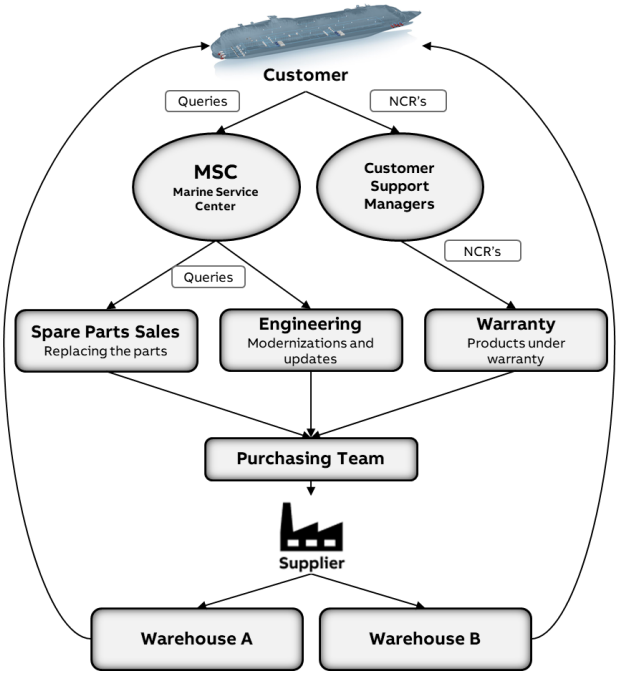


Figure 24. Communication within the supply chain

SCM in the department is a broad concept that can be divided into different processes. The upkeep and development require close cooperation between different teams and stakeholders. Chain of operation begins with the need of the customer. At first the customer contacts assigned MSC from witch the request is directed to the corresponding team, depending on its characteristics. Team personnel contacts category responsible purchasing engineer and he will contact the supplier. In case of a request for quotation (RFQ), it is passed from the supplier to the end-customer along same information chain. In case of material need, the supplier sends required materials to the assigned warehouse, from where it is directed to the place of delivery, indicated by the customer. For this chain of events and information to work flawlessly, many details have had to be agreed in advance. Also, to achieve the desired result, systematic and strategic work is needed. (ABB, 2017b)

3.2.2 Procurement

In order to manage the organizational structure, the performance of the suppliers, and the different supply chains, it is natural that the materials and suppliers are categorized.

Categorization makes it possible to have a certain contact person for each category, in both purchasing and sourcing. Thus, the flow and sharing of information, inside and outside the organization, should be as simple as possible. However, to maintain the healthy competition, the department strives to maintain more than one supplier for each category. It is not generally desirable to become dependent on one external factor. The role of PS procurement is illustrated in Figure 22 in a simplified manner.

Figure 25. The role of sourcing and category management

Two teams are responsible for the operational purchasing: new building and service. New building handles all materials related for configuration of new Azipod®-units in Finland while service purchasing team is responsible for the procurement of spare parts and all materials related to the maintenance of existing fleet. Characteristics of these spare part purchases can differ considerably from each other. Occasionally only customer-initiated individual spare part purchases are done, but usually material purchases are made as part of broad dry-dock or modernization projects designed by the service department.

The day of purchasing engineer consists of, in addition to participating to various different meetings, creating and updating POs from PRs, solving issues with vendors, upkeeping previous purchases, handling invoices and updating and handling notification reports. The activity cycle of a purchasing engineer is illustrated in Figure 25.

Figure 26. The activity cycle of purchasing engineer (ABB 2017b)

Purchasing engineers are working in close, day-to-day collaboration with both suppliers and project engineers of the department. The purpose of the detailed operational purchasing process is to ensure that goods and services will arrive cost efficiently, at the right time, according to the required quality into the right place. Although the purchasing engineer is mainly responsible for the process, supplier contracts and frame agreements are playing a major role in the success. (ABB 2017b)

Description of the procurement process is shown in Figure 25. The responsibility of purchasing engineer begins with the receipt of the purchase requisition (PR) that is issued by a project, spare part or warranty engineer. Usually PRs are received via email, but in certain cases they are automatically created by the ERP. Often PRs include a number of items to be purchased from several different suppliers. Procurement responsibilities are divided into categories based on the material. For example, if there are electric motors to be purchased, they are automatically labeled on the responsibility of a particular buyer. The PRs are also generally sent to the category-responsible purchasing engineer. Every byer has their own ID-code in the ERP system, so each PO will leave a trace of who created it.

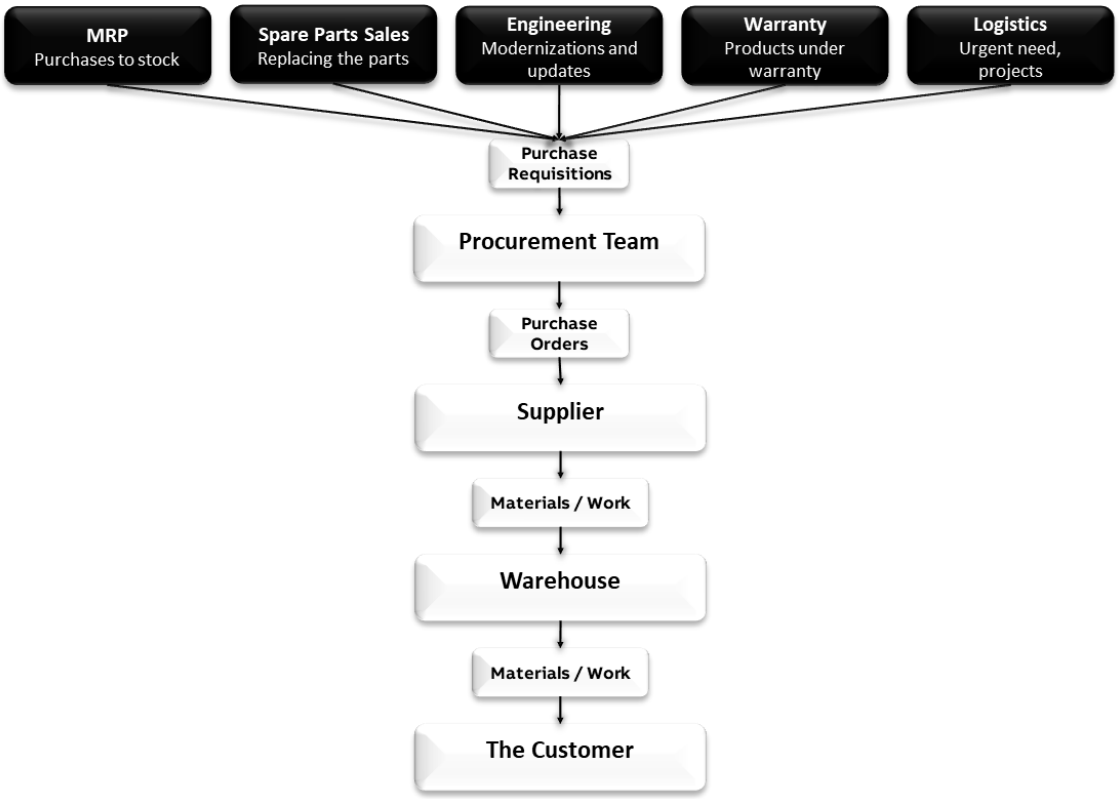


Figure 27. Purchasing process

When PO is created, supplier is selected first. By doing so, all lines targeted to a certain vendor can be combined into one PO. All other information is then filled based on the order and this information consists general details such as desired delivery date, delivery place, material prices and delivery and payment terms. The order is then sent to the supplier as an automated PDF file via ERP. After receiving the PO, supplier confirms the order according to their capabilities or asks for more details. The purpose is to receive the official order confirmation to document the transaction correctly. Generally, all materials are first delivered to the warehouse and goods receipt (GR) transaction is made by warehouse personnel in the ERP. Orders are also collected, combined and packed in the warehouse before they are sent to the customer.

In addition to only creating POs and receiving order confirmations, purchasing engineer is responsible for a number of other activities such as improving the material availability, sending and forwarding RFQs, participation in various meetings and other daily co-

operation with suppliers. Purchasing engineers are encouraged to contributing the development of the supply chain by maintaining the relationship and performance with supplier.

Each PO has an unique PO-number created by ERP. The number is used as reference for tracking purposes and all ERP purchases are saved in the system. With this number, each PO, and related PDF-document that is sent to the supplier, can be individually viewed. Important information such as, who was the purchaser and who made the PR can be viewed at any time by using this PO-number.

3.3 Business process management

The core belief in process thinking is that a specific chain of activities is established to produce the maximum value for the customer. The key processes in this master's thesis are purchasing and notification process. Purchasing engineers are responsible for any quality notifications that are related to their own purchases, so they are acting as managers of the respective area when non-conformities happen. Both processes consist of different activities and with the systematic management and development, the case company strives to meet the needs of the customer.

3.3.1 Process management in propulsion service

ABB Marine & Ports has a matrix organization structure. It is a combination of permanent functional organizations and temporary project team structures which are formed for each maintenance or modernization project. Typical stakeholders in the dry-docking project are as follows: the customer, project team, engineering, supply management, multiple different suppliers and logistics (Korpi, 2017, p. 54). Successful project management requires cooperation between all these stakeholders.

Daily work of purchasing engineer is relatively independent. Purchases are made for several different projects within own category responsibilities in which case the PR's are received from different persons. Purchasing engineers are responsible for following their own purchase orders and generally the quality of their own work. In order for independent work to be possible, ABB personnel are trained regularly. In addition to regular training, it is also possible to participate in additional trainings organized by the company within the

scope of own responsibilities. For example, quality training and belts are given to specific employees, which are expected to use them in their work. (Nummisalo, 2018, p. 54)
All employees use the annual appraisal cycle to agree on targets, review personal performance, plan development actions and explore career preferences. Information from the appraisals enables performance reviews globally or by specific target groups. It is important as employees use it to evaluate their own individual performance and managers use it to review employees' past performance and identify future development needs. (ABB 2019f)

3.3.2 Process development

In order to develop any business process, one must be able measure it. For this reason, key performance indicators (KPI) have been created. Like many other companies, also ABB Marine is setting KPI targets yearly and they are followed quarterly.

Process development is carried out in ABB in many different ways. Comprehensive development measures are communicated from management level to employees. They are first informed via email and usually discussed in departmental meetings. Supplier development and relationship management is carried out through supplier audits, periodical meetings and performance evaluations.

Continuous improvement and feedback are mentioned as the responsibility of each member of the procurement personnel. Yearly targets and development activities are agreed together with Supply Chain Manager and Purchasing Managers. A process for quality reporting and communication with suppliers has been developed and suppliers are evaluated with variety of different indicators (ABB 2017b). The most important KPI's for SCM department are illustrated in Figure 26.

Figure 28. SCM key performance indicators (ABB 2017b)

3.3.3 Quality management

The high-quality standards of ABB are due to the strict requirements of customers and stakeholders. To ensure customer satisfaction, the suppliers must comply with standards of ABB and commit to make continuous and sustainable improvement in a transparent way. (ABB 2019b) The quality and functionality of the product is tested at the factory acceptance tests (FAT) which are performed for the most critical materials. In addition, ABB is using a variety of different quality tools. For example, a recent globally implemented tool is top 5 quality issues that is used to determine the five most important threats and systematic issues in a department. According to Nummisalo 2018, these cases are evaluated monthly and potentially escalated up the quality management hierarchy. Also, since late 2017, ABB has begun implementing the principles of Lean and Six Sigma, such as DMAIC, which is utilized for quality management processes. (Nummisalo, 2018)

Ensuring the highest standards, ABB has made a culture of quality one of the most focuses. Reachability is a major challenge for critical component manufacturers of maritime industry, which emphasizes the importance of quality responsibility. The quality management of the company complies ISO 9000:2015 standard, quality management systems.

One of the key performance indicators (KPI) is on time delivery (OTD). The term indicates the proportion of orders that the supplier has been able to deliver on time. It can be measured either by the number or by value of orders. The actual date when the goods arrive to the warehouse is compared to delivery date that is mentioned in the order confirmation. The on-time window is ten working days. If materials are delivered seven or less working days beforehand or two or less working days late, they are still considered to be on time. OTD-window is illustrated in the Figure 26.

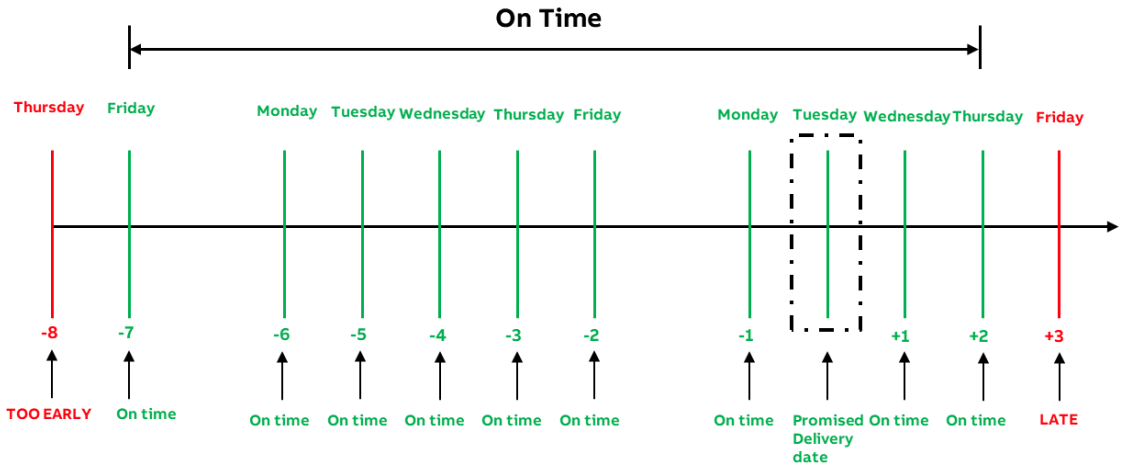


Figure 29. On Time Delivery

On top of other duties, notification handling and monitoring is one of the daily duties of purchasing engineer. Quality related matters are however mostly communicated through department and team leaders. Guidelines for creating quality notifications are based on the ISO 9001 standard and management requirements.

3.4 Complaint management of propulsion service

The concept of complaint management consists the whole process of handling, managing, responding and reporting customer complaints. In the context of this thesis, it also encompasses all the challenges related to the supply chain, products and procurement that result from the activities of an external supplier. The concept includes detecting problems, reporting them, conducting the ERP notification process, communicating with the supplier, performing corrective actions, and crediting the costs incurred.

In this chapter the whole notification handling process is described. It is explained in chronological order from the problem observation to the corrective actions. This study focuses on the complaints that are associated with the supplier: Thus, internal notifications or engineering errors are excluded from the scope of the research.

3.4.1 Non-conformity report (NCR)

In practice, the reclamation process begins when someone notices a problem that is related to the supply chain, ordered materials themselves or any other phenomenon that is in breach of the contract. It can happen in any phase of the supply chain and there can be

many different reasons for the violation. Process-oriented approach is created to be able to understand the characteristics of the problem, guide it to the right personnel and solve it as efficiently as possible.

NCR acts as a statement that something problematic has happened. It contains details such as the problem description, who is reporting and their contact information. The description should contain at least the following information:

- What is happening?
- Why is this a problem?
- How do we know we have a problem?
- Where and when did the problem happen?
- Possible immediate actions such as repair need.

NCR can be received from the customer, ABB personnel or any other non-conformity observer. Thus, it can act as either an external report of a problem or it can be a quality notification created by internal ABB personnel through ERP transaction. The purpose of predesigned process is to take corrective actions as efficiently as possible and prevent the problem in the future. In the next chapter, the process is described in more detail.

3.4.2 Quality Notification process in ERP

Notification creation is planned to be executed in ERP. There are two different transactions: the first one is used for creation of the notification and the other for editing and sending it to the supplier. Notification is created by the problem observer or the first ABB Marine employee who receives the NCR from the customer. The creator of the notification is referred as author. Thus, notifications can be categorized according to where they are detected and from where the notification is sent to service procurement. Information flow varies depending on the observer.

Detailed process is created in order to communicate the problem always at the same standard way. After the non-conformity has been noticed, immediate action is taken not only to maintain customer satisfaction but also for the legal perspective. After saving the notifica-

tion, an automated email message will be sent to all assigned partners by the ERP. Author also contacts all relevant parties, excluding the vendor, to inform what has happened and to provide additional documents. If observer is ABB personnel, usually NCR is created directly to the ERP. The creation is illustrated substantially in Figure 27.

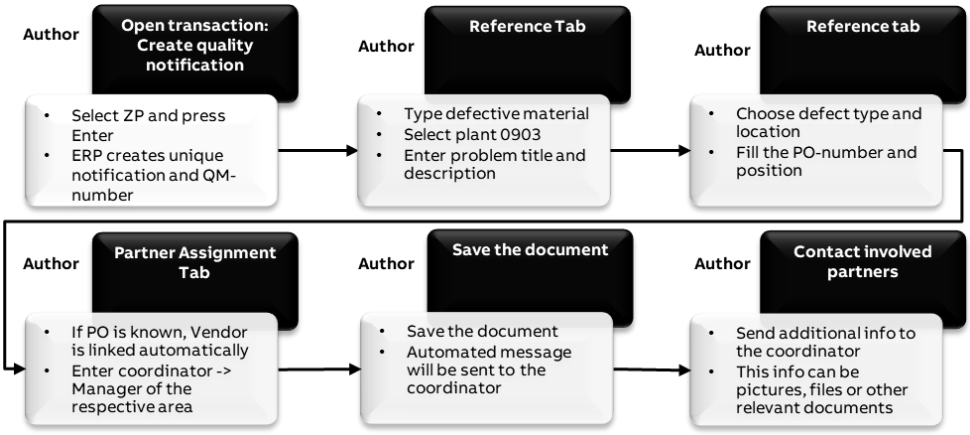


Figure 30. Tasks of the author when opening the quality notification

Since this transaction is used only for creation of new notifications, another transaction is utilized in order to change and update the created ones. After receiving the email and unique notification number, the coordinator is able to see all the details and descriptions that have been written in the notification by using the ERP-transaction. In principle, the purchasing engineer is in charge of notifications that are related to his purchases. The policy is followed because the engineer generally has all the information in hand that is related to the supplier and the PO. Before sending a reclamation document to the vendor, the non-conformity event is called notification or claim and only when communicating with the vendor it is called reclamation.

The state of the notification has been divided into six different parts in ERP, referred as statuses or status updates. In addition to only streamlining the communication, this breakdown will also assist involved partners to understand the current status of the notification. Coordinator is in charge of creating reclamation that acts as an action plan on the basis of received information. The communication to the supplier is also handled by the coordinator. The aim is to solve the problem together and take corrective actions to prevent the

problem from happening again in the future. After successful cooperation, the notification is closed. The chain of events is illustrated in Figure 28.

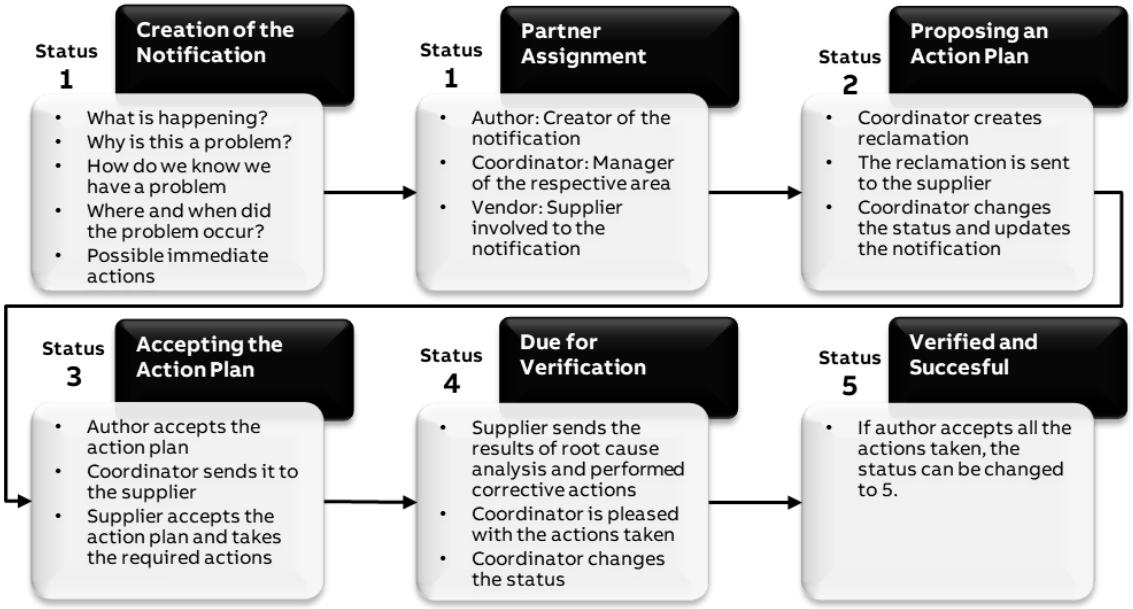


Figure 31. Changing the quality notification

3.4.3 Customer care response process

As with any other intra-company trading, also Azipod® configurations are utilizing ABB group's own materials as fully as possible. To accelerate internal company notifications, a dedicated tool has been developed and it is called customer care response process (CCRP). With the help of the tool, the concept of continuous improvement can be applied for internal trading more comprehensively. In addition, not all ABB personnel can access Finnish ERP interface, but CCRP is a platform that can be utilized globally.

In practice, the platform is an internal Internet page that aims to speed up the quality notification process and make internal notification handling more efficient. It can be done individually without ERP notification creation or in addition to the normal procedure when they will support each other. The information and steps related to CCRP creation is relatively similar to ERP transaction, only the platform is different. The process is illustrated in Figure 29.

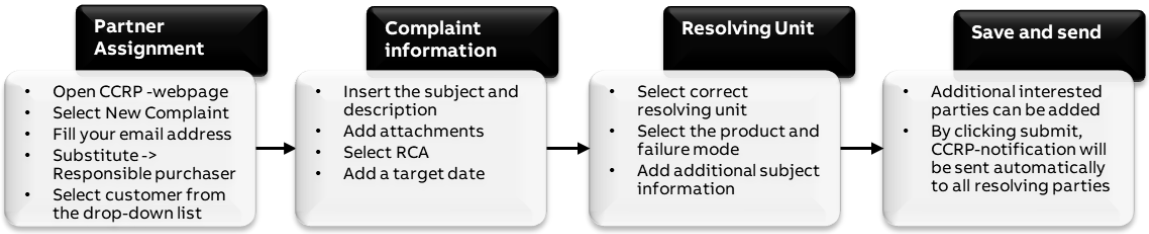


Figure 32. CCRP Process

3.4.4 Warranty

In addition to own purchases, purchasing engineers are responsible for the claims of the warranty organization within their own material responsibilities. The new building procurement team has purchased these materials, but service department is responsible of handling the related notifications. Depending on the contract, the manufacturer promises to guarantee its products for certain amount of time. If the product or device breaks down before the expiry of the warranty period, the manufacturer must replace it. Usually the original supplier grants a guarantee to the ABB and then the ABB grants it to the end-customer. In the event of a breach, the end customer requires a replacement from ABB and ABB then communicates the problem to the supplier who is responsible to provide a replacement. The NCR report is forwarded to the right buyer based on either the PO number or the material responsibility.

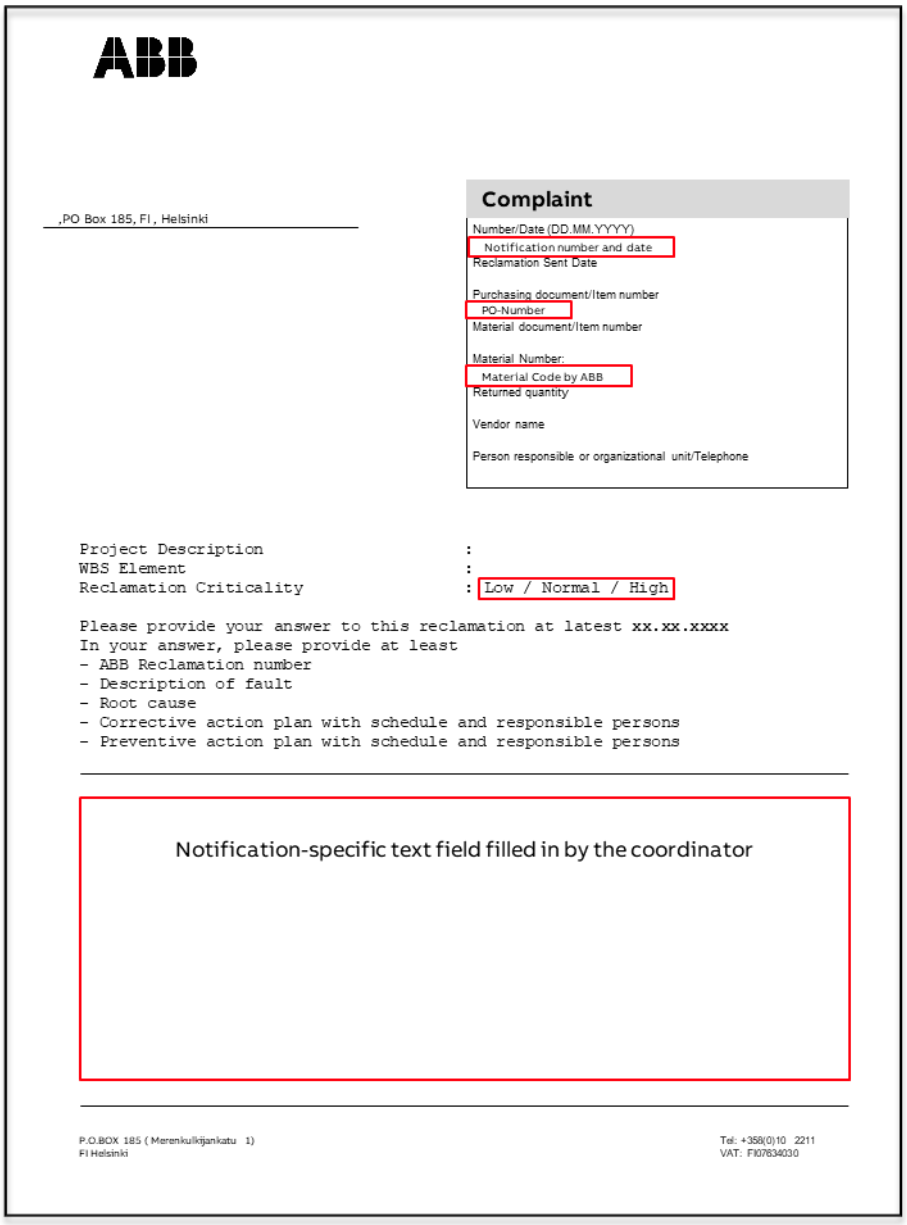
3.4.5 Documentation

Due to the different business needs, there are variation between the business contracts that are made with the suppliers. Some suppliers deliver occasional orders now and then, in which case the general terms of trade apply. However, due to the OEM responsibility for quality and complex legislation of the maritime industry, ABB strives to maximize synergies by concluding high quality partnership agreements. The business relationship is maintained on a regular basis and contracts are signed annually. When non-conformities happen, it is thus not always clear what is agreed with the vendor. For this reason, cooperation within ABB personnel is required to communicate the problem and deliver the notification to the supplier as efficiently as possible and in the right format.

When purchasing engineer is creating a purchase order, he is practically completing a pre-designed PDF-document with the help of the ERP software. The base of the procurement document is always identical only the details are changing. These details consist of the general trading matters such as the vendor selection, identification of the current purchasing engineer, materials to be purchased, the price, additional material-related information, desired delivery date, delivery place and reference. For reference it is desired to write the destination and PO-number to simplify the tracking and future collection made by warehouse personnel. Each document also mentions the compliance with a frame agreement or the general terms and conditions of ABB (ABB GTC). This clause also states, where GTC-clause can be found. It is created for protecting the case company from the unfair trade.

In addition to making a quality notification, a PDF document is created. Six tabs are displayed during the transaction where the quality notification is modified. First tab is called "reference" and it is meant for sharing internal information. This text is not supposed to reach the supplier and it is only meant for explaining the problem internally. Along with this explanation, good practice is to attach all related files and documents behind the notification. Then they will be available for all related personnel instead of staying in one individual email folder. This can be done under the fourth tab called "Linked Documents".

The field intended for communication with the supplier can be found under sixth tab called "reclamation texts". This explanation should consist a detailed reference to a breach of a contract and corrective actions required by ABB. The text will be visible in the reclamation document that is sent to the supplier and this document is illustrated in figure 30.



,PO Box 185, FI , Helsinki

Complaint

Number/Date (DD.MM.YYYY)
Notification number and date
Reclamation Sent Date

Purchasing document/Item number
PO-Number
Material document/Item number

Material Number:
Material Code by ABB
Returned quantity

Vendor name

Person responsible or organizational unit/Telephone

Project Description :
WBS Element :
Reclamation Criticality : Low / Normal / High

Please provide your answer to this reclamation at latest xx.xx.xxxx
In your answer, please provide at least
- ABB Reclamation number
- Description of fault
- Root cause
- Corrective action plan with schedule and responsible persons
- Preventive action plan with schedule and responsible persons

Notification-specific text field filled in by the coordinator

P.O.BOX 185 (Merenkulkijankatu 1)
FI Helsinki

Tel: +358(0)10 2211
VAT: FI07634030

Figure 33. Blank reclamation document

There is another blank space in the sixth tab, which is meant for the vendors reply. After receiving the action plan from the supplier, it is pasted into this field, so the answer can be examined by other internal personnel as well. In addition to notification number creation, ERP also creates an unique quality management order number. This number is used for cost allocation: if there are some costs that are occurred due to the non-conformity, they can be allocated under this number in the ERP system. It can be found under the fifth tab called “reclamation” and it is created for cost allocation. If the company incurs extra costs or if new PRs and POs are made due to the quality problem, they will be allocated under

this number. This method of operation is recommended to facilitate cost estimation. All reclamation-related costs can thus be seen under the notification whereby claiming these costs is simpler. Either part of the cost or all the costs can be claimed from the vendor, depending on the contract and characteristics of the claim.

3.4.6 Notification types

Non-conformity can be basically anything that contradicts the agreement or ABB GTC. Thus, the definition of different violations is not always straightforward. To make the identification of the violations simpler, they are categorized in the ERP. Currently all Azipod®-related vendor notifications have been divided to 9 different categories according to the defect locations. This categorization is illustrated in Figure 31.

Figure 34. Defect Locations

In addition, categorization may also be made according to the type of the breach. A total of 17 different options have been opened in ERP. To facilitate the resolution of the notification, the author should be careful when choosing this category.

Figure 35. Defect types

4 RESEARCH METHODS

The writing of this master's thesis took place from the beginning of February 2019, to the end of May 2019. Majority of the literary part was completed before April 2019 and then the focus shifted to research the case company. Theory section utilizes a wide range of industry articles, researches and books that were mainly found from the library or the database of the University. Presentations, process descriptions and other company-related material were found from internal databases and applications.

The literature review built the foundation for knowledge of the subject in general. It was followed by the description of the current state of the supply chain of the department in question, ending with describing the concept of complaint management. This description gave direction for the research and enabled process performance analysis.

Qualitative research was chosen for the research method, as the study aims to understand the performance of a broad business process. Issues related to the current notification process were not possible to gather comprehensively and explicitly using only a quantitative method. Although quantitative data were also utilized to support empirical data and to allow comparison between two different procurement teams. According to Zhou (2012), qualitative research is used for understanding the world in which we live and why things are the way they are. It is concerned with finding the answers to questions which begin with: Why? How? In what way? It also aims to understand individual cases as part of their research and usually starts with information and try to make sense of it through an inductive approach (Zhou 2012). The methods used for the collection of research material are presented in more detail in the following sections.

4.1 Internal interviews

Empirical information was obtained through semi-structured interviews. This research method was chosen, due to the very specific nature of the subject. With the use of semi-structured interviews, the researcher was able to form an overall view of the current reclamation process, internal flow of information and cooperation with different teams. The interviews took place between February and May, were organized for a total of twelve and lasted from an hour to hour and half. The interviewees consisted of representatives of the

departments that are involved in the process. Each procurement engineer from PS service was interviewed and the rest of the interviewees consisted of team managers, warehouse foreman and quality engineers.

In spite the fact that unique presentation was prepared for each interview, the structure of them was very similar. First the subject of the thesis was presented followed by research questions and objectives. Then the issues were addressed through questions related to the reclamation process and finally the development proposals were planned. Notes and responses were written separately for each presentation document and summaries were written after the interviews. Finally, thematic analysis was used to evaluate the results.

4.2 Benchmarking and ERP-data utilizing

ERP data was utilized to support empirical observations and assumptions. In addition, new building and service procurement performance could be compared by using the historical data of key figures. These figures concerned the number of ships that are equipped with Azipod propulsion system, the amount of lines that are purchased monthly and yearly, and the number of ERP-notifications compared to the number of purchased lines. Some of the data was obtained from a monthly performance analysis performed by quality engineers and some were transferred from the ERP system to Microsoft excel document format. Data was then displayed by using different graphs and diagrams. Also, direct distribution and cross-tabulations was carried out with excel.

According to the UEF (2018) benchmarking is an assessment where organizations are comparing their activities and processes with another organization. Generally, comparison organization is perceived to be better in some particular mode of operation. In this thesis, benchmarking was carried out by comparing new building processes to service and the results are found in the chapter 6.1, development proposals. The interviews revealed that some certain functions are carried out much more comprehensively on new building and some measures can be utilized at service side as well.

5 RESEARCH FINDINGS

This chapter discusses the research findings from the internal survey. These present the reality, like how certain functions are actually processed and illustration of issues regarding the systems and practices of the reclamation process. This section mainly answers to first two research questions, pointing out the problems of the process and the underlying reasons for them. The chapter begins with a fairly detailed description of the procurement operations of the department, as these procurement-related observations are used to understand the causes for non-conformities. The method of analysis is thematic, and the themes are divided according to the structure of the chapter three. The development proposals for solving the issues are presented in the chapter 6.

5.1 Information management and storage networks

In this section the usage of ERP and other systems are discussed in general, and in chapter 5.4 the notification process in ERP is illustrated in more detail.

Based on the study it turned out that, the biggest information management -related problems were incomplete communication, inconveniences in ERP usage, incomplete communication and inadequate documentation and instructions. Problems and their causes are illustrated in Figure 33 and discussed in the following sections.

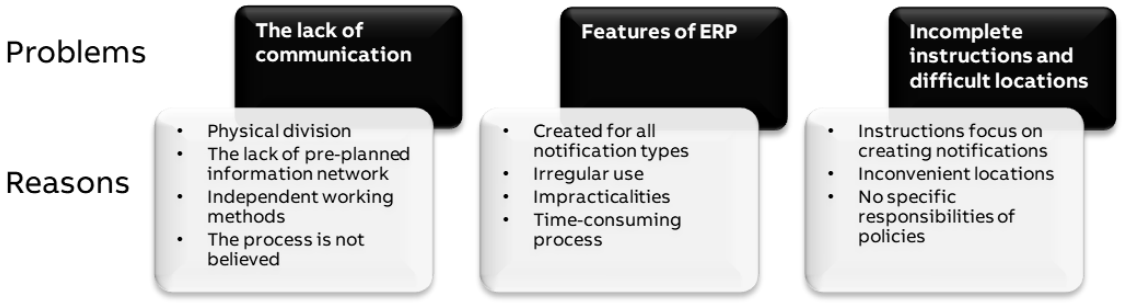


Figure 36. Information management -related problems

5.1.1 ERP & PLM

The daily work of purchasing engineer consists mainly of creating, updating and tracking POs through ERP-transactions. It is thus the main software by which the work is performed. Although the use of the software requires initial learning, its use is seen as relatively practical. However, in some situations the software shows its inflexibility when the base is intended for multiple business operations. It is known that the software can be modified and developed by certain application professionals, but it is not clear to the purchasing engineers how to communicate the development proposals further. Therefore, it is not understood whether the development measure requires large resources or whether it can be implemented with a very simple effort. Tips, such as keyboard shortcuts, to use the ERP software more practically, are basically shared internally from team member to another.

PLM software usage is seen relatively straightforward, even though software training courses would be welcomed. Currently purchasing engineers are basically using only the search function with ABB material codes. Using the search function is easy and as long as the material has been created carefully and all related documents are attached, using this feature is fast and efficient. According to the research, the PLM software sometimes has insufficient or incorrect information and purchasing engineers are not fully aware how this information could be corrected. Purchasing engineers do not have the right to edit program titles themselves.

Linking these two different software programs is seen as relatively practical. Predefined text fields are automatically copied from the PLM software to the PO that is created by ERP. With this function, it is possible to avoid mistakes or time-consuming communication with the supplier. In addition, this linking has begun utilized even more comprehensively. The intention is that ERP will automatically attach mechanical drawings and parts lists from the PLM to the PO. With this feature, the operative working time of purchasing engineer becomes more efficient and the margin of human error shrinks.

5.1.2 Other systems

According to the research, it is felt that there are too many different portals and information storage locations in use. Some of the interviewees were not even aware of the existence of all of them. The existence of several portals is probably due to the scale of the case company and the desire to keep the same practices in use despite the business in question. All available systems and the frequency of their use are shown in Table 1. The table is based on own empirical experience and is supplemented by interview information.

Purchasing Engineer's software solutions			
	Daily	Weekly	If necessary
ERP	x		
PLM	x		
Local Server		x	
ECM			x
SharePoint			x
IMS			x
Lotus Notes			x
Inside+			x
Email	x		
Skype	x		
ProSupply			x
Invoice Handling		x	

Table 1. Software solutions of purchasing engineer

Experienced employees have the general understanding of the places where the needed information can be found, but this knowledge is based on experience and is difficult to communicate effectively to another employee. Due to the several locations it is common that purchasing engineer gathers and stores the most important instructions to his personal computer. Different storage locations and other best practices are also agreed on a team-specific basis, which may differ from the general guidelines. The procurement team in question is using local server for storing and sharing information for purchase-tracking purposes. This storage location is used as it allows several people to edit the same document and see the updates at the same time. For example, if the purchasing manager wants to see the status of all purchases related to a particular project, he will save the tracking document in the server. Each purchasing engineer is thus able to update the status of own purchases to one document instead of several.

Web based storage methods are used at the level of the whole department. SharePoint is used as storage location of supplier price lists and dry-docking schedule. This location is generally considered practical as it has been commonly agreed and is usually known. SharePoint link can also be sent via email, making it easy to access a specific file if needed. Edits of these documents are also updated for everyone, which is generally good. However, the one should be careful when reviewing the documents, as inadvertent edits are updated also for everyone. Other web-based locations, such as IMS, Lotus Notes, ECM and Inside+, contains additional instructions or agreements. ECM is in the daily use of new building department, but service uses it less often. Lotus Note is a data base that will be abandoned, but some of the purchasing engineers are still using it occasionally. The documents that are stored in these databases, consist of different flowcharts, process guides, material surface treatment instructions, supplier information and also, some vendor agreements can be found. It is not seen convenient, that additional software specific account is needed to access ECM and Lotus Notes. This might be the reason why their use has been reduced.

Based on the research, one of the main challenges is the preservation and accessibility of supplier contracts. This solution is called ProSupply+ and it is global solution for strategic supplier management. Application aims to be a central repository for all relevant documentation and information around ABB suppliers and their relationship to ABB. However, the use of this application is seen challenging and the purchasing engineers were not very familiar with it. Sourcing managers are also storing some of the contracts in SharePoint and it is seen more convenient location. Common view is that updated agreements should be accessible easily at all times when needed. Consequently, all the storage locations for information, additional guides and practices and other applications are known, but their use is not experienced to be particularly fluent.

5.1.3 Information sharing

Department-level communication is made easy while the whole procurement organization is located in the same office. On one hand, this arrangement creates synergies but on other hand, the service procurement is located apart from other service organization. Actually, the whole service department is divided between three different places, reducing the quali-

ty of information flow significantly. In addition to these three locations, during dry dock projects, the project personnel are working on sites around the world. Distant location makes the daily communication even more challenging. Consequently, it is difficult to agree on things together, because of the different locations. However, these challenges have already been identified on one level and collaboration among different teams has recently been added. Once a week it is planned to arrange a common meeting between procurement and spare parts team. In the same context, the most important future projects with project staff are reviewed. It is not the only purpose of informing about the work, but also of improving the inter team awareness.

Based on the interviews, the efficiency of the information flow may depend on the experience of the purchasing engineer. When he immediately knows the right contact person for the task in question, location does not play such a major role. However, it turned out that employee turnover also poses clear challenges for efficient information sharing. Certain agreed practices do not pass on to new employees and organizational learning is not seamless.

Even though purchasing and sourcing responsibilities are shared according to the material categories, the material-related knowledge is highly limited. Based on the research, mechanical engineers and designers are sometimes assuming that category responsible purchasing engineers know all the products thoroughly. It is difficult to outline how much technical expertise is required from purchasing engineer. For this reason, the information sharing is sometimes incomplete, and the time of the purchasing engineers is sometimes wasted for additional emails or negotiations. The deeper reason for this kind of problem arises from the fact that there has not been clear discussion about the challenges.

5.2 Supply chain management – Propulsion Solutions Service

Procurement process and supply chain management is perceived to be relatively similar between new building and service. However, according to the research, there are some noteworthy differences between them. New building and Azipod production have been developed systematically over a long period of time and in addition, all activities take place

in Finland. The service organization is much younger, and the activities are distributed around the world. Certain functions in the supply chain are more vulnerable to errors or they still need to be developed. These functions were identified during the study and are presented in the Figure 34 and discussed in the following sections.

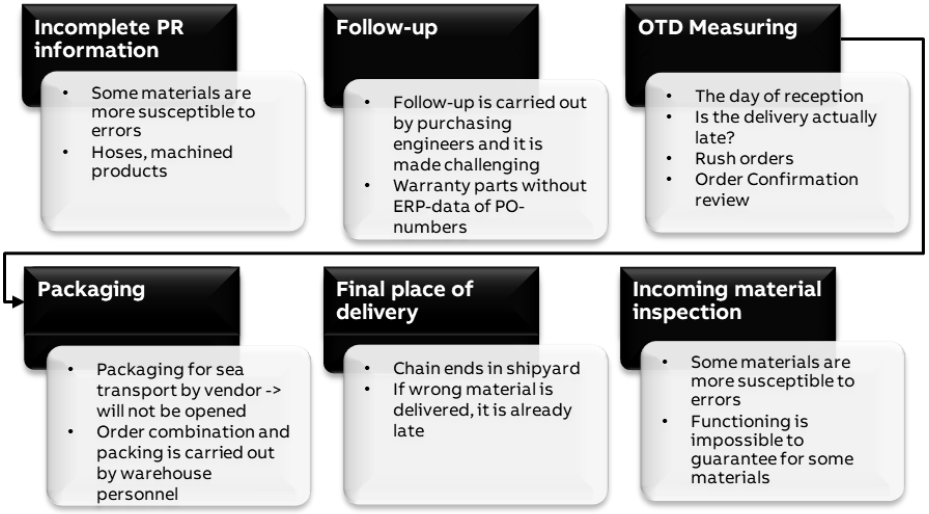


Figure 37. Research findings related the supply chain operations

5.2.1 Characteristics of operation

According to the research, the service organization and dedicated procurement team is relatively new. On the new building side, the daily responsibilities have been shared among several purchasing engineers and the practices have been developed systematically. At first, the new building was responsible also for service procurement but due to the noticeable growth of customer vessels, category-responsible purchasing engineers has been assigned to the service as well. The increase in the number of ships equipped with the Azipod® propulsion system is shown in Figure 35.

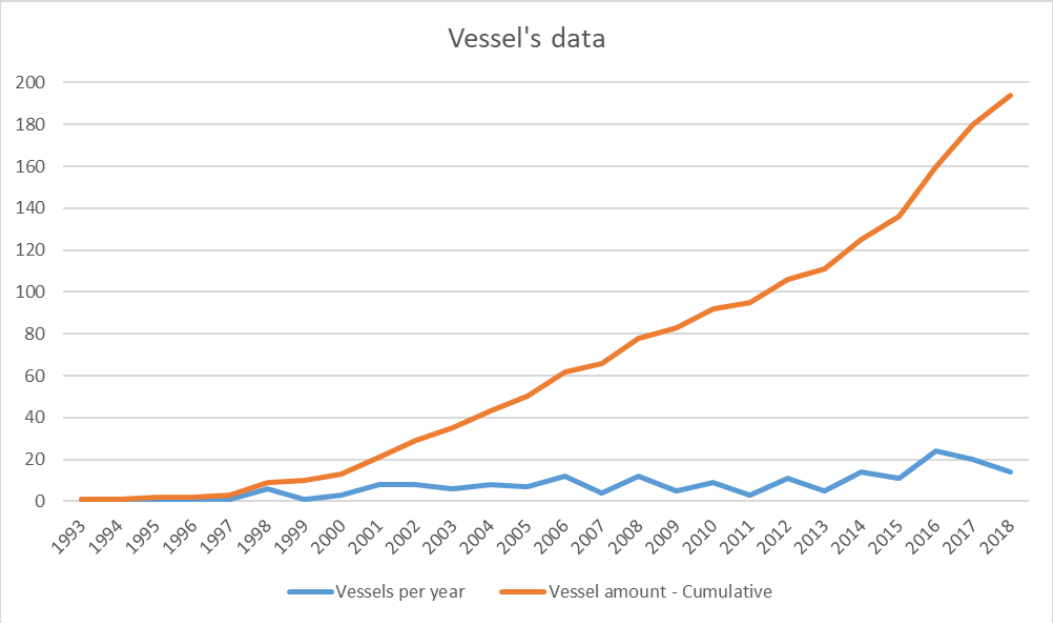


Figure 38. Amount of customer vessels

While the life cycle of a modern cruise ship or cargo vessel lasts for decades (Fet, 1997), service department will continue to grow also in the future. After the vessel is delivered, the responsibility for all spare parts and warranty department purchases is transferred from new building to the service department. Service business growth is measured by the number of lines purchased per month. The growth between 2009 and 2018 can be seen in Graph 36.

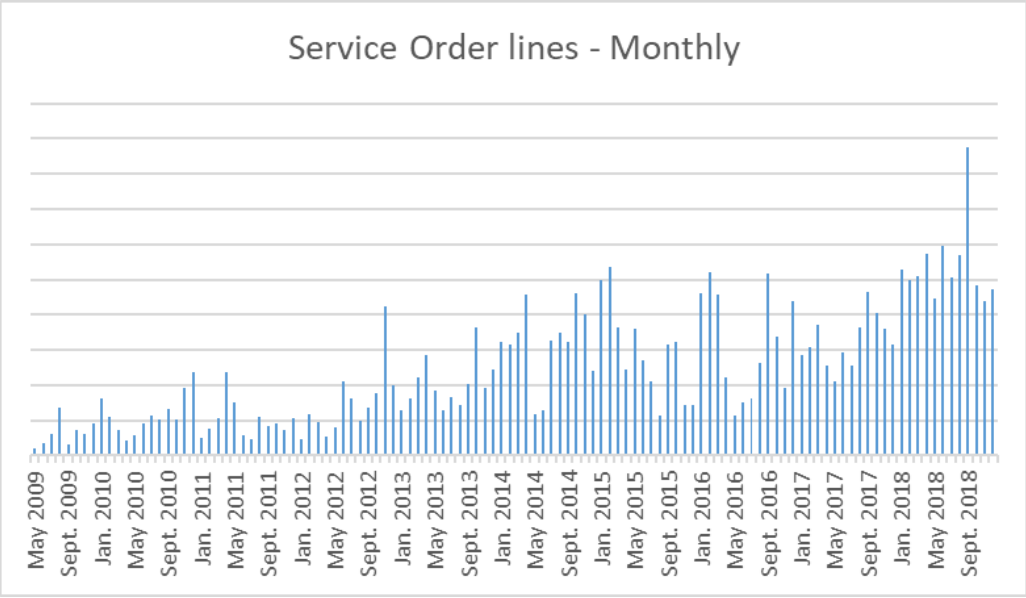


Figure 39. Service Order lines 05/2009 – 12/2018

As seen in the Figure 36, the number of lines purchased each year is constantly increasing. In addition, the seasonality of procurement can also be seen from the graph. According to the research, this seasonal nature of procurement causes organizational challenges in certain months. In some months, there simply would not be any extra time for additional tasks or clarifications as they will take time from other vital matters. Rush and extra pressure are perceived to affect increasing margin of errors and to the general waste of working time.

If the purchases were evenly distributed throughout the year, the number of needed personnel and daily work planning would be easier to estimate. Thus, one important feature of a purchasing engineer is the ability to prioritize. Sometimes prioritization causes problems for everyday work, because nobody can align that which task is more important than another. It has been discovered that even small improvements in daily work can greatly increase the efficiency of working time. For example, POs can be made in large quantities as long as the PRs are made correctly, and notification handling is fluent as long as they have been properly created by author and so on. Further clarification takes a considerable amount of time for the purchasing engineer and in many cases, it could be avoided.

5.2.2 Sourcing

The performance of the supply chain is considered to be material and supplier-related. The business relationship is obviously very different when, for example, main bearings are compared to simple consumables. With long-term suppliers, operating methods have been systematically developed for years and are constantly being developed. Thus, cooperation is advanced and information channels are working well. These core suppliers are collectively getting the majority of the spend and they are usually also key players in the maritime industry. These relationships are extremely valuable, and the partnership is seen strategic.

The ultimate goal is to create value to the stakeholders of the company by manufacturing and servicing technically superior maritime systems. This is not possible without carefully designed cooperation with external suppliers which are used to produce different components according to the needs of the company. However, the business relationship is obviously affected by the fact, that how important customer ABB is to the supplier. There is a

great difference in the success of continuous improvement if the business is developed together or unilaterally. This is why frame agreements are made and B2B relationships are a constant concern. However, maintaining multiple vendors is remarkably expensive and the balancing with too many or just the right amount is challenging: The company does not want to become dependent on one external supplier, but also does not want to maintain too many expensive overlapping partnerships. According to the research, the range of suppliers used to be quite wide, but has recently been reduced. This measure aims to create deeper cooperation and more precise agreements with existing core suppliers.

Based on the study, it is not cost effective to organize annual meetings and frame agreements with all the vendors. Thus, they are prioritized as well. At the moment it can be measured by a single project, that how big percentage of the project spend is provided by an uncontracted supplier. Based on the interviews, the ratio is roughly 80% of the spend goes to the contract suppliers and 20% to uncontracted ones. If the percentage of lines are measured, the ratio could be reverse. It can therefore be concluded that contracts are being made with the suppliers of the most valuable and important parts.

New building and service are not intentionally being separated from each other in the eyes of the vendor. Some suppliers have differentiated personnel for service and product support, so they also have different contact persons for both purchasing teams. There is also no differentiation to the agreements for the needs of service and new building, so both agree on the same contract. Within the framework of their own material responsibilities, sourcing managers are managing both the new building and the service-related issues.

5.2.3 Operational purchasing

The purchasing process is considered to be relatively logical by purchasing engineers. Getting started with the ERP-software requires some familiarization but due to the daily use of the software, the most common transactions are quickly learned. PO creation process is perceived as quite straightforward as long as all the necessary information is provided to the purchaser. The purchasing process is illustrated in Figure 37.

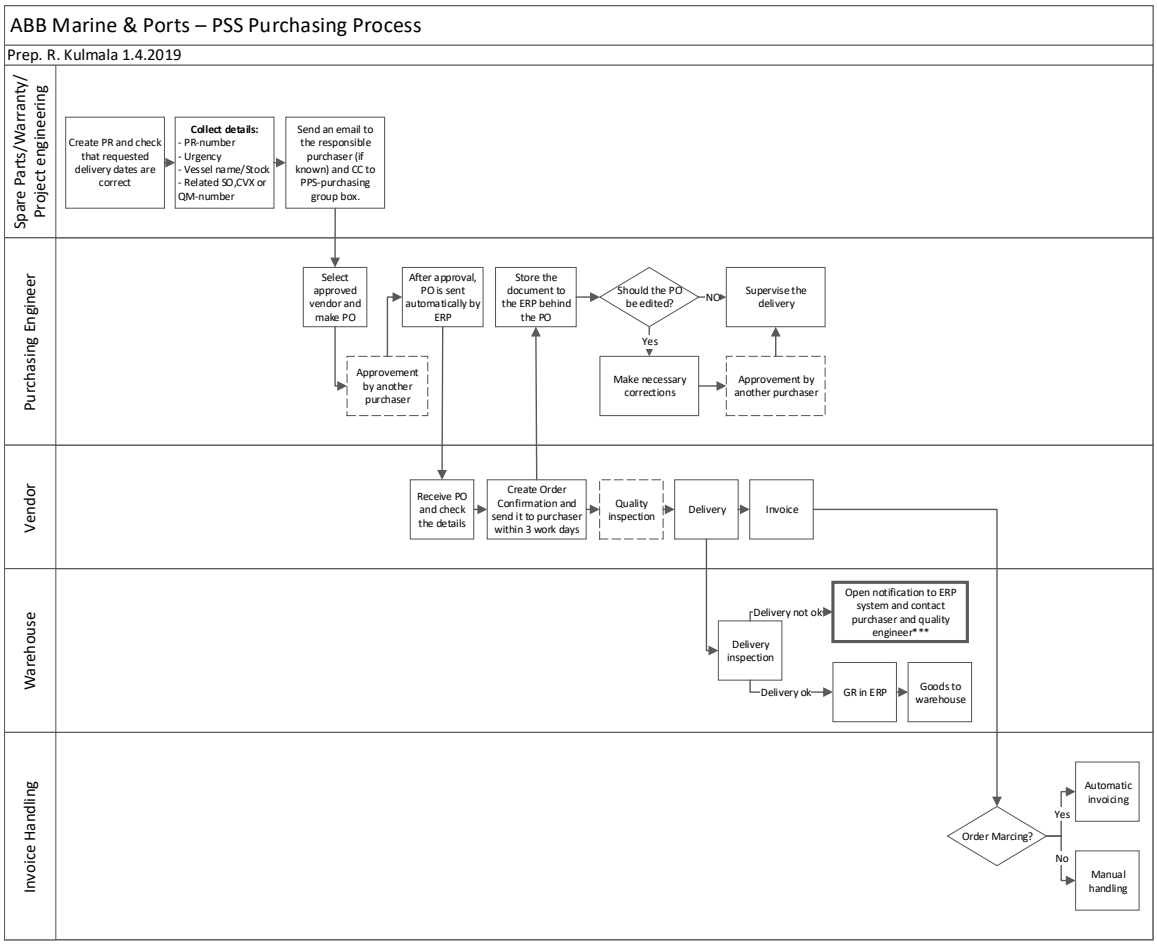


Figure 40. ERP purchasing process

It is extremely important that the supplier accepts the order in writing and acknowledges the terms of the PO with the confirmation. PO is then confirmed in the ERP system by purchasing engineer according to the order confirmation. Attention must be paid to the price and the date of delivery confirmed by the supplier. Based on the study, the purchasing engineer must also be careful when handling procurement-related documents. It is typical that the supplier only sends an order confirmation via email, leaving the email text field blank. The confirmation may include changed details, for example the delivery date and the price can be completely different when compared to the PO. Legally, the vendor confirms the transaction on the basis of his confirmation of order, and the terms of the transaction only apply to the content of the confirmation. If the purchasing engineer does not interfere with these possible changes, then they cannot be appealed.

5.2.4 Unpredictable events

In addition to planned material procurement, service organization should be prepared for unpredictable events as well. In maritime industry, these events may be safety or environmentally hazardous, so this responsibility requires rapid operational capability throughout the organization. This responsibility poses considerable challenges for systematic action as the priorities of the organization may change very suddenly.

Although ABB defines its product maintenance program, the customer decides on the docking schedules. Sometimes the timing is decided considerably late or the date changes from what was originally agreed. All of these factors are typical of the service business in maritime industry and they pose significant challenges to material procurement. According to the research, service procurement is more sensitive to errors than a new building because from time to time purchases have to be done urgently and with inadequate input. In order to prepare for long delivery times and unknown events, the department maintains inventory for certain components. Stock levels and material needs are managed through material resource planning (MRP) that is integrated to the ERP system. Purchasing engineers are responsible for placing MRP-orders within their own category responsibilities.

The inventory values can be viewed and adjusted in the ERP system and the warehouse personnel is responsible for the accuracy of the levels. Full preparedness is, however, very challenging and the storage of large components is extremely expensive. Due to seasonality and the growth of the business, both, number of warehouse personnel, and limited storage space have caused challenges. However, in recent years the whole warehouse has been reformed and new premises will be available within this year.

5.2.5 Supply chain research findings

In recent years, both purchasing teams have developed their own ways of working and additionally the supply chains and the warehouse locations differ from each other. Due to the tens of thousands of different parts and their variations, PRs must be equipped with all the necessary information. In certain circumstances, a mere reference to the own material number of the manufacturer is sufficient when in some cases procurement should include detailed additional information on material-related measures, such as: Measurement proto-

cols can be required, some materials must be classified according to the correct classification society, some purchases include testing or calibration before delivery and the surface treatment of some materials varies according to the application.

Interviews revealed that warehouse personnel have only shortly been informed that it is vital that they will do the GR in exactly the same date, when goods arrive. The personnel had given priority to the collection and packing of orders and sending them on time. They were not told that one of the KPI of the supplier is based on ERP-transaction made by them. According to the research, at peak times, they have had real challenges to make all GRs on time, as all parts must be checked and counted before GR can be made.

When Azipod® propeller systems are assembled, the operation is carried in the own premises of ABB. Incoming goods inspection is carried out by dedicated inspection team. The demanding measurements and testing of the materials can be carried out so that the drawbacks are detected instantly. Inspection of materials that are sent to the end-customers is more challenging. According to the study, warehouse personnel have not been trained to carry out comprehensive inspections. It is not either possible to test a comprehensive amount of materials in warehouse premises, as the functioning can only be seen when they are properly connected to the propulsion system. The inspection is thus carried out in a very comprehensive manner. Mainly it is inspected that the correct amount of materials has arrived and that they correspond to the ERP-data. During the research, it became also clear that the inspections are taking a considerable amount of time. In busy months, if the resources are misdirected, the lack of staff weakens the quality of them.

Certain materials are already packed for the sea transport by the supplier. Without proper protection these materials are susceptible to failure during transportation. Thus, they are not opened in the warehouse and in these cases, only the material documents can be compared with ERP data.

Although the responsibility for the follow-up ends when the materials are received in the warehouse, the supply chain does not end there. Subsequently, the materials are shipped to the customer and installed or placed in the stock of the customer. In case of a larger dock-

ing project, it is the responsibility of the project management to go through all the materials delivered into the shipyard. In practice, there is never more than one day for performing this inspection. Project personnel will mainly go through the packing lists and calculate that the right amount of packaging has been delivered. Challenges are mainly caused by a tight timetable.

5.3 Business process management

Purchasing process brings value to customers when a desired product will be delivered in the right place in the right time as cost-effectively as possible. Any extra clarification and unnecessary communication wastes value as it consumes the available resources. The quality of the procurement process and the number of notifications therefore go hand in hand: It has been noticed, that reducing problems in the procurement process reduces the number of quality notifications. Biggest challenges in the purchasing process are related to incomplete information sharing.

Notification process brings value to the customer eliminating recurring problems and developing business in general. Basically, something problematic and value-eliminating has happened when the notification process begins. Based on the interviews, it turned out that problems are strived to be solved as quickly as possible to maintain customer satisfaction, but this approach only removes the problem once and does not prevent it from happening again in the future. In addition, failure to follow a pre-planned process often results in ABB bearing the responsibility for the incurred costs. Employee engagement and definition of responsibilities have created challenges. At the moment, it is not entirely clear who is responsible for what part of the process.

Biggest process management -related problems are low governance, the lack of motivation and also, the lack of time. The problems and underlying reasons are illustrated in the Figure 38 and discussed in the following sections.

Figure 41: Process management challenges

5.3.1 Process management in propulsion service

Purchasing engineers are used doing their job independently. The trust of management in employees is quite high, as their performance is hardly monitored. Also, no one follows the daily work and it is the sole responsibility of purchasing engineer to forward quotations, follow his orders and monitor notifications. If the purchasing engineer is absent from work for some reason, transferring this responsibility to another person is not particularly convenient. Almost all conversations with vendors or other stakeholders have been through personal email, and they cannot be accessed by third persons.

These challenges in tracking POs have already been identified. Challenging orders, such as POs that have been confirmed late, will be delivered late or are already late, are monitored once a week with the logistics department. Monitoring is complicated by the structure of projects: A single docking project includes numerous procurement entities and it is not possible to print one project-specific list of all POs from ERP system. Making this listing requires a considerable amount of manual work which increases risk exposure. It is interesting to monitor if the problems are reduced and the department will improve its OTD due to this weekly meeting. On other hand, notifications are not monitored at all except for occasional reminders from sourcing managers. Their completion and corrective actions are the sole responsibility of the purchasing engineer and the supplier.

According to the research, one other project management related challenge is the lack of orientation of new employee. The practices agreed with the previous employee will not be efficiently advanced to the new one. Thus, turnover is causing problem for the success of the whole process. This may partly be due to the fact that teams are located in different lo-

cations, where inter-team training is difficult. An attempt to fill the gap left by the exited person may also be to rapid, so the orientation remains incomplete. Policies may also be introduced internally within the teams and not communicated to the entire organization.

Another problem is the lack of understanding of the big picture. Daily operations of purchasing engineer are independent and focusing on the use of ERP transactions. Activities outside own responsibilities may be perceived less important. In addition, due to the independent nature of work, working methods will stabilize and are not being questioned.

5.3.2 Process development

It would be important for buyers to be able to critically evaluate both the performance of the process and own work on a regular basis. If mediocre performance is enough, development cannot be expected. It is not mentioned in the daily instructions of the purchasing engineer, but one of the most important tasks is to take part in continuous improvement. If any recurring error is detected, such as some impracticality in the daily practices or in the ERP system, he should know who to inform about it or how to fix it. Purchasing engineers are good at evaluating the practicality of daily operations. They should be able to address a significant amount of incurring impracticalities and prevent their happening again in the future. However, according to the research, not always there is time to address the incurred problems or knowledge who to inform.

In certain cases, the person being informed will not react in any way. This leads to the decreasing enthusiasm to report the next upcoming problem. There is no clear path created for development suggestions, and at the moment, some easy-to-fix challenges can make themselves redundant. However, if the knowledge to solve a problem lies among the service procurement team personnel, finding the solution is experienced to be quite straightforward. This is due to the open office facilities and openness between employees.

One challenge for process development is employee motivation. Normal performance and responsibility management are usually enough. How could it be possible for an employee to develop or change his own daily activities and/or how to get employee involved in con-

tinuous improvement? What would be the motivational factor that could increase the personal development on an individual employee?

5.3.3 Quality management

The common perception of the quality culture of the company is seen positive. Even if the main quality related matters would not primarily concern procurement department, employees understand the importance of quality and strive for it in their day-to-day activities. According to the interviews, the concept of quality should not only be perceived as characteristics of the products. In SCM, quality refers also to the information flow efficiency, compliance with the agreements, continuous development of practices and general fluency of activities.

When the quality problems are left unreported, the purchasing engineers will not be aware of them. In these cases, problems cannot be solved, or corrective measures performed. ABB bears responsibility for all incurred costs and the problem is not prevented in the future. There are several possible reasons for this chain of events: Maybe the notification process is not understood, it is perceived to be too complicated or another way to solve the problem is easier.

One of the problems encountered relates to monitoring quality costs. Total cost-tracking is perceived to be difficult and requires a considerable amount of manual work. For example, the tracking-related difficulties make it possible to buy a new product to replace a broken one, and the supplier does not even get to know about it. Also, there is not a common approach to the allocation of costs. Procurement personnel are not informed when costs are added to the notification, so they may not be claimed at all. This leads to an increase in the lead time for notifications as they are not intended to be closed if it is assumed that some additional costs are still expected.

5.4 Complaint management

According to the research, there are always at least three members participating in the supply chain: Supplier, ABB Marine and the end customer. When the problem or violation is detected the chain of operation must be clear for all participants in order to take corrective

measures to maintain customer satisfaction and prevent future problems. Thus, the observer should know who to contact, how to communicate it, which communication channel to use and what is the correct way to report it. The contact person should then immediately be able to create a proper document and action plan and communicate the case to the supplier and solve it with cooperation.

Based on the study, process-oriented approach to complaint management is applied to maintain continuous improvement and for business development in general. Primarily, the complaints are made in order to approach supplier cooperation and secondarily to cover the incurred costs of breaching the contract. If the problem does not depend on own activity of the case company, there is no reason to end up being the payer. In the first instance, if the material is wrong or damaged, it is only wanted to be replaced to the correct and functioning material as soon as possible. Based on the interviews, it is unfortunately not always so straightforward due to the characteristics of the maritime industry.

Interviews showed that there are several reasons for not submitting notifications in the required way. The biggest problems are related to the lack of guidance, mistrust of the process and unclear responsibilities and they are illustrated in the Figure 38 and discussed in the following sections in more detail.

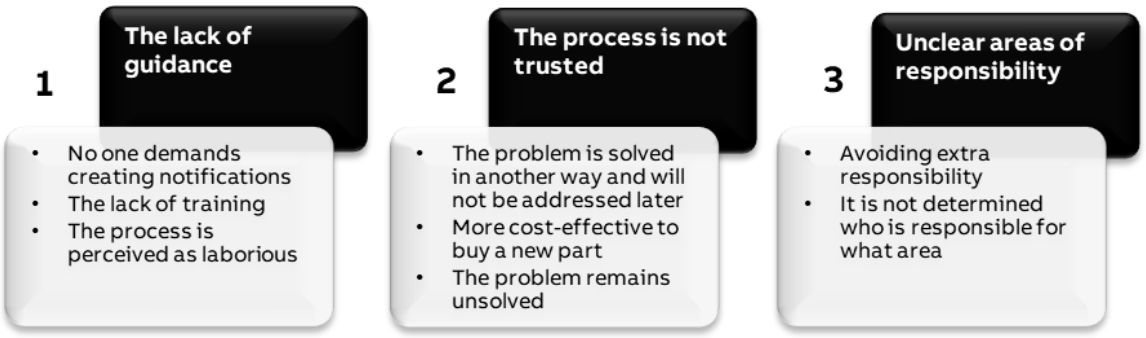


Figure 42. Problems related to the creation of quality notification

5.4.1 NCR

Based on the study, the concept of NCR and Notification are basically meaning the same thing, even if they are sometimes used for different purposes. NCR can be received from

the customer and the quality notification is made in ERP according to this information. It is agreed that the problem observer, or the one who receives it from the customer, is the one who creates notification.

The initial idea of commissioning this study was the general view that these notifications are being made too rarely. Therefore, the belief was, that the number of vendor-related non-conformities is much higher than they are documented. For some reason, they are simply left unreported and the case company is bearing the responsibility for the costs incurred.

According to the interviews and data analysis, this view has found to be true. If the number of lines purchased is compared to the notifications created yearly, this division ratio is clearly different between service and new building. In 2018 the ratio for service department is only 0,25%. 2014 the figures were closest to each other, but after then the difference has only increased. Table 2 illustrates the ratio of notifications to the number of annual purchase lines. On the other hand, this relation also means what is the annual probability of making a notification against one purchased line.

Number of Notifications / Lines purchased yearly		
Year	Service	New Building
2010	0,53 %	2,95 %
2011	0,76 %	2,35 %
2012	0,61 %	1,44 %
2013	1,01 %	2,00 %
2014	1,11 %	1,27 %
2015	0,80 %	1,42 %
2016	0,70 %	1,86 %
2017	0,48 %	1,42 %
2018	0,25 %	1,40 %

Table 2. Notification ratio

Basically, this decrease in probability should also indicate a decrease in the number of non-conformities. However, the interviews revealed that as the business grows and the number of annual purchasing lines increases, the amount of associated problems will also increase. Due to unpredictable problems and ever-changing schedules, the service business is more

unstable that new building. Most of the installation work is done in remote locations with a tight schedule, where problem solving is much more difficult. However, the priority is to solve the problem in one way or another. The problem is that the non-conformities are not dealt with or properly communicated to the entire supply chain organization, but they are often left unreported.

5.4.2 ERP Claim creation process – Responsibilities of author

Based on the research, the whole quality notification module in ERP shares opinions: People who use it on a regular basis experience both transactions fairly clear. They would make some small additions or edits to the process but are generally satisfied with the operation of these transactions. On the other hand, people who do not regularly use these transactions, feel a little confused of the functions. The research findings are divided into two, according to the responsibilities of the author and coordinator. Author is the one who creates the notification and finally, after corrective measures are taken, closes it. The responsibility of the coordinator is to handle the rest. Consequently, the coordinator creates an action plan, communicates it to the supplier, accepts or requires further clarification of the actions and suggests the closure to the author.

On the basis of the interviews, a recurring problem for those who had challenges with the ERP process, was the partner assignment. The representatives of the different departments were not entirely sure how and to whom the challenges would be communicated, ie who would be appointed as coordinator. In the Figure 39 the structure of partner assignment is shown, and the challenges are highlighted.

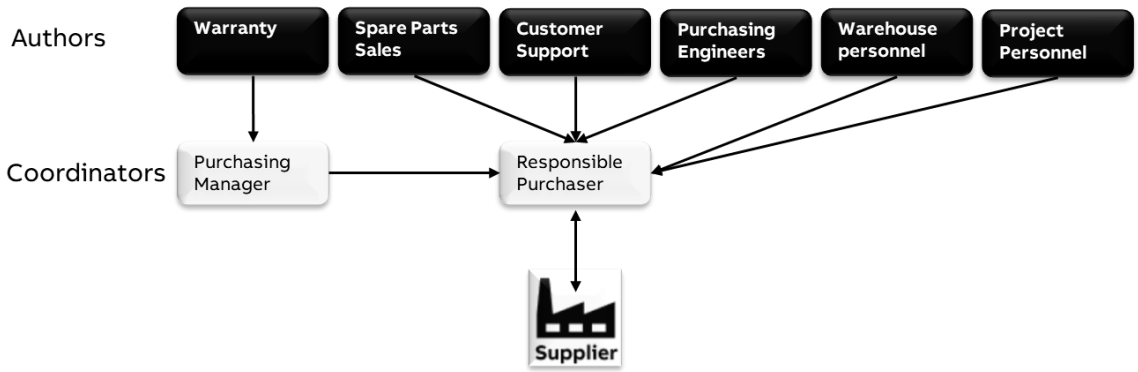


Figure 43. Partner Assignment

Although the purchasing engineers seems to know well how the roles are distributed around the notification, they are rarely the ones who observes the breaches or non-conformities. When purchasing engineer observes a non-conformity, it is almost without exceptions a delay. Basically, in all other cases, some other internal staff will notice the problem or receive NCR from some external personnel, ie representative of the customer. However, the delays are monitored regularly in the company as OTD is one of the most important KPIs for the supplier. The OTD data confirms the view that notifications are made to a small extent in relation occurred breaches. OTD percentage is illustrated in Figure 40.

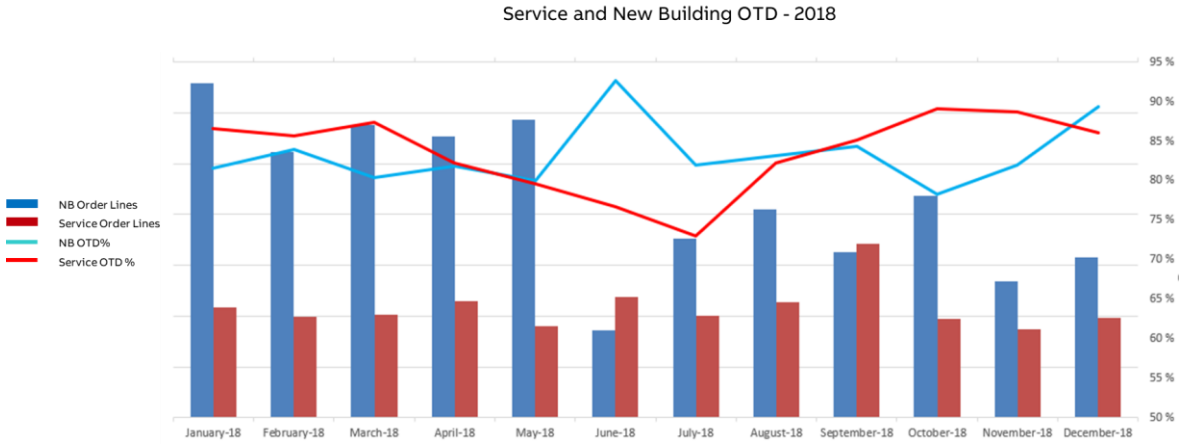


Figure 44. Service and New Building OTD 2018

For example, in the year 2018, the total OTD percentage for service was 83% but only 32 notifications were made in whole year. It can be concluded, that neither the purchasing engineers are creating significant amount of notifications on their own initiative.
The reason is, in fact, that no one has demanded to make delay notifications. OTD is actively monitored by the procurement manager and quality engineers, but it is hardly developed through the deviation process.

5.4.3 ERP Claim creation process – Responsibilities of coordinator

Creation of the action plan on the basis of the notification have been perceived quite clear by the purchasing engineers. However, some specific details would require clarification

and there is a common feeling that the process could be streamlined through a few development proposals. The greatest challenges are related to the facts, that the received notifications are often very inadequate, they arrive too late or are created completely wrong. If notifications are received completely inadequate, they will be more clearly prioritized at the bottom of the task list. Other main challenges for the coordinator are illustrated in the Figure 41.

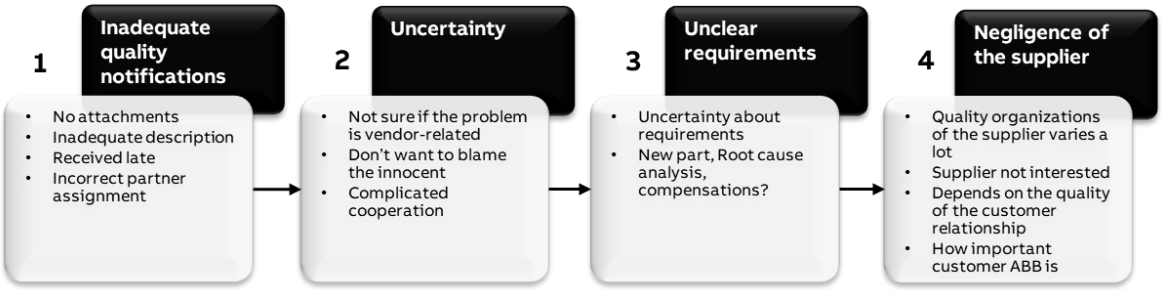


Figure 45. Challenges for the coordinator

The nature of the non-conformities has been experienced to vary a lot. In clear cases process has been perceived to work quite well, but if the case requires more clarification, the responsibility is even avoided. Service procurement department does not have a dedicated person who is responsible for the claims. Purchasing engineers have experienced this as a clear defect, as reclamation-related clarification and communication takes a considerable amount of time. The service business is characterized by intermittent hecticity. Thus, to fulfill the needs of the customer, procurement engineers are sometimes required to ask vendors for services that they are not even required to respond on the basis of the agreements. Consequently, for unpredictable situations, engineers are trying to keep business relationships, to the representatives of the supplier, as close as possible. Based on the interviews, this is one reasons why the purchasing engineers do not experience the sending of complaints to be particularly pleasing measure. It is felt that cost-claiming can damage the business relationship and make it more difficult to ask services in the future.

5.4.4 CCRP

According to the interviews, CCRP is seen as excellent tool for internal complaint management. Internal trade always has its own challenges, since its upkeep or maintenance is not seen as important as external customers. Internal trade is assumed to be self-sustaining,

even though it is not. When solving internal trade problems, resources are consumed by a double amount. For this reason, the business methods and internal practices should be given careful attention.

CCRP-notifications receive special significance due to the regular tracking. Managers attach great importance to open CCRP-notifications and remind their subordinates regularly if they are left untreated. According to the study, this kind of monitoring significantly improves the resolution of complaints. In addition, the process is considered to be logical and the user interface moderately good, by the purchasing engineers.

5.4.5 Warranty

The activities of the PS warranty department differ from other PR and quality notification creators considerably. Warranty engineers does not purchase anything, but they are allocating all costs to notifications according to their QM-numbers. In other words, if anything needs to be purchased a notification must have been created before that. The warranty department is located in the same premises as the procurement department, so communication is perceived to be particularly easy. Also, PRs and quality notifications, created by warranty department, are felt to have been carefully done. Interviews revealed a few reasons, in addition to the strategic location, why communication and action with warranty department has been successful.

Warranty department maintains their own document of all the undergoing and already managed cases. According to this documentation, they nominate a manger to each case, who is thus responsible for all the communication related to it. This way of doing things is felt to straighten the operations and eliminates overlapping functions.

Warranty department creates two types of notifications: ones that are not claimable from vendor and the ones that are. The first ones are mostly mistakes made by your own designers and these notifications are not part of the scope of this thesis. Instead, the notifications that are claimable from vendor are related to the POs that purchasing engineers of the new building procurement team have made. However, it is agreed that the service is responsible for handling all vendor-related notifications that are created by PS warranty. Since, in this

case, the purchaser and the coordinator are different persons the partner assignment is carried out differently: Purchasing manager is always coordinator as warranty engineer remains as author. The purchasing manager then delegates the notification to responsible purchasing engineer and switches him to the coordinator. This mode of operation has been considered relatively good, since it raises the threshold to send incomplete notifications and reduce extra email conversation as the notification will be efficiently forwarded to the correct person. Warranty department is also using IMS-portal for storing interdepartmental guidelines. Instructions for creating notifications and PRs have been prepared together with the procurement manager and all team members apply the same guidelines.

The study also revealed some challenges. It is generally felt, that in case on clear breach or non-conformity it is still easier to purchase new material, than get the vendor to supply a replacement product to a defective one. For this reason, too often, new POs are created, and costs are allocated through notification instead of only receiving a replacement. This mode of operation is not cost-effective, as costs are easily staying uncompensated and the working time is wasted. In addition, interviews revealed that the notifications that are created by warranty department are causing a considerable amount of additional work for service purchasing department. Purchasing team is responsible for all communication with the supplier and this is becoming problematic, because it takes a considerable amount of time to resolve these anomalies.

In some cases, the supplier requires the defective or wrong part back, before sending the replacement. When it comes to ship docking, usually thousands of miles away, this is not possible in order to get the replacement on time. In addition, even if the supplier sends a replacement part without getting the defective one in exchange, it is a real challenge to receive that on time. Also, the tracking of the replacement poses another challenge as it is not registered in the ERP system of the company. It is only the memory of the coordinator and the supplier that matters for the replacement part.

5.4.6 Documentation

On the basis of the study, the procurement engineers experience some challenges related to the documentation of the claims. A contract seminar was recently arranged for the whole

PS procurement department and the seminar was seen as very useful because it provided a lot of new information for purchasing engineers. Since the concept of reclamation is based on the mandatory law of business-to-business trading and the frame-agreements with the supplier, procurement engineers are experiencing uncertainty when writing a reclamation document.

The document acts as a legal and formal notice of a breach of a contract. Based on interviews, the document base should be more comprehensive, so the coordinator could only complete the event-specific information. Currently the document is blank, and the coordinator is responsible for all the content. However, the PDF-document, that is printed out from the ERP, was never intended to be sent to the supplier. Reclamation was planned to be communicated only via email with attachments of the relevant files. At some point, sending this PDF-document printout from ERP has become an automation. The operation is seen as positive, only the document base is considered incomplete.

At the moment, it is also felt that most of the complaint-related information is only visible to the coordinator in a personal email folder. The purpose is to update the discussion with the supplier to the ERP under the notification, so it will be available for other partners as well. In reality this does not work particularly well. Either the discussion is not updated, or long email chains are inconvenient to read from a small text box of the notification.

The interviews also revealed that the cost-claiming has been experienced difficult. Actually, all the quality notification guidelines end to the stage, where the reclamation is sent to the supplier. There are no instructions for further actions even though, in many cases, ABB would be entitled to claim incurred costs from the supplier. Based on the study, there are practically two different ways of claiming the incurred costs from the supplier: First, and recommended one is to require a credit note for the QM-number. The amount depends on the contract and the characteristics of the violation. For example, in case of delays, the liquidated damages shall be 2,5% of the total purchase price of the PO for each commencing week of delay. It is also common that a new material has been purchased as a replacement, and the cost of the action and the part will be claimed from the supplier. If violation is noticed only at the shipyard, the costs of the breach may increase to a multiple of the purchas-

ing price. These costs are allocated under the notification as well but only the costs that are agreed in the contract can be claimed from the supplier. Alternatively, second option for claiming costs is to send an invoice to the supplier. Based on the study, this mode of operation is not very cost effective, and it is only used in the most significant breaches of contract. It is hardly necessary for the purchasing engineers to be responsible for these.

In certain cases, it has been possible to agree something else than the ABB GTC is stating. Thus, the frame agreement between the vendor is always followed first. If there is no agreement negotiated with the supplier, then ABB GTC is followed, as it is mentioned in PO-document. The interpretation of the non-conformity gets even more challenging when trading is international. As a rule of thumb, the law of the seller country is always followed. In addition, it has been possible to agree some specific details that go beyond the law, as long as it is not mandatory law.

According to the interviews, there are currently several challenges that are related to cost-tracking. No one is disclosing the occurrence or allocation of costs to the notification and costs are reported inadequately. It has repeatedly been discovered that when the notification is closed, costs have still been transferred there. This may be due to the fact that the person performing the work does not know about the obligation to report the costs to the coordinator, nor has the method of reporting been agreed. In addition, cost-monitoring is laborious when it requires 2 different time consuming ERP drives and generated data still needs to be manually filtered.

5.4.7 Notification types

Based on the interviews, categorization of different notifications is not always straightforward. Often, the category of the defect location is wrongly selected or left completely unselected. However, the type of the notification is chosen correctly more often. During the research, it was discovered that it is more essential to process development that notifications are divided according to the following breakdown:

- Categorization according to the characteristics of the non-conformity
- Categorization based on where the non-conformity is detected

The feature-based breakdown is based on the fact that, non-conformities can basically be anything that contradicts the agreement or ABB GTC. During the study, it was found that four main categories are sufficient to simplify operations:

1. Delivered material is not in accordance with the agreement
2. Material is in accordance with the agreement, but it is defective or broken
3. Material is not delivered at the agreed time and/or place
4. Material has functioned as agreed, but it breaks during use in breach of the contract.

During the study, it was found useful to classify the notifications based on their observers. The breakdown helped to understand different chain of information and events. These findings are shown in Figure 42.

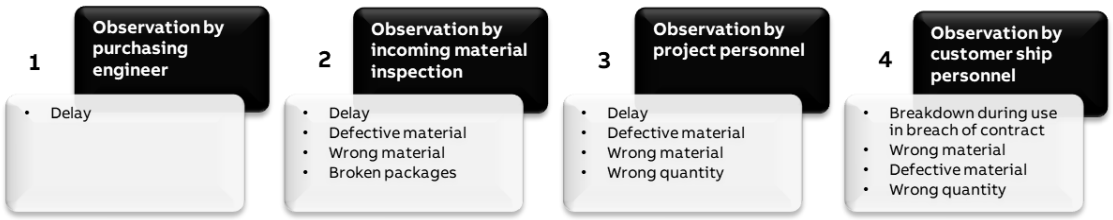


Figure 46. NCR observation

Based on the interviews, only type of non-conformity that purchasing engineers are observing, is delay. Buyers know quite well all their late lines because they are reviewed weekly, but it is unclear when official ERP-notification should be made. There is no guidance on this, and it is not meaningful or cost-effective to complain about every late line.

Material inspection is carried out by warehouse personnel. According to the interviews, notifications are rarely coming from the warehouse even though non-conformities are often observed there. Based on the study, the material inspection is carried out quite lightly as warehouse personnel does not have resources or equipment to perform comprehensive inspection for all materials. However, they do know how to communicate the problems to responsible purchasing engineer. They are just not trained or even required to create quality notifications. According to the research, the latest training took place more than three

years ago and the warehouse staff has largely changed over this period. In addition, the day-to-day workplace of the warehouse manager is located in a different city than the warehouse. For this reason, the management of change is perceived as challenging and clearer training was desired for the implementation of any new change proposals.

Due to the lack of comprehensive material inspection in the warehouse, a considerable number of non-conformities are only noticed in shipyards. This is one clear difference between new building and service. New building has advanced operations and a dedicated team for incoming material inspection. As a result, problems are usually detected already in Vuosaari. If the defected or missing part is noticed at the shipyard, the problem solving is very challenging due to the tight schedule, remote location and the lead time for a replacement part. Based on the study, the atmosphere in the shipyard is hectic. When and if the problems get solved in the shipyard, the nature of them will often be forgotten and not communicated further. It is not entirely clear to the project personnel how the problems should be communicated, who should be contacted or who is responsible of creating the quality notification.

In case the representative of the customer notices a non-conformity, for example defect component, the communication chain is quite similar than in the case of spare part need: First he will contact assigned MSC or customer support where the NCR is directed to either the warranty department or the spare parts sales. According to the research, this information chain works remarkably well. The challenges arise when Spare Parts Sales begins the communication with procurement team and the supplier. The problem is that often the suppliers require the wrong or defective part for themselves before agreeing to send a replacement part to the end customer. The communication with the suppliers in problem situations is perceived to be difficult. For this reason, the process is not believed to be particularly effective and significant amount of quality notifications will not be created.

6 SUMMARY AND CONCLUSIONS

Numerous studies show that competition is getting more intense every year in the field of manufacturing industry. Continuous improvement has been found to be the most effective way to increase productivity and maintain competitiveness for any manufacturing system (Li, J. 2013). Furthermore, the capability of manufacturing processes is an important factor for business continuity (Inrawati S. & Al. 2015). In an attempt to improve cost effectiveness and quality, as well as create a long-term competitive advantage, manufacturing organizations are beginning to initiate strategic alliances with their customers and suppliers as part of their supply chain management (Love, P. & Al, 1999).

Based on conducted interviews and ABB Marine & Ports presentation material for suppliers, the case company has a certain quality vision and requirements for its suppliers. Doing business with ABB requires commitment, cooperation and the pursuit of continuous improvement (ABB 2019b). Collaboration with suppliers and customers is vital when the company is manufacturing critical and quality superior products. Notification process is one of the tools for developing operations and there are several reasons for improving it. The process is designed and standardized to maintain customer satisfaction and supplier collaboration. The development of the process aims to ensure reliable and safe operation of the product and its correct use. In addition, the process improves internal collaboration between departments, when it is performing properly.

This chapter introduces development proposals to improve process performance. In addition to practical suggestions, the chapter also discusses more theoretical alternatives for process improvement. The chapter is divided into three parts: The first part presents the development proposals with which the notification and reclamation process could be more straightforward and efficient. Recommended steps for implementing the suggestions are also discussed. The second and third part summarizes the lessons learned during the research process and presents suggestions for further research.

6.1 Development proposals

The most important aspect of the process development is management of the chance. Someone has to follow the lead and follow the change from a higher level and share the responsibilities for development measures. The commitment of the management and employee engagement are prerequisites for successful implementation of development proposals. For example, once the need for training has been identified, it is first necessary to identify responsible persons and the available resources to plan and organize them. During this thesis, it is not possible to identify responsible persons or define precise instructions for implementing development proposals. However, this aspect is considered and some suggestions for responsible persons are mentioned.

Based on the research, a significant number of non-conformities will not be reported whereby the amount of created ERP notifications is much lower than it should be. In addition, the response rate for the reclamations was only 60%. Consequently, neither notifications are made sufficiently, nor the created reclamations are solved efficiently. This combination is the starting point for development proposal creation. To prevent the emergence of new bottlenecks, the process must be seen as a whole and be developed step by step. These development proposals are presented in Figure 43 in general level and in the following sections in more detail.

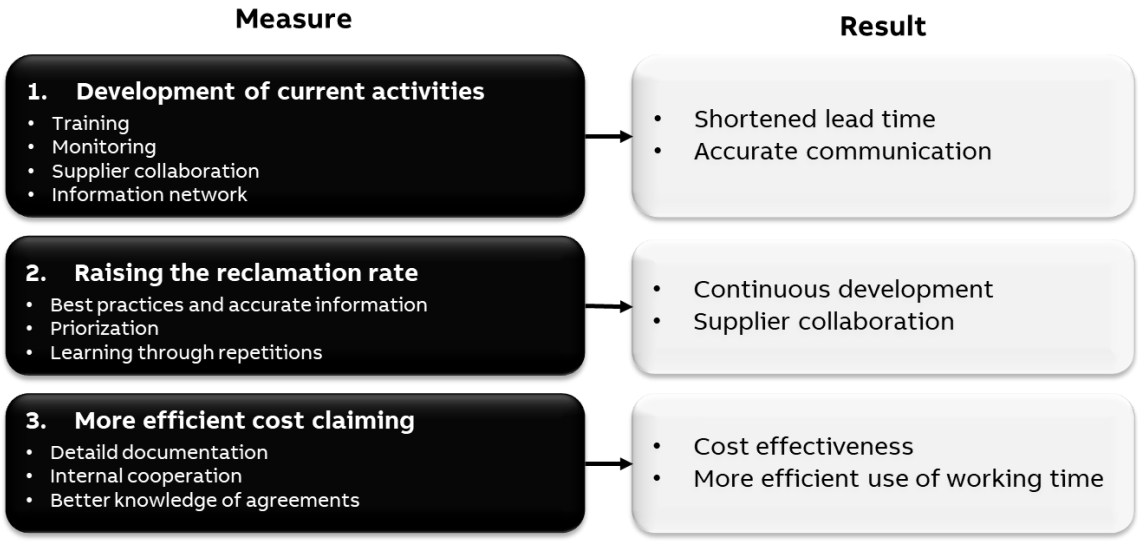


Figure 47. Development proposals

6.1.1 Development of current activities

Before attempting to increase the number of ERP-notifications, it is necessary to improve the functioning of the current complaint process. Rapid increase in the number of ERP notifications, without improving their quality, will not solve the problem but will only cause a new bottleneck. Development proposals for process development are presented in Figure 44.

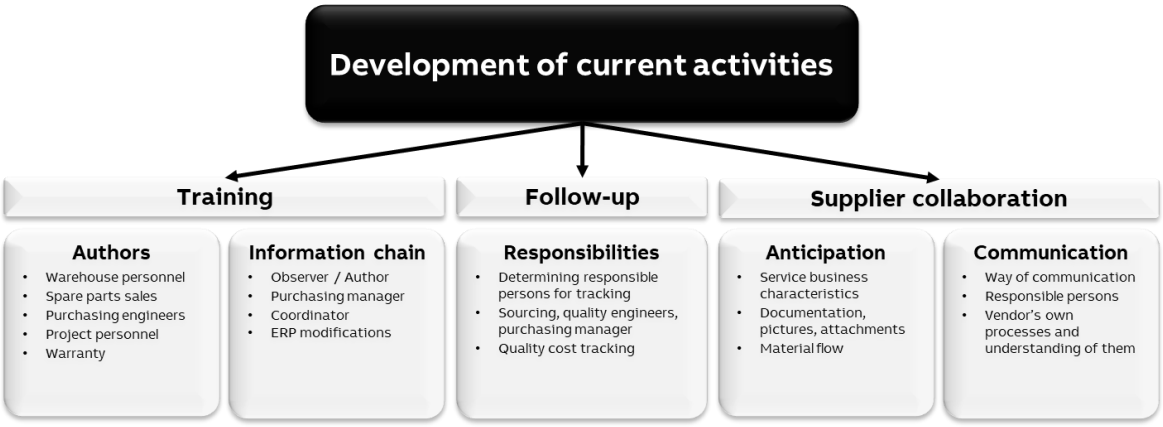


Figure 48. Complaint process improvement

During the study it turned out that training, related to the complaint process, is not systematically arranged. The ERP process is perceived to work well as long as repetitions have been made, but when used rarely, the process is experienced rather complicated.

Along with this study, comprehensive instructions for performing the ERP deviation process are created. However, interviews revealed that larger scale training should be arranged whereby step-by-step illustration from ERP notification creation process is not enough. The primary objective of the training should be to motivate the staff and present illustration of the whole process explaining why things are planned to be done in a certain way. A responsible team should be set up to plan and organize these trainings and managers should make sure that all team members know how the process works.

In addition, a proposal for new information chain is presented in order to address inadequately created notifications immediately and to prioritize created notifications within the limited resources. The development proposal concerns the introduction of the same approach that is currently used with the notifications created by warranty department: Purchasing manager will be assigned as coordinator for each vendor-related notification. The

aim of this approach is to improve the lead time by reducing the number of inadequately made notifications, targeting all notifications straight to the right person and enabling the prioritization of deviations. This change can be seen in the new notification instructions and its implementation could be the responsibility of the team leaders.

Also, the same method of operation, that is already in use for POs, was proposed to notifications as well: Email chains and their attachments can be forwarded straight from email to ERP, so they can be seen by everyone. In order to improve communication around the notification, it would be practical to be able to save the documents behind the notifications as well. The introduction of this proposal requires technical expertise of ERP usage and should be directed to an ERP-responsible person.

One development proposal would be to increase the follow-up of the created notifications. Due to the growing business, the working hours of the procurement engineers are very limited. Because the reclamations are not systematically followed by anyone, they will often be prioritized at the bottom of the worklist. In order to facilitate the seasonal workload of purchasing engineers, it would be desirable to nominate certain responsible persons to follow the reclamations. Based on the interviews, purchasing engineers are experiencing it logical that they are acting as coordinators of notifications by themselves. However, additional resources would be needed to improve the follow-up and reminding of the suppliers. This monitoring responsibility could be shared between sourcing managers, quality engineer and the purchasing manager. According to the study, the service business will continue to grow, so the creation of a new position should also be considered. If a person in charge of managing the whole process was found, it would certainly increase its performance. Meanwhile the responsibility could be carried out by new building quality engineer, procurement manager or ERP-responsible person.

According to the interviews, the frame agreements between supplier and ABB are the same, even there are certain differences between new building and service procurement. One suggestion for improvement is to start clearer communication of the features of Service to the supplier. The biggest problems are related to the remote locations of working sites and extremely tight schedules. Neither service business challenges have not been

communicated with the supplier in a sufficiently clear manner, nor predetermined operating methods created for problem situations. It would be rational to prepare for future problems together with the supplier and agree on measures in specific situations. Problems can be categorized and based on this it might be possible to agree on issues with major suppliers in advance. Major suppliers refer to ones with whom ABB has a valid framework agreement and periodical meetings are arranged.

It would be possible to identify certain materials that are challenging to inspect in the warehouse according to their category. The expertise of spare parts sales and project personnel could be used for this identification. In addition, it would make sense for the project staff representative to be involved in the seasonal meeting at least once a year in order to bring the challenges of the service business into concrete communication with suppliers. In the basis of the interviews, it turned out that bi-directional material flow is not cost effective for either party. In case of defect of wrong component, the communication should be done through photos or other documents, when the supplier should automatically bear the responsibility for the non-conformity.

An exchange of problem-related information with the supplier should also be agreed in advance. When it is automatically known, who should be contacted, how to communicate the problem and what documents are needed, the solution will be achieved much faster. These issues are related to supplier management, and their refinement would require collaboration between the service organization and sourcing.

6.1.2 Raising the reclamation rate

When the goals of the process are clear to the participating personnel and the creation and communication of notifications is clear, it is possible to start raising the notification rate. During the study, it turned out that many problems are solved in some other way than planned and are not documented as desired. In these cases, there is a high risk that the problem will not disappear but will recur in the future. Development suggestion for raising the reclamation rate are illustrated in the Figure 45.

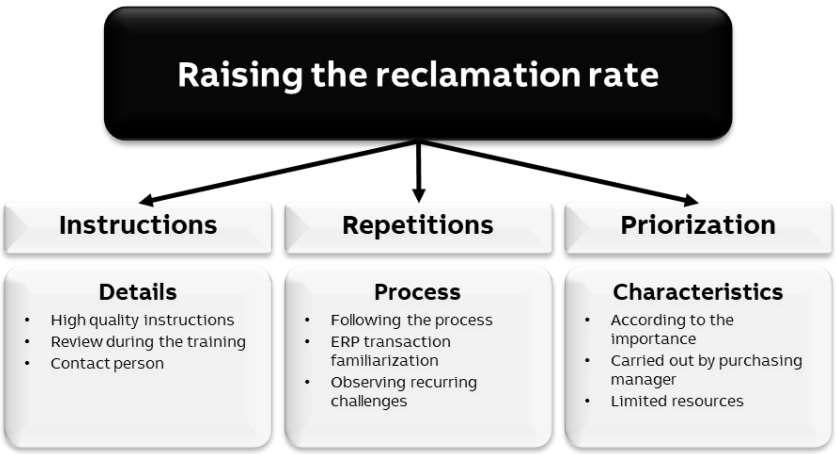


Figure 49. Raising the reclamation rate

Notifications should be made to improve the business and eliminate problems. If they are done wrongly or negligently, they will have exactly the opposite effect. Multiple employee time will be wasted, and no development takes place. For this reason, the instructions and responsibilities must be accurate. If there are any ambiguities regarding the instructions, it must also be clear who to contact. As a result of this thesis, new instructions that are more specifically targeted at the use of the service organization, have been created. It is intended that they will be available to each author and coordinator. In the future, the process should follow only these instructions, and thus would always be the same. Their introduction will remain the responsibility of the Procurement Manager

The ERP has its own difficulties, but through repetitions, the usage is perceived being clearer. Also, in case of creating and editing quality notifications, only repetitions make the process clearer. I would suggest that all vendor-related problems should be communicated through the ERP process. Even if it is not clear whether the problem is related to the supplier or not, the notification should be made and resolved with the supplier. Also, discretion should be applied when communicating with supplier, as there is a great difference in the way of communication. Either the supplier can be blamed for accusing serious problems to the end-customer or the supplier can be pointed out about the non-conformity and asked for solutions how to resolve it. Consequently, the intention is to achieve synergies in the form of business development.

With clearer instructions and training, the number of notifications will increase. However, resources to resolve them are limited, so they must be prioritized. The suggestion is that all the notifications go through the purchasing manager so that he can perform this prioritization. The most important problems could be solved more efficiently, and smaller challenges will be still documented.

6.1.3 More efficient cost-claiming

Most of the supply chain problems cause costs in some form. According to the study, there have been challenges when claiming the incurred costs from vendors. In certain cases, credits have been received, but they have been allocated to the wrong place. It has also been discovered that in some cases the costs are marked in the notification without any notice. It is understood that it is very difficult to estimate the total cost in advance in some cases, but the coordinator should always be informed when they are marked in the notification. After asking a credit note from the supplier, changing it is quite difficult and not a good practice. Proposals for more efficient cost-claiming are illustrated in Figure 46.

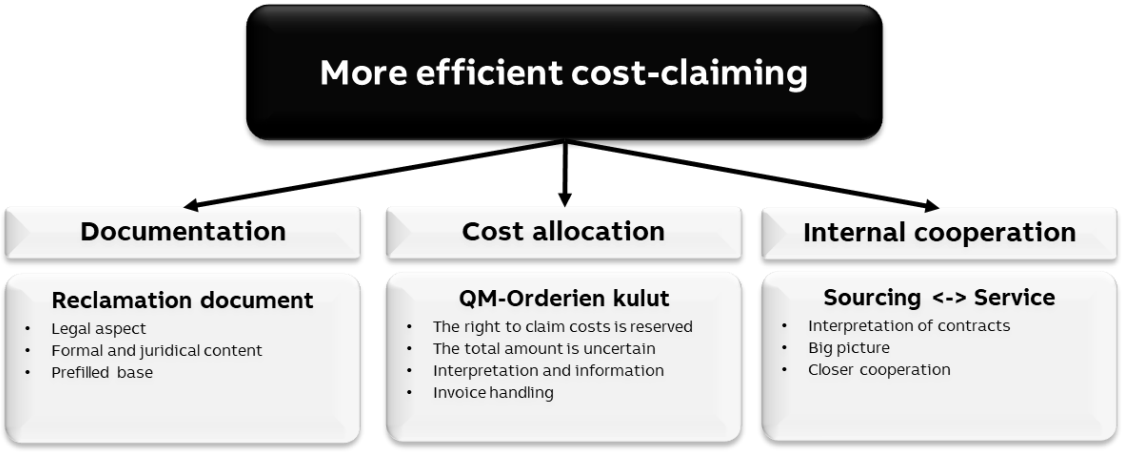


Figure 50. Cost-claiming

During the research it was found that the reclamation document was not meant to be sent to the supplier in the first place. The process was meant to be communicated via email and only attach relevant pictures to the email message. However, sending a pre-designed reclamation document has been considered a good practice: Only the document would require updating. For example, each PO contains an indication of the terms of the contract and the rights of ABB. The suggestion is that an automatic reference should be made to the com-

plaint document as well and document formatting could also be updated. The reference should mention all the necessary legal information and the fact that the company reserves the right to claim the incurred costs of the non-conformity. The pre-filled document base could reduce legal errors and speed up the process. However, the implementation requires ERP-knowledge, so this matter should be discussed with ERP-responsible person.

While it is sufficient for the procurement engineer to claim only the costs entitled by the agreement, the quality engineers are responsible for monitoring the total amount of quality costs. Currently, the cost monitoring is particularly challenging and requires lots of manual filtering and other inconvenient operations. Consequently, managing the total quality costs that are allocated to notifications is very difficult. The idea for development is to develop a user-friendly tool for cost tracking. This development requires a deeper knowledge of the ERP system, so it must be done in collaboration with specialist and quality personnel.

During the study it was also revealed that some of the credits are allocated under the PO instead of the notification. Transferring the costs out of the PO requires a considerable amount of work and is therefore not cost effective. The development proposal is more detailed instructions on the references of the credit note. The credit note must contain only the notification number, the QM-order number, and the name of the coordinator. If the PO number is also mentioned in the credit invoice, it is possible that the credits will be directed under it. Both, invoice handling and the procurement will be informed regarding the correct references.

In most cases, it is not possible to claim all the costs incurred from the supplier. The operation follows the agreement and usually in case on non-conformity ABB is entitled to claim a certain percentage of the total amount of the order. For example, in the case of delays, it is quite clear how much ABB is entitled to claim from the supplier. However, often the situation is not as clear. On the basis of the interviews, it became clear that procurement engineers would need help in interpreting contracts. During the research, it was noticed that a larger scale should be considered in all activities, especially when claiming the costs. In certain cases, seamless continuation of cooperation is more valuable than claiming for individual costs. A single unconsidered event can have extremely negative effect on supplier

agreements if it happens at the wrong time. One development proposal is to improve internal cooperation between Sourcing and Service. Before submitting a contract penalty, it would be a good to communicate with the categorical sourcing manager that the activity is necessary and check if some additional information is required.

6.2 Recommendations for further research

In this chapter, possible further research topics are discussed. Suggested recommendations are divided into three categories: External perspective, implementation and impact of practical development measures and review of theoretical proposals. The development proposals, that are mentioned in the previous chapter, are not yet deployable, but their implementation requires further research and preparation.

6.2.1 External perspective

It would have been interesting to have an external perspective on development of the internal process of ABB. Consequently, all the challenges are solved with the supplier, so why process development would not be carried out in collaboration. At least a discussion of the complaint process of propulsion service should be held with the major suppliers. In the development of the process, it should also be noted that the quality organizations of the suppliers differ significantly. For this reason, the solution developed with one supplier is not necessarily working as such for another.

6.2.2 Implementation and impact of practical development measure

The implementation of any development proposal requires some further research. Primarily, a responsible person should always be assigned as manager of the respective area in order to put the idea into practice.

In order to assess the performance of any process, it must also be measurable. Therefore, performance indicators need to be developed and measurements taken regularly. Immediately after the training and the implemented changes, performance monitoring should be started. The simplest KPIs for complaint process can be the number of created notifications, the number of responses from the suppliers, the number of successful reclamations

and average lead time for the notification. By tracking individual indicators, the emergence of potential bottlenecks can be noticed and removed more efficiently. Organizing the tracking of reclamations and performance indicator creation requires further research. I would consider that, after training measures, follow-up and performance measuring is the most important subject of further research.

6.2.3 Review of theoretical proposals

Some of the development suggestions were presented only theoretically, as bringing them into practice requires considerable external expertise. The most significant theoretical suggestions relate to changes in ERP. When a procurement engineer feels that some ERP function is difficult, it is not known how the matter should be communicated further. Also, it is not known whether the change requires extensive amount of work or whether the remedy could be a very simple procedure for a specialist.

The development suggestions that were related to ERP software usage were: A tool for more practical monitoring of quality costs and a way for forwarding documents straight from email to ERP-notifications. This latter proposal has already been implemented with POs, so the function might be possible for notifications as well. Further research is required to put these development proposals into practice as ERP development requires additional expertise. However, a first further research topic would be to provide information channels for ERP development proposals. Currently, it is not even known how to start communicating them.

6.3 Other conclusions

The ultimate goal of a business is to create value for its owners. ABB Marine & Ports creates value by developing superior, high-quality solutions for maritime industry. Propulsion service department creates value by extending the life cycle of existing Azipod®-units by providing spare parts, servicing them, and upgrading them to be even better through various modernizations.

The purpose of successful complaint management of the company is to maintain customer satisfaction through continuous improvement in complex supply chains of maritime indus-

try. To maintain high quality of operations, detected problems must be addressed, communicated and solved in collaboration with the supplier. The successful complaint management also aims to prevent same problems happening again in the future. In addition, to upkeep cost efficiency and competitiveness, the costs that are incurred from external problems, can be more effectively covered through a pre-planned complaint process.

The process development begins with the identification of all parties so that existing challenges will be revealed from as many different perspectives as possible. In addition, problem identification is simplified when the process is split into smaller subprocesses. After identifying the existing parties and problems, process development can begin to be planned. The process must be seen as a whole, as the development of only one function may can cause new bottlenecks.

The development proposals should be carefully reviewed with all parties involved and their implementation should be agreed together. At the same time the performance indicators and responsibilities for process monitoring must be decided, because continuous development of the process is only possible through repeated monitoring.

During this study, a number of challenges were encountered in maritime service business in general. Identifying these challenges helped to understand the operation of the notification process and different areas of it. The process does not work as it was designed and a variety of causes have been found for the low performance. The research revealed that most of the challenges are due to the lack of time, unclear communication and/or lack of training or employee engagement. Through careful training, better commitment, accurate requirements and better communication, the process will certainly evolve.

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APPENDIX 1. LIST OF INTERVIEWS

18.2.2019	Quality Engineer
3.4.2019	Spare Parts Manager
9.4.2019	Controller
10.4.2019	Warranty Manager
11.4.2019	Warehouse Foreman
15.4.2019	Purchasing Engineer
15.4.2019	Purchasing Engineer
16.4.2019	Project Manager
23.4.2019	Purchasing Engineer
23.4.2019	Purchasing Engineer
3.5.2019	Sourcing Manager
7.5.2019	Quality Engineer