YRKESHÖGSKOLAN
NOVIA

Study of How Spare Part Kit Information is Kept Up to Date Within Wärtsilä Technical Information

Wärtsilä Marine Solutions – Technical Information

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Degree Thesis for Bachelor of Engineering

Degree Programme in Industrial Management and Engineering

Vasa 2020

EXAMENSARBETE

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Titel: Kartläggning över hur informationen för reservdelsstrukturer hålls uppdaterade inom Wärtsilä Technical Information

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Datum 22.3.2021 Sidantal 43 Bilagor

Abstrakt

Denna avhandling gjordes för Wärtsilä Finland Marine Business, speciellt för Technical Information avdelningen, med huvudsyftet att kartlägga hur information för reservdelsstrukturer skapas samt hanteras i Wärtsiläs produktlivscykelshanterings (PLM) system

Wärtsilä ville veta om möjliga problemområden, med tanke på att W31 motorns strategi utvecklas från att sälja enskilda reservdelar till att sälja mera helheter. För dessa helheter krävs att produktstrukturer skapas samt underhålls i Wärtsiläs PLM system.

Metoderna i denna avhandling har varit insamling av dokumentationsdata från livcykelhanteringsapplikationer, intervjun med dokumentationsingenjörer samt möten med gruppchefer. Resultaten från dessa analyserades, samt förbättringsförslag presenterades enligt dessa.

Utvecklingsområden som hittades inkluderar förstärkning av extern kommunikation samt förbättring av revisionshantering och dataöverföring. Dessutom gjordes en RACI (ansvarsfördelning matris) över produktion samt uppdatering av reservdelsstrukturer (kit), eftersom uppgiftens ansvarsområden var oklara.

Språk: Engelska Nyckelord: Teknisk information, Produktlivscykelhantering, Reservdelar, Ansvarsfördelning matris

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Nimike: Tutkimus miten varaosapakkauksien tietoja pidetään ajan tasalla Wärtsilä Technical Information osaston sisällä.

Päivämäärä 22.3.2021 Sivumäärä 43 Liitteet

Tiivistelmä

Tämä opinnäytetyö tehtiin Wärtsilä Finland Marine Business yritykselle, erityisesti Technical Information osastolle, sen päätarkoituksena selvittää miten varaosapakkauksia koskevia tietoja luodaan ja ylläpidetään Wärtsilän tuotteiden elinkaaren hallintajärjestelmissä (PLM)

Wärtsilä halusi tietää ongelma-alueista huomioiden, että W31 moottorin varaosavalikoima on valittu, tavoitteena lisätä varaosapakkauksien käyttöä ja vähentää käytettävissä olevien osien käyttöä. Nämä muutokset edellyttävät, että varaosien tuoterakenteet ylläpidetään Wärtsilän PLM järjestelmissä.

Tämän opinnäytetyön käytetyt menetelmät, olivat dokumentaatiotietojen kerääminen elinkaaren hallintasovelluksista, dokumentaatioinsinöörien haastattelu, sekä tiimijohtajien kuuleminen. Näiden tulokset analysoitiin ja niiden mukaisesti esitettiin kehitysratkaisumenetelmät.

Löydetyt kehitysalueet olivat ulkoisen viestinnän vahvistaminen sekä versiokäsittelyn ja tiedonsiirron parantaminen. Lisäksi RACI-taulukko (vastuunmääritysmatriisi) perustettiin varaosapakkauksien päivitystä ja tuotantoa varten, sillä tehtävän vastuualueet eivät olleet työntekijöiden yleisessä tiedossa.

Kieli: Englanti Avainsanat: Tekninen informaatio, Tuotteen elinkaaren hallinta, Varaosat, Vastuunmääritysmatriisi

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BACHELOR'S THESIS

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Title: Study of How Spare Part Kit Information is Kept Up to Date Within Wärtsilä Technical Information

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Date 22.3.2021 Number of pages 43 Appendices

Abstract

This thesis was conducted for Wärtsilä Finland Marine Business specifically for the Technical Information department, with the main purpose to find out how information for spare part kits is created and maintained in Wärtsilä's Product Lifecycle Management (PLM) systems.

Wärtsilä wanted to know if there were problem areas considering, the assortment of spare parts for W31 has been chosen with the aim to increase the use of kits & sets and to decrease to use of available parts, this change requires that engineering Bill of Materials (BOMs) are maintained in Wärtsiläs PLM systems.

The methods used in this thesis were collecting documentation data from lifecycle management applications, as well as interviewing documentation engineers and consulting team leaders. The results were analyzed, and a development solution was presented according to these.

The development areas found were within strengthening external communications as well as improving revision handling and data transfer. Also, a RACI (responsibility assignment matrix) was established for the spare part kit update and production, since the responsibilities within the task were uncertain.

Language: English Key words: Technical Information, Product Lifecycle Management, Spare Parts, Responsibility Assignment Matrix

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1 INTRODUCTION

This chapter will briefly present an overview of this thesis, including its background, problem area, and purpose. The dispositions of this bachelor's thesis will be presented to get an understanding of how this thesis is structured, as well as some central terminology that is used throughout this complete work.

1.1 Background

This bachelor's thesis was conducted for Wärtsilä Finland, Marine solutions, specifically for the Technical Information department. The task was to research and find out how information is created for sealing kits and spare part (SP) kits in general, as well as how these are kept up to date, within Content Management at Technical Information Finland. The task was also to find development solutions for these subjects that could emend spare part documentation for Wärtsilä engines. This task was presented and given to me in the autumn of 2020 by my supervisor at Wärtsilä, Tommy Wester. I want to thank him for this great opportunity, enabling me to do research for this market-leading company in the maritime industry.

Having up to date information within Wärtsilä is one of the most important parts of any service business. This corresponds to ensure that the documents are always relevant, topical, and valid. Poor technical documentation within organizations leads to increased support costs. When technical documentation fails to fulfill its purpose of passing on technical information, the responsibility of sharing that information is transferred somewhere else. In turn, this leads to increased cost throughout the entire supply chain, as alternative support must be provided to manage this problem. (Marlow, 2005, p. 5).

1.2 Problem Area

Technical Information within Marine Solutions is mainly responsible for all spare part documentation for Wärtsilä engines, and that these are updated correctly, with the right information when changes or revisions are presented. The assortment of spare parts specifically for W31 has been chosen with the aim to increase the use of modules, kits & sets, and exchange spare parts, and to decrease the number of available parts. The goal is to increase the amount of field service, as well as reduce the amount of small spare parts to be

handled and maintained by Wärtsilä. This makes the ordering process for the customer much easier, by not having different spare part numbers for every ordered component.

Technical Information has a big role, in that this documentation process works correctly. It is though unclear how information for spare part kits, and changes & revisions are presented to TI, but since SP kits have been around for a long time, there is a certain routine on how these are established. It is very common that information for SP kits is shared through emails and private conversations, which leaves others not getting their hands on this important data. This yields problems for future updates since the information is not documented. This is also briefly mentioned in Chapter 3.2.2 “Challenges with Product Lifecycle Management,” p12. For older engine types, the use of completely new kits is rarely needed. These are usually handled by implementing changes to existing spare part kits. With the new W31 engine where many new spare part kits were needed, it was well noticed, that there is not a clear process or division of responsibilities within these subjects.

1.3 Purpose

Due to the fact that spare part kits and sets for the W31 engine, are aimed to increase in the near future, the documentation for SP kits must be up-to-date and superb, for the documentation process and maintenance to work fluently. That is why the purpose of this thesis is to figure out how information is created for spare part kits and work out how these will be kept up to date within Technical Information, in the future. This will be done firstly, by collecting documentation data from lifecycle management applications, and secondly by interviewing documentation engineers and team leaders. Since spare part kits and their documentation process has been restricted and unclear for several stakeholders, the purpose is also to get a better understanding of the documentation process for SP kits in general, as well as figure out, who the subject expertise organizations are, who decide what different spare part kits and sets contain. Since the responsibilities and roles have been unclear for several stakeholders, the purpose is also to create a RACI matrix, which is a responsibility assignment chart showing project roles and responsibilities within different tasks, that can be implemented on the Technical information process site on Compass.

1.4 Delimitations

Technical Information (TI) department is handling majority of the spare part documentation for Wärtsilä engines. The documentation process varies a bit depending on the engine. For

instance, spare part documentation for the W31 is made in 3D which includes using 3D CAD programs, while other engines are documented in 2D. These pictures are primarily made using Adobe Illustrator.

While the same issue of uncertainty of information can be found in numerous spare part documentation components for different engine types, for this thesis not to be too extensive, it will be mainly focused on the sealing kits, and kits in general for the W31 engine, although when collecting data from lifecycle management applications, the scope must be broader to understand the bigger picture.

1.5 Disposition

The first chapter introduces the background, problem area, and purpose of the thesis. Delimitations & abbreviations will be presented.

The second chapter contains information about Wärtsilä and more specific information about Technical Information and its internal segments.

The third chapter will explain basic theory behind the bachelor's thesis, as reference to the research. This relevant information that is brought up, should help the reader get a fundamental knowledge of the subject, that I have used as a base for my study, as well as the results to rely on.

The fourth chapter will present the methods that were used, to gather information and data about the subject, as well as the creation process for document management at Technical Information. This should give the reader a comprehensive understanding about the topic, and the way of working at Technical Information.

The fifth chapter contains the results of this bachelor's thesis, also development solutions for the subject are discussed.

The sixth chapter will conclude this thesis with a summary, as well as further research and how it could be achieved.

1.6 Terms and abbreviations

TI - Technical Information

CM – Content Management

SPN - Spare part number

SPS – Spart Part Structure

SPC – Spare Part Catalogue

PLM - Product Lifecycle Management

DMS – Document Management System

DC – Delivery Center

ECO – Engineering Change Order

CR – Code Resolution

BoM – Bill of Material

SP – Spare Part

CAD – Computer Aided Design

RACI – Responsibility Assignment Matrix

2 WÄRTSILÄ

Wärtsilä is a global company founded in 1834 that first started as a sawmill in Karelia. (Wärtsilä Corporation, 2020) Today Wärtsilä is a global leader in smart technologies and complete life cycle solutions in both energy and marine industries. Wärtsilä operates in more than 80 different countries and employs over 19 000 people.

The increasing demand for clean and flexible energy is affecting the way that customers drive their businesses. This forms the basis for Wärtsiläs purpose, which is to enable sustainable societies with smart technology (Wärtsilä Corporation, 2020) Wärtsiläs purpose and strategy is represented below. (Figure 1)

Wärtsilä aims at a zero emissions society by choosing environmentally friendly technologies and low emissions fuels. This starts with identifying the conditions of the marine or energy installation, then planning on how to optimize the performance by improving efficiency and reducing emissions. (Wärtsilä Corporation, 2020)

Wärtsiläs annual revenue in 2020 was 4604 million euros, which was a 11% decrease from 2019. The covid-19 pandemic and its long-term economic implications effected Wärtsiläs operations and monetary performance. Vessel contracting declined to record low levels, new power plant investments were postponed, and all service operations were affected by the decrease in installations. (Wärtsilä , 2020, p. 9)

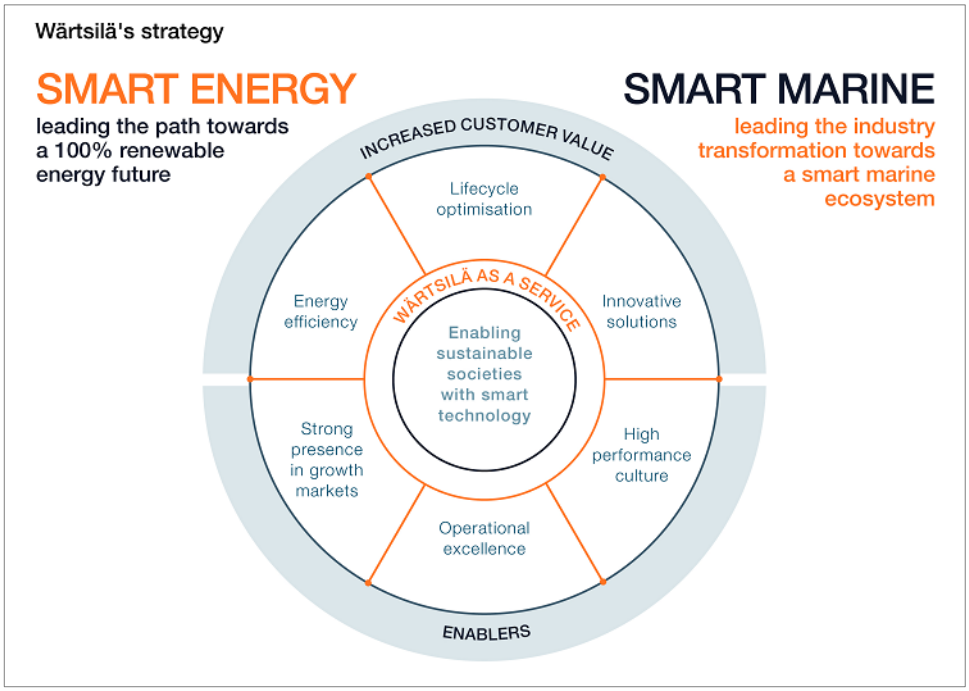


Figure 1. Wärtsilä purpose and strategy (Wärtsilä , 2020, p. 18)

2.1 Wärtsilä Energy Solutions

Wärtsilä Energy Business is a market leader in energy transition. By offering life cycle solutions that maintain and optimize power plant performance, they can ensure operational efficiency as well as safe operations. They also offer energy solutions for data center customers, according to their requirements. Wärtsilä energy business portfolio consists of 74 gigawatts of power plant capacity in 180 countries all around the world. (Wärtsilä Corporation, 2020)

2.2 Wärtsilä Marine Solutions

Wärtsilä Marine Business is a market leader in all major marine and offshore oil & gas systems. Wärtsilä delivers reliability, efficiency, flexibility, and sustainability to strengthen the business of its customers. (Wärtsilä Corporation, 2020) Their portfolio consists of reliable well-performing products in the maritime industry. This includes engines, propulsion systems, hybrid technology, and powertrain systems. Wärtsilä also offers a wide field of services ranging from spare parts delivery to field service businesses, as well as optimizing their customers operations. (Wärtsilä Corporation, 2018)

2.3 Technical Information

Technical Information (TI) is a subdivision within Marine Solutions whose main tasks is to ensure that information for operations, maintenance, overhaul, and repair of the installed Wärtsilä solution are accurate and easy to use for their customers, as well as Wärtsilä employees. TI: s target is to be a market shaper by applying new delivery solutions to their customers and setting standards for processes and systems that are related to Technical Information. Technical Information's vision is:

"*Efficiently create, provide and maintain excellent technical information products and services in an easily readable and understanding way that help our customers to optimize efficiency and performance throughout the lifetime of their installations.*"

The term TI can be used for both the function and the organization. Technical information as a function is any information with a purpose to explain how to maintain, operate, overhaul, and repair the Wärtsilä solutions and its equipment. Examples of technical information are spare part catalogues, as well as operation and maintenance manuals.

Technical Information main deliverables

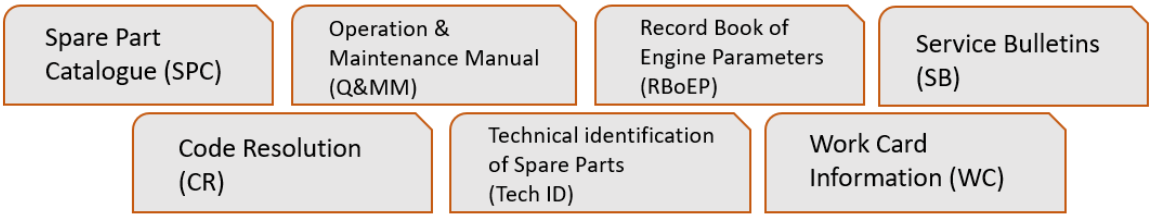


Figure 2. Technical Information deliverables

Technical Information production, distribution, and support consist of 120 employees in different delivery centers located in Finland, Norway, Netherlands, and Italy. This is also represented in Figure 3. Finland consists of Delivery Center 1 (DC 1) operating in Vaasa and Turku. This department consist of the following divisions:

2.3.1 Content Management

Content Management is divided into different teams. The number of teams can vary between various delivery centers. CM's main tasks are to produce spare part lists, illustrations, and related spare part data based on production modules and parts. Serial number specific spare part catalogs are created from these. During the creation process of making spare part lists, individual material numbers are assigned to spare part numbers (SPN). This is the base of the code resolutions (CR) data. Content Management works together closely with all teams within Technical Information.

Change Management is also part of Content Management. They are responsible for the content of the operation and maintenance manuals (O&MM). Change management receives and monitors all change requests, which are linked to the manuals.

2.3.2 Content Distribution

Content Distribution oversees managing orders and requests for documentation, distributing, and publishing of the content as well as making the technical information available to Wärtsiläs stakeholders and customers. Content Distribution teams' main tasks are order management, publishing, as well as translation administration.

2.3.3 Parts Data Lifecycle Management

The Parts Data Lifecycle Management (PDLM) team is maintaining the code resolution database. Their main activities are improving quality for supported products, as well as maintaining code resolution data. The technical identification team is also supporting spare parts sales, regarding the spare part data.

2.3.4 Service Bulletins

The Service Bulletins team is responsible for creating service bulletins together with the responsible product teams in Technical Services and Product Management. Their main activity areas are creating bulletins and maintaining specific product information, planning, as well as producing illustrations for the needed bulletins.

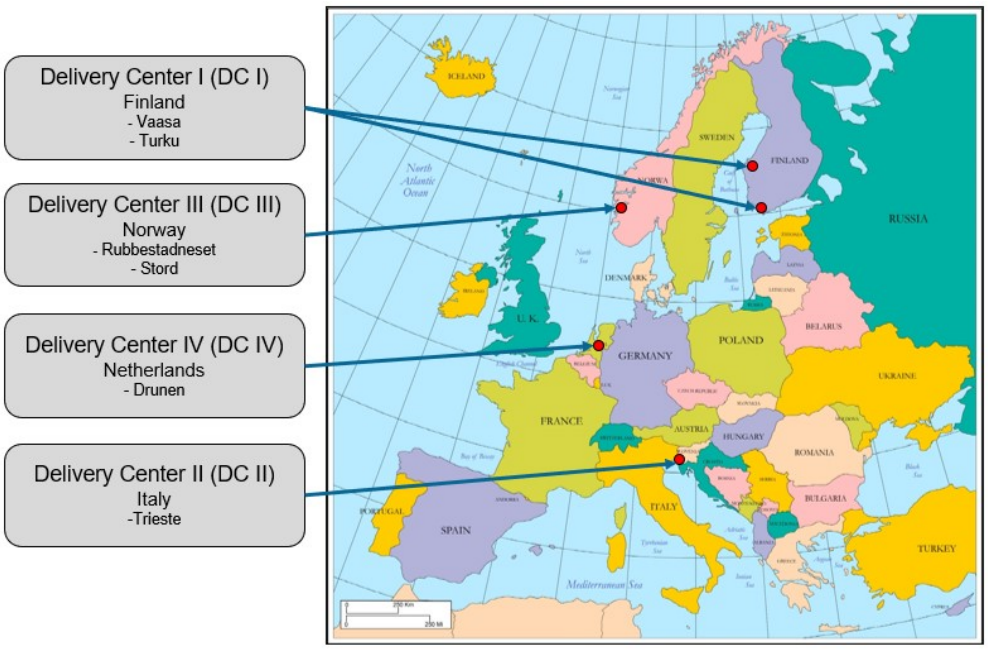


Figure 3. Technical Information delivery centers located on the map (Wärtsilä Compass, 2020)

3 THEORY

This chapter will present the theory of this bachelor's thesis. The purpose is to get a better understanding of how the problem can be solved by focusing on the theoretical framework. This chapter will help explain product lifecycle management and what values and benefits it brings in today's business environment. How document management and different DMS's are used to maintain crucial information within organizations and furthermore the importance of having up-to-date information. This helps me, and the reader understand why outdated information can be so brutal, what consequences might occur. This chapter will help me draw connections to my findings, which are based on existing knowledge, observations, and ideas. Chapter 3.3 Responsibility Assignment Matrix will moreover be used as reference and a guide for my own RACI matrix, that will be presented in Chapter 5.

Product lifecycle management is discussed very thoroughly in this chapter. This is because it functions as a foundation for maintaining up to date information in today's service business environment. It is a crucial factor and a tool for businesses to keep track of their documents, change orders and requests, that are also the main discussed subject in this thesis. This will also give me knowledge of what PLM software can do in certain situations, as well as how it can be used to develop Wärtsiläs day-to-day activities. The challenges of PLM will give me a heads up of what problems should be acknowledged and taken into account, while considering development solutions.

3.1 Product Lifecycle Management

As stated, this chapter will introduce product lifecycle management and give the reader a fundamental knowledge of the subject. This should help the reader understand the operational benefits and values that a PLM software can bring to any organization, and how these can be used to develop the business. Since one of the methods used in this thesis, included analyzing data from PLM systems, the reader can come back to this chapter for further answers, if any questions occur in the later chapters, regarding the functionality of these engineering systems.

3.1.1 What is PLM?

Product Lifecycle Management or PLM is the process of managing a products data for its entire lifecycle from initial inception, engineering, manufacturing, sales, and services of the product. PLM has a long history in the manufacturing space, although today it is generally referred to a software solution that is used by almost all major organizations. (Propel, n.d.) To understand what PLM software is today, and why there is clearly a growing need of PLM, we firstly need to look at its background.

The first applications of PLM were used back in 1985 by American Motors Corporation, who wanted to enhance the product development process for the Jeep Grand Cherokee. They quickly noticed that accuracy and consistency was increased by storing drawings and documents in their organizations database. This improved the engineering change process because engineers could easily correct their documentation. (Rudeck, 2014). In today's manufacturing space every major organization uses PLM software to keep track of their products. To keep track of e.g., computer aided design (CAD) files, PLM software allows to standardize items, control documents, maintain BOM's and revision levels, and to see relationships between different parts and assemblies. PLM software allows engineers to quickly access these files for different revisions. PLM systems also reduces the risk of using wrong design versions and increasing the use of already existing product information. (Saaksvuori & Immonen, 2010).

Companies can operate engineering change orders and handle support calls more easily and quickly due to efficiency improvements in the operations. Thanks to PLM software, people across the business can work faster with information retrieval, and reusing data etc. This also helps with better traceability and information security, within important information and their departments. (Stark, 2011)

PLM can be seen, as an asset from many different angles, however the benefits of operational PLM go far beyond savings in the organization, giving revenue growth not only by implementing new software but also by making changes and getting control over the lifecycle of the products. (Saaksvuori & Immonen, 2010) The return on investment for PLM software is based on a wider value for the business. Being able to streamline business processes that help deliver innovative and new products, will also increase the organizations market share and profitability.

The capacity of product information being stored and shared with PLM software has expanded. PLM is a business tool developed to manage products and their entire lifecycle, including not only items and BOM's, but also test specifications, quality standards, engineering requirements, change orders, component suppliers as well as different analysis of technical information and results (Figure 4). (Saaksvuori & Immonen, 2010).

Many companies have reported payout periods of one or two years, or even less, which is usually based on reduced development costs within the company. Companies can increase revenue streams by increasing their product development. Having control over the products whole lifecycle gives new opportunities to make sure product margins are excellent and remove poorly performing products from their portfolio. These mentioned benefits make the return on investment extremely compelling. Product lifecycle management can be seen, as an essential solution for both software, manufacturing, as well as service businesses. (Saaksvuori & Immonen, 2010).

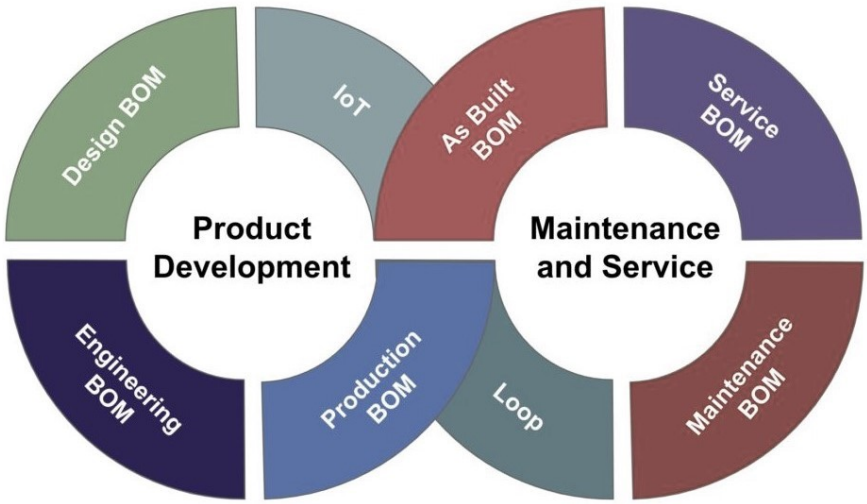


Figure 4. PLM can be used through the whole lifecycle of the product, from product development of designing BOMs to maintenance and service of individual parts and components (Beyond PLM, 2019)

Big companies handle a considerable amount of product information. Manufacturers with customer related products across a large product range, can distinctly not operate without managing their data efficiently. Software and service companies produce complex products with many levels of different structures and different configurations. Within these businesses it is certainly important to master the definition of each component, to be able to design the product further, as well as handle the product and its whole lifecycle more accurately. (Saaksvuori & Immonen, 2010, p. 5).

3.1.2 Challenges of PLM

Product lifecycle management (PLM) is one of the most crucial breakthroughs in manufacturing history, it can help your organization plan smarter, organize better, and improve the communication with all stakeholders. Although, the task of integrating a PLM system to your business is a long and challenging process. (Frontech Solutions Inc, 2020) Even though PLM can be seen with several benefits, there are some challenges that need to be considered, these are:

1. The process of integrating a PLM system to your organization will not go without problems, there is a long adjustment time that will make the organization think twice, if it was a good decision. PLM software usually show its positive output in the long term. (Frontech Solutions Inc, 2020)

2. The concept and the terms for product lifecycle management is not defined within the company. This means that the PLM software used, and its information connected to certain terms are not clear enough. E.g., “What is product lifecycle and what are the different phases?”. (Saaksvuori & Immonen, 2010, p. 9).

3. The consistency of information produced within different departments cannot be guaranteed. This problem occurs when information or product data is produced and stored in either paper documents or different data types. One problem can be for instance, clarifying the location of the latest revision for a document. (Saaksvuori & Immonen, 2010, p. 9) Coworkers start to update documents and store them on their own workstations or computers, this results in that nobody knows for sure, whether the latest revision is up to date.

4. A PLM system should be enough to solve the problem of siloed information. For that to happen, the PLM software must be connected with other key systems, for instance ERP solutions. ERP systems should send out information to PLM software, at the same time, PLM should act as a storage place for everything that is related to the development process for the product. (Frontech Solutions Inc, 2020)

The challenges mentioned above for product lifecycle management can be solved using information processing systems that are supported by product lifecycle management. Information processing systems have advanced rapidly in the last few years, although it has not been possible to remove all these problems, PLM software is nowadays more integrated than ever before. (Saaksvuori & Immonen, 2010, pp. 10-11)

3.1.3 Business Value and Benefits Through PLM

Organizations can integrate several different information systems in production use, like CAD systems, ERP systems, and sales systems. The information system environment sets high demand that the integration of all systems, are done the right way, and the transfer of information between all these runs smoothly. PLM systems are extremely suitable for developing internal communication within the company as well as communication with other external suppliers in the same network. The improvement of communication between these departments and companies, is let alone the most important business value driving factor of product lifecycle management. (Saaksvuori & Immonen, 2010).

PLM can be used to improve communication, transfer of files between departments and companies, as well as conversions between file formats, this is important when organizations use different types of software for managing data. Improved communication brings many indirect advantages. The speed and quality of the processes can be developed when mistakes are caused by bad communication and wrong information. The PLM system also reduces non-important information that is processed. Work that has already been done once, can be utilized better in the future. (Saaksvuori & Immonen, 2010) The following list shows some ways to get more business value through PLM software.

1. Organizations usually start the PLM implementation with high expectations and different plans. It is very common to get through the first implementation, and then stop. There is much more, than just the first implementation. Most business value is concentrated through additional projects through the lifecycle of the system. (Frontech Solutions Inc., 2020).

2. Having better insights within the company's different departments equals more business value. The main characteristics of PLM is that it can track real-time data. This information is available to all people within different segments. Once there are insights into different departments, and all the changes they make, it is so much easier to pinpoint the important areas. (Frontech Solutions Inc., 2020) This way information is also easier kept up to date.

3. Increased business value, by being able to adapt to the quick changes that digitalization brings to the markets. Businesses who have implemented a PLM system, does not have to deal with the negative consequence of digitalization. PLM can identify other aspects beyond engineering that it can benefit from. It can even

support the internet of things (IoT) (Frontech Solutions Inc., 2020), which refers to a system of internet connected objects that can collect and transfer data via wireless networks.

4. Driving business value by simply increasing productivity within the companies' departments. PLM is an incredible tool for remarkably increasing the organizations productivity (Frontech Solutions Inc., 2020), although it is not the only solution for operating a successful company.

PLM provides benefits throughout the whole lifecycle of the product. Some examples of this are getting products to market much faster in the beginning of the lifecycle, providing better support in the middle of the lifecycle, as well as managing their end-lifecycle greater. (Stark, 2011) PLM focuses on the organization's products, and the benefits are usually described in four main areas. This is shown in Table 1.

Different companies have different purposes and goals with implementing PLM to their daily operations. Common targets for PLM software within businesses, are to increase product revenues by at least 30% and to decrease product maintenance cost by 50%. (Stark, 2011) This can be achieved within a couple years from implementing the PLM software to the business.

Table 1. Benefits of operational PLM.

Area of Benefit	*Example of Benefit*
Financial Performance	increasing revenue by earlier market introduction, reducing product development cost.
Time Reduction	reducing project overrun time, decreasing engineering change time.
Quality Improvements	reducing manufacturing process defects, decreasing the number of returns, and reducing the customer complaints.
Business Improvements	increasing the innovation rate, growing product traceability, and ensuring 100% configuration

(Stark, 2011, p. 12)

It is very difficult, but not impossible to convert the benefits of operational PLM directly into euros. The advantages can be described in two different areas: Savings accomplished in operations, as well as bigger earnings possibilities in the future. The savings is demonstrated in the decrease in expenses and business assets, whereas the new earnings possibilities in the future, matters more on the organization's future strategy. (Saaksvuori & Immonen, 2010) The advantaged mentioned above are not only due to the PLM system. The changes usually result from a successful change in their companies' processes. However, a PLM software is an excellent tool for making this happen, as well as ensuring that product information is up to date.

A study that was made in 1994 by Coopers & Lybrand shows that a small part of the working time of an engineer is spent on planning and designing product structures and items. This is shown in (Figure 5). Approximately 30% of the engineers' time is spent on distributing, retrieving, and maintaining information. 20% of their time is spent on making revisions, and redoing things that already has been done once. 14% is spent on actual meetings, where the main purpose is to provide information to others who are working on the same subject. (Saaksvuori & Immonen, 2010) This shows that the time engineers use in their typical working day, is almost every time somehow connected to a PLM software.

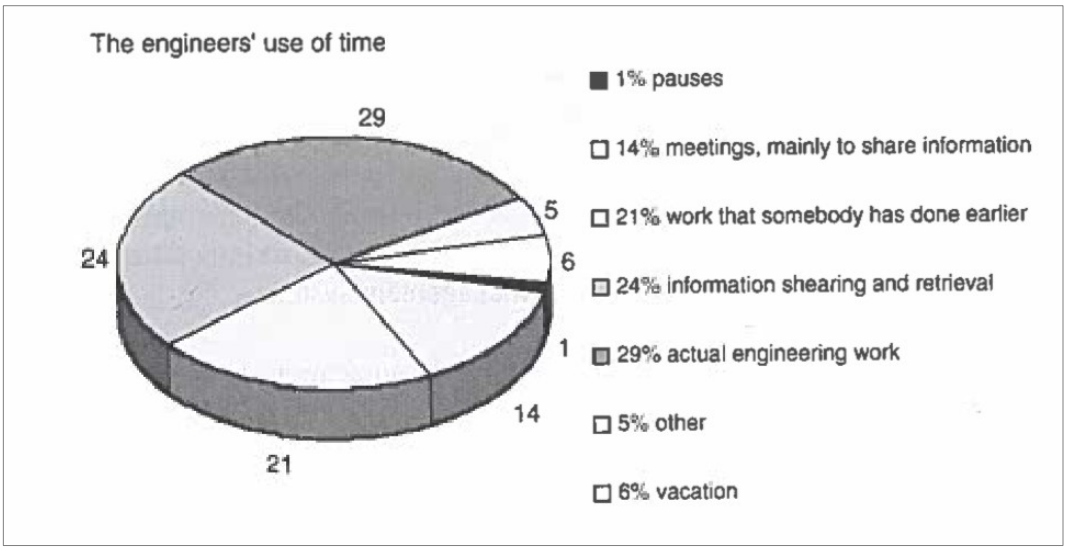


Figure 5. The engineers use of time (Saaksvuori & Immonen, 2010, p. 94)

3.2 Document Management

Document management is one of the most important technologies for content management. Document management, often called Document Management Systems (DMS) is the use of computer systems to store and manage electronic documents for an organization. (Aiim, n.d.) According to (Sutton, 1996, p. 6) a document is: "Legally sanctioned record of a business transaction, or decision that can be viewed as a single, organized unit" This chapter will introduce document management within organizations and furthermore study, why up-to-date documentation is so important.

3.2.1 Documentation in General

To this day a lot of paper documents are still produced, but during the last decenniums, the quantity of electronic documents has incremented substantially. At the same time, the need of organizing this data has become more important. Nowadays it is very easy to share documents and information, this leads to that non-essential data has also increased. The biggest dilemma seems to be finding the relevant, up-to-date information from this non-essential data. (Anttila, 2001, p. 1)

To understand the concept of document management and documentation in general, it is important to understand what document, and what management means in this substance. A document is usually referred to a drawn, written, or recorded representation of someone's thoughts. Documents represent packages of data within the company. These can be for instance e-mail messages, studies, descriptions and so on. A document does not have to be a paper version of data, it can be a digital representation of data, that is incorporated for the employer's use. This can be for example, a purchase order, change request or even a check. (Sutton, 1996, pp. 6-7) The main objective for documentation within an organization is communication of information and sharing important knowledge. These objectives mean using documentation as a communication tool. Documentation can also represent evidence, that something has been done. An example of this is technical specifications, which are generally used within organizations for development or designing. (Valkonen, 2015, p. 12).

Defining management when it applies to documentation, is described by (Sutton, 1996, p. 7) A frequently acquired definition is: "Management is the design and maintenance of an environment in which recourses, organized in groups can attain common objectives through efficient and effective performance."

Combining these two and defining “Document Management” can be done as following. Traditional document management in organizations was achieved through business programs for records management, forms management, reports management, directives and manuals management, and archives management. These long-established programs have been buried within the last half-century. This is due to big volumes of transactions and the difficulty of saving electronic documents and records. Document management can be defined as the process of overseeing the organizations business transactions, records, and temporary important documents, which are displayed in a format of a document, regarding if it is an electronic or paper version. (Sutton, 1996, pp. 6-9)

3.2.2 Definition of Document Management System

A document management system (DMS) is used to manage and store electronic documents and reduce paper in modern, up-to-date business operations. DMS is not simply a tool for organizations to manage their documents, but an electronic cabinet that can be used to organize all paper and electronic documents, that the organization handles in their daily operations.

The most straightforward level of DMS is a folder type structure on the user’s PC, where different spreadsheets and documents can be stored. The biggest difference with this system and a DMS provided by a merchant, is the amount of data that is being managed. The main task of DMS’s is to help the entire enterprise to store, create, and retrieve documents. DMS’s and their users can have the information accessible anywhere, unlike the folder structure that is only accessed by the owner of the computer. (Valkonen, 2015). In a DMS the user can search the documents with the data-feature and the document content, the system also manages the revisions and takes care that only one user can modify the specific document at a time. It can also grant permission and give access to documents to certain people, who can either read or modify these documents. (Anttila, 2001, pp. 4-5).

To this day there are many different document management systems on the market, and they all differ by functions. The most fundamental feature that belong to every DMS, is that they require a database where the information is stored. In addition, file storage for the documents is required as well as the link created between these. (Valkonen, 2015). (Anttila, 2001, p. 20) has described the essential features of a document management system in his book, these are listed below. This is also visually represented in (Figure 6. The essential features of a document management system).

- Web browser interface
- Documents meta-data stored in the database
- Document search by data-feature and document content
- Version and revision management
- Document backups
- Documents check in/out process
- Access rights of documents
- Workflow management

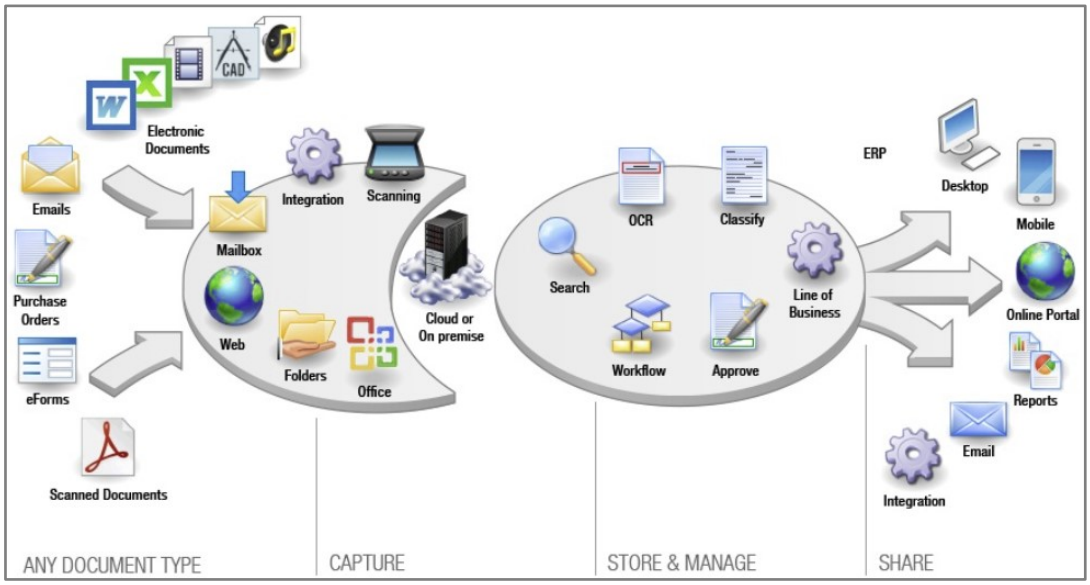


Figure 6. The essential features of a document management system (Nexus Imaging Solutions, 2020)

3.2.3 Importance of Up-to-Date Documentation

Having up to date information within organizations is the most important part of the documentary review. This correlates that the documents are always topical, valid, and relevant. By having up-to-date documentation businesses can get rid of outdated information, which reduces the risk of making mistakes, giving inaccurate information to employees or customers, and ending up with mistaken data. (Picomto, 2019). Errors in documentation is frequently seen by customers as mistakes in the product itself. When companies cut corners in documentation, consumers get confused where to go for help, and how they can trust the product, let alone the company itself. This snowballs very quickly into a complete rupture of trust. (Samuels, n.d.) This actively demonstrates that having up to

date documentation is even more important for the customer satisfaction and the eminent customer experience.

A survey that was made by Tech-Clarity revealed that 30% of leaders operating in service businesses, believe that their technical documentation contains imprecisions (Spaulding, 2017). When service companies or departments operate several different engineering change orders (ECOs), it is very likely that the information can be outdated in some parts. For instance, if a technical writer does not get the information of an ECO, these changes will never get documented in service manuals or spare part catalogues, leaving open ended information. (Flaherty, 2017) There are some important steps organizations can follow to keep track of their documentation, and make sure they are up to date.

For instance, switching to digital service manuals. According to (Flaherty, 2017) 41% of field service engineers use smartphones for their daily operations. The use of mobile devices in field service teams, makes sense to use digital service manuals. This provides technicians and engineers an easy method of accessing these documents and service information, and enables documentation engineers to quickly update technical documentation, when ECOs occur. (Spaulding, 2017)

Companies with effective communication in change management and engineering teams are more likely to gain an advantage over their competitors. Improving communication can be done by encouraging upper management to speak about working together with other departments or having meetings with the product designer about different details. (Flaherty, 2017).

Having out-of-date service information can furthermore cause field engineers to execute outdated instructions, or even customers to order wrong spare parts, adding extended customer downtime due to secondary service visits. This actively demonstrates how important up-to-date technical documentation really is within different service departments or businesses.

3.3 Responsibility Assignment Matrix

A responsibility assignment matrix (RACI) is an effective way of defining and writing down project roles and responsibilities. It is very important to know who is responsible, accountable, consulted and informed in a specific task or duty. This significantly improves the chances for success in different projects, and the cooperation between different

department teams increases. (Kantor, 2018) This sub-chapter will further discuss how to make quality RACI matrixes, as well as function as a base for my own suggested RACI matrix, that is presented in Chapter 5.3.

There are many different alternatives to the original RACI matrix, these are for example RATSI, RAPID, RASCI, and DACI. There are mainly two reasons why people look for alternative responsibility assignments charts. The terminology in RACI can seem unclear and can also lead to confusion within different departments. Applying a RACI system often leads to big and complex data that needs to be stored and documented. If RACI charts combine different processes, they usually get overwhelmed and hard to process. (Willis, 2020) When a responsibility assignment chart is needed in an organization it is important to make sure that this chart is going to be beneficial for the project or company. Also, when choosing the model, make sure to understand and have a definition for the terms along doing the matrix, or even have them visible alongside the chart. (Haworth, 2021) This clearly helps the employee to understand what different terms means, and what the person is responsible for in the specific task.

The process of making a RACI matrix can be started by writing down the main areas of responsibility and the tasks that need to be done, followed by writing down everyone who needs to be involved in the process. These can be for example persons who own the process, service, or product, even managers may be involved. Also writing down all the team member who work with the task, on a daily basis, or give requirements, approve the work that has been done or just give meaningful advice on a process or task. The result of the RACI matrix should not contain individual names but rather titles or groups, this is because people in the organization change over time. By using roles or titles instead of individual names, it is much easier to keep the documentation as well as the RACI matrix up to date. (Flora, 2020) When creating a new RACI model, it is important to look at other RACI models within the organization. If the same role or person is responsible for numerous activities, it can put too much pressure on one person or team by delegating them too much work.

It is important when choosing the accountable role, that only one person or title can do this, and not a full group. This could lead to confusion as well as slower decision making in the future. Also, this person must understand how the process or task works on a daily basis, for being able to make a competent decision. This means choosing a manager as the accountable may first seem like a god idea but may not function in the long term since this person usually has limited knowledge of the small details.

4 METHOD

This chapter will introduce the methods that were used to find out and gather information for this bachelor's thesis as reference to the research. This chapter will also explain the TI manage creation process that content management teams follow to create documentation data. Firstly, I will explain my choice of method proceeding with how the meetings and interviews advanced.

4.1 Choosing the Method

Defining the goal is the first step one should take to determine the specific research method for the project. There are numerous different research methods, but the most common ones are qualitative and quantitative data gathering. The ideal primary research strategy would be to use both involving quantitative and qualitative methods. Because the research goal of this bachelor's thesis was to get deepened knowledge and to get more specific information about the documentation process, the qualitative method was chosen for my primary research method. However, quantitative data has also been analyzed to ensure that the limitations of one type of data are balanced by the strengths of the other. Combining these methods will help me solve the underlying problem, as well as reach my practical purpose with the study. Interviews with documentation engineers, collecting documentation data from Polarion, as well as specific meetings with team leaders, has been the primary collecting data source.

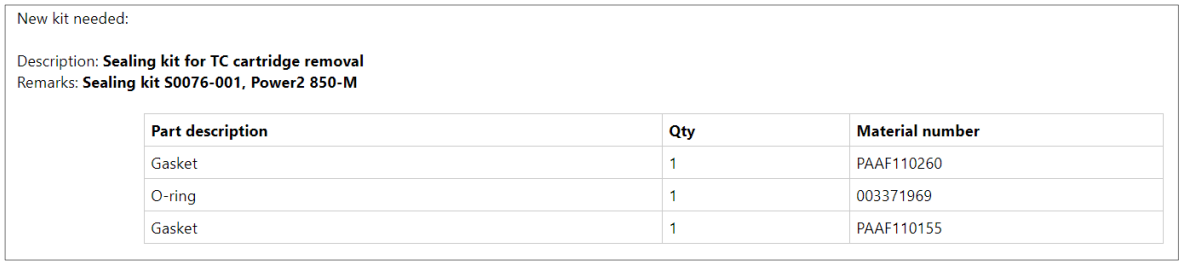
4.2 Meetings with 3X Team leader

As described earlier Content Management is divided into different sub teams, each working with document management for different Wärtsilä engines. Every team has a team leader that oversees the functionality in the group by providing guidance and instructions. The team leader must have a deep knowledge of the work process, as well as the ability to look outside the box, for other ways of working and strategic improvements.

Taking this into account, since this study was focused on the W31 engine, which documentation is overseen by team 3X, we decided to have regular meetings with the 3x team leader at Technical Information and do a thorough systematic description of the problem and how it can be solved by focusing on the empirical part. We had a handful of meetings in the autumn of 2020 with the 3X team leader, were we emphasized the underlying problem by looking at earlier cases, and how these have been solved. New spare part kits or changes & revisions to already existing kits, can be requested by anyone at TI, usually they

are handled by team leaders or senior documentation engineers. The indirect internal stakeholder will be defined later in the study.

The requests are made in Polarion from a task management site called Spare Part BoM request. The spare part BoM requests can have the information available (part description & material numbers) that is needed to create the Spare part kit, this is usually the case with the new W31 engine. Or it can solely be a request without the specific information. In this case the documentation engineer that is assigned, needs find out the parts and material numbers himself. This part is unclear, how the information will be perceived. If the kit information is available, it is usually written down in the description of the request, this is presented in Figure 7.



New kit needed:

Description: **Sealing kit for TC cartridge removal**
Remarks: **Sealing kit S0076-001, Power2 850-M**

Part description	Qty	Material number
Gasket	1	PAAF110260
O-ring	1	003371969
Gasket	1	PAAF110155

Figure 7. SP BoM request in Polarion regarding new kit for W31

The request can also be regarding changes to already existing spare part kits, these are usually much easier to handle since the information for the previous revision is available. Because the task management site in Polarion is used for several different SP BoM request types, we made the decision to study these requests from a longer time period, to get more in-depth knowledge as reference for this study.

The task management site “Spare part BoM request” in Polarion is divided in two different work items. SP BoM request and Article number, we need to take a closer look on both request types. Article number request is used when line items inside a structure does not have material numbers opened, while the SP BoM request is for the whole structure. To get a better comprehensive understanding of the different spare part BoM requests Technical Information handles, we decided to go through all SP BoM requests and Article numbers, that was made in Polarion between 1.1.2020-31.12.2020.

In this case study we broaden our perspective from the W31 engine, to get more search results and data to analyze. After a thoughtful meeting with the 3X team leader, were we

discussed the different engine types that could be taken into consideration, we agreed upon the following engines, these are represented in (Table 2) with the number of requests within the time frame. The particular reason why these engines were chosen, was because we wanted to limit this study to Wärtsilä Finland engines, these engines' spare part documentation is maintained at Technical Information delivery center 1 in Vasa. Wärtsilä certainly has other products as well but these were chosen because SP kits & sets are mainly meant to increase in engines, and not for example in LNGPacs or Auxiliaries.

Table 2. Reference types and the number of requests for Polarion study

Engine type	***SP BoM requests***	***Article number***	***Sum row***
W20	0	16	16
W32/W34	37	21	58
W46/W50	22	17	39
W25	0	0	0
W31	21	3	24
W46TS	8	0	9
Total requests	**88**	**57**	**145**

The next step was to go through all this data and document what was found out from the case study. The results for this will be presented in Chapter 5.1. Going through SP BoM request data in Polarion is a time-consuming process, since we wanted information documented on every single SP BoM request and Article number. Total requests to analyze were 145. From this data we hope to find the answers to these questions.

- ✓ Who is the Internal stakeholder that handles most SP BoM requests?
- ✓ How many requests are handled on a monthly basis?
- ✓ How many are considering completely new kits? (This question is interesting, since the biggest issue is regarding new kits and their update process)
- ✓ How many of these concerns spare part kit, and how many assemblies?

- ✓ What is the distribution of Wärtsilä kit/Sub-supplier kit?
- ✓ What are the main challenges with the SP BoM requests?

4.3 RACI as a Method

The RACI method was picked because previously there was not a clear arrangement in responsibilities and roles for the creation of spare part kits and their update process. Even though the production of SP kits has been established with a certain routine, there is still no documentation on how the process should be done, and who is responsible for the different stages. The RACI model was also chosen because it was noticed that creating and updating spare part kits, contains a lot of cooperation with other employees in different departments within Technical Information. This chart will show exactly who is responsible, accountable, consulted, and informed in the specific task. As mentioned, there are a lot of alternative models to the original RACI chart, why was this model them chosen? Simply because Technical Information uses this original model for their other process variants on their Technical Information process site on (Wärtsilä Compass, 2020). My suggested RACI matrix will hopefully be implemented on this site in the future as well.

After the Polarion research as well as the interview was held, and all necessary information was gathered from all stakeholders and processes, the RACI matrixes was done in cooperation with the 3X team leader. We used all the information gathered from the different research methods, to produce a RACI matrix that will show the task responsibilities.

The responsible role was easy to determine, since we knew the individuals within TI, who takes care of this process variant. From the Polarion research we could define the internal stakeholder for the SP BoM request, that furthermore could be used in the RACI matrix. The consulted individuals and departments could be defined from the interviews with the documentation engineer, an additional department was also added here, as suggested from the team leader. The informed person was pondered between two different titles, although the theory chapter describing how good RACI matrixes are done, helped us determine the most suitable character for the specific task.

The RACI matrixes was then established and produced within Microsoft Words table function, to look identical to the other RACI matrixes found on Technical information process site on (Wärtsilä Compass, 2020).

4.4 Interviews as Research Method

The main approach for gathering information about the subject, and specifically how the information for new spare part kits is collected and kept up to date, has been done through interviews with a documentation engineer, who is in different ways working with the documentation process of SP kits. This will give better insights from an employer's point of view, as well as give me the possibility to understand were the problem lies, and how it can be fixed.

Interviews are usually connected to the qualitative research technique, by asking open-ended questions to gather data about a specific subject. (King & Horrocks, 2010) Consultations with one specific documentation engineer were chosen instead of surveys with several respondents, because this gives me the opportunity to get more in-depth knowledge about the subject and gives me the possibility to ask supplementary questions that could have gone by, in a survey-type research technique. The negative aspects of only interviewing one person, is that opinions from other stakeholders are left unexamined.

There are several different types of interview techniques, but for this study we chose the unstructured interview method, in other words in-depth interviews. Unstructured interviews are usually described as conversations held with a purpose. (Questionpro, n.d.) This technique also enables me to develop friendly relations with the interviewee, which usually leads to gaining more detailed information about the discussed subject. The difference between structured and unstructured interviews is that the structured view relies on a set of questions, during the interview process, that needs to be followed. In this interview questions were prepared beforehand, but there was not a strict rule of following them in orders, like in a structured fashion.

4.5 Interview with Documentation Engineer

The interview was held in the Autumn of 2021 with the mentioned documentation engineer. Due to the Covid-19 pandemic Wärtsilä encourages social distancing in daily work by using online meetings and restricting all critical travel. Due to this the meetings were held online via Microsoft Teams.

As mentioned, a documentation engineer from Technical Information was chosen for this part of the study, because it was well noticed that this engineer had significant information about the subject, and how SP kits are maintained on a daily basis. As stated in the first

chapter SP kits have been around for a long time, and there is a certain routine on how these are established and maintained. But, since new SP kits & sets are meant to increase in the future, we need to establish who is responsible for maintaining this information, as well as how new SP kits are kept up to date in further revisions. The ambition for this interview were to find out:

- How is specific SP kit information found out, that is not available in the SP BoM request?
- With which internal departments within Wärtsilä does Documentation Engineers have to cooperate with, to find correct up-to-date information?
- Are the roles clear, who is responsible and accountable for the task?
- Do either Wärtsilä kit or sub-supplier kit have more problem areas concerning the document maintenance?
- Since new SP kits are meant to increase in the future, are there considerable challenges with the production and maintenance of SP kits, from an employer's point of view?

4.6 Validity and Reliability

Validity is described by the extent of which a concept is correctly measured in a quantitative study. The validity of the Polarion research can be questionable and have some inaccuracies, because the information received depends entirely on how good the requests have been filled in Polarion. That is also the reason why we looked at numerous different SP BoM requests (145). This means if some requests did not fulfil its purpose by providing me the needed information, it should not affect the result that much, and the main questions regarding SP BoM requests should get answered.

The reliability can be described by the accuracy of the instrument used. This can be measured by the extent to which the results can be reproduced when the study is replicated under the same circumstances. Since the Polarion research was done manually, by going through different SP BoM requests, there is always human errors to be considered. Although, I have done my best to get accurate and valid information, that can be used as reference for this study.

4.7 TI Manage Creation Process

This sub-chapter will briefly present the Technical Information manage creation process for the spare part content update and production, as well as the spare part BoM creation, which is a follow up from the SP BoM request, that has been mentioned earlier in this chapter. The information for the flowcharts that are presented below, has been retrieved from (Wärtsilä Compass, 2020), but the flowcharts has been created by the thesis writer, using PowerPoint design tools. Standardized flowchart symbols have been used, according to ISO 5807.

4.7.1 Spare Part Content Update and Production

In (Figure 8) the structure of the creation process for the spare part content update and production is presented and visualized. This was done to get a better understanding of the process that content management teams follow to create spare part lists, illustrations, and related spare part data. This structure should also help the reader of this thesis understand the way of working at Technical Information and the insights of how spare part structures are created, maintained, and updated. From this flowchart we can obtain information and understand in which part of the process, there is question marks and not a clear division of responsibilities. This structure is a simplified model where focus was set on the essential parts, and unnecessary tasks were left out.

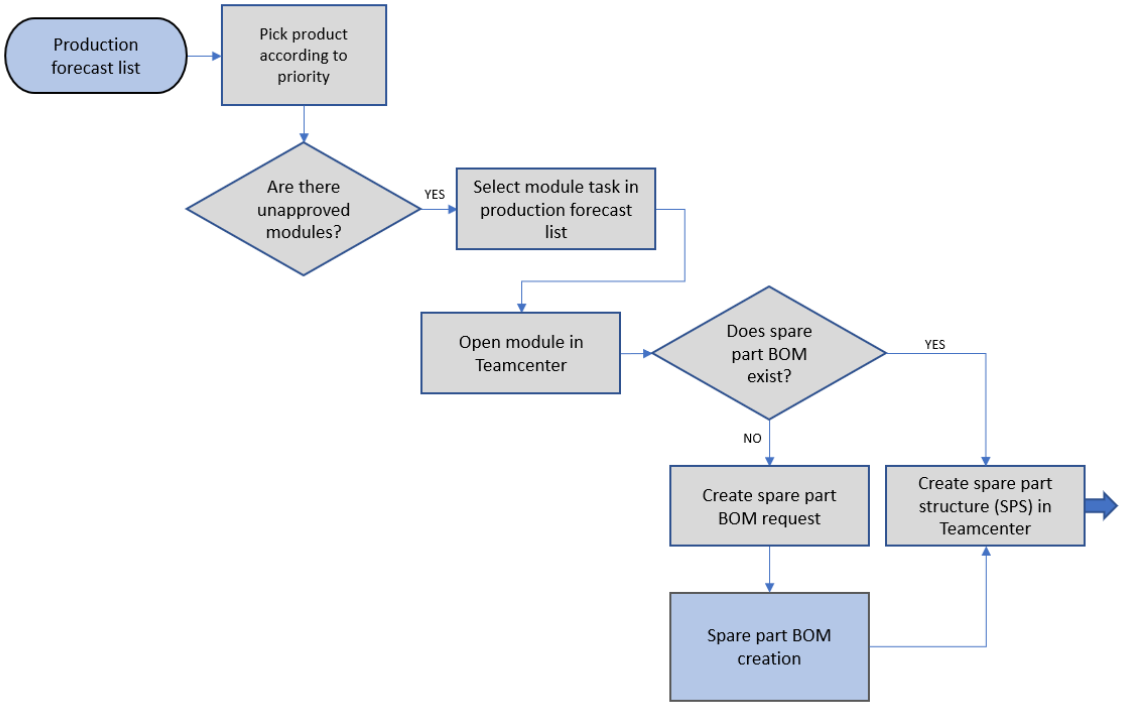


Figure 8. Spare part content update and production flowchart (Wärtsilä Compass, 2020)

The process starts with the documentation engineer picking a product from the production forecast list, in this case, the Polarion site TI production management system. In Polarion, the products are ranked with a priority, determined by the projects due date. Higher priority modules appear higher up on the list. The priority rank is displayed either 10, 20, 30, 50, 60, 80, 85, or 100, and changes automatically when getting closer to the due date of the project. The documentation engineer picks the product from the list with the highest priority. If the product has unapproved modules, a documentation engineer takes responsibility that these will be approved and finished in Teamcenter. In the case, that the module has an existing spare part BoM in Teamcenter, the documentation engineer can create a spare part structure (SPS), which will eventually consist of the right spare part list, with the right spare part numbers (SPN) as well as the illustration for the spare part. This illustration is done in either Adobe Illustration or PTC Creo, depending on the engine type. Although if no spare part BoM exists for the product, the documentation engineer must create a spare part BOM request, which another engineer will handle. This documentation engineer must identify which parts need to be added to the BoM and complete the bill of material by working closely with other departments. Since these subject expertise organizations are not defined anywhere, they will be defined from the interviews held with the documentation engineer.

4.7.2 Spare Part BoM Creation

The creation process for the spare part BoM starts with the spare part BoM request from an internal stakeholder, this internal stakeholder will be clarified from the case study mentioned earlier. The first step when creating the spare part BoM, is to determine if the request is valid. A non-valid request could be an already existing BoM, with another material number. In this case the engineer can inform the requester that this BoM is already in existing. If the request is valid, the engineer must find out if the required information is available to create the BoM. If the necessary information is not available, this must be requested from another department. As mentioned, these subject expertise organizations will be defined later in the study. The next step is to identify which parts need to be added to the BoM. If material numbers are not opened, the engineer can proceed with opening new material numbers for the specific parts. Although, if material numbers are already opened, the engineer can continue with creating the spare part BoM with the specific parts and material numbers. The Bill of Material has been finalized in the ERP and PDM system, and the requester can be informed. A flowchart for the spare part BoM creation is presented below in (Figure 9). This same procedure is followed when creating a spare part kit BOM.

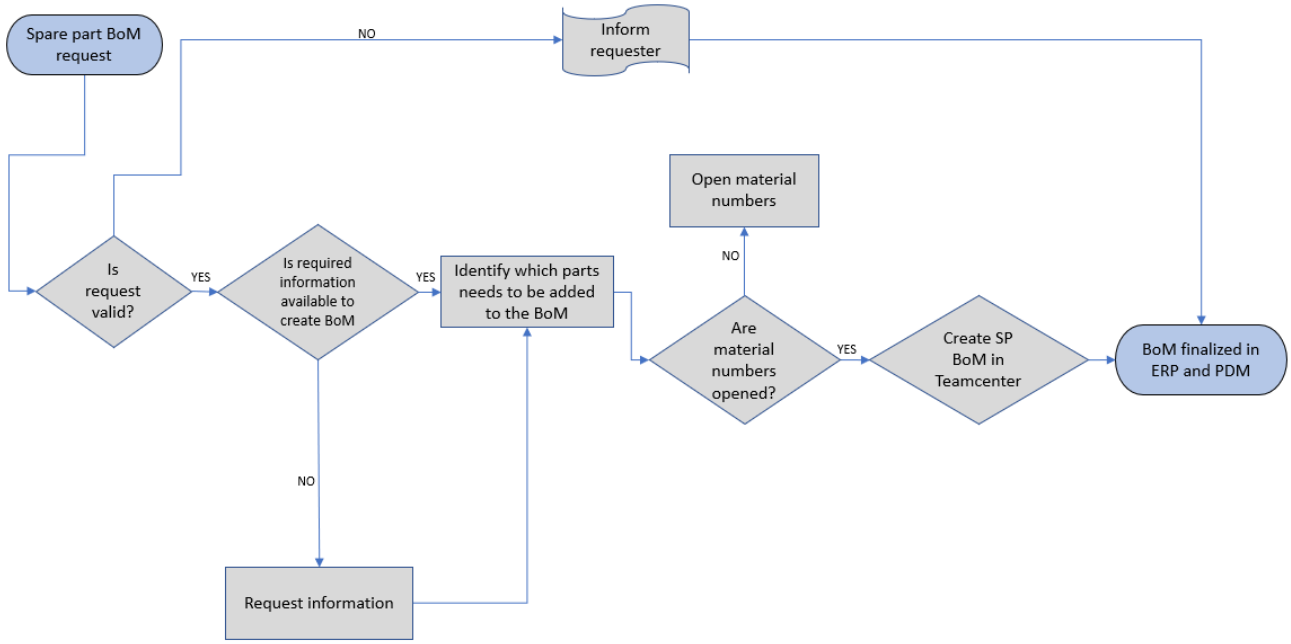


Figure 9. Spare part BoM creation flowchart (Wärtsilä Compass, 2020)

5 RESULTS

This chapter will furthermore explain the results that was found out from the Polarion research as well as the interviews held with the documentation engineer. Also, development solutions are considered and discussed. This chapter is also based on the theoretical framework and a dialogue between the subjects mentioned, are constantly maintained.

5.1 Polarion Research Analysis

By analyzing the data that was gathered from Polarion the following information has been found out. This information is also presented in (Figure 10), which provides efficient visual representation of the findings. The two different work items used for spare part BoM request (SP BoM request and Article number) are documented in the application with small differences. The SP BoM requests contain both "Author" and "Requester". The author in this case, is the person who has created the request in Polarion, and the requester can be another subject expertise organization who is requesting for a change in the product. This request comes to TI and is managed by an employee within the department. Since the Article number request only consist of the "author", the internal stakeholder that handles most SP BoM requests is defined according to this. Nevertheless, the subject expertise organizations will be defined from the interviews.

From the study, it was well noticed that there is no clear division in employees, who operate these requests, as intended. They are made by anyone from documentation engineers to team leaders and even managers. The "Other" column with 23% submissions, is usually external document coordinators who work for Wärtsilä. From (Figure 10), we can see that senior documentation engineers have made most requests during the last year, but this margin is very shallow, so we cannot solely define these, as the internal stakeholder. **Henceforth, the internal stakeholder that handles most SP BoM requests can be defined, as anyone within Technical Information, or any external partners who work with document management for Wärtsilä products**. The amount of spare part BoM requests handled per month during the last year has been approximately 12 submissions. These vary monthly, and the beginning of the year seems to be quieter, while the last two quarters contain a lot more requests. This can be explained by the end of summer vacations and the compiled work tasks during the summer period.

The distribution between assemblies and spare part kit requests for the last year has been approximately 66% assemblies and 34% SP kits. **Furthermore, when looking closer at the**

spare part kits, the distribution between completely new kits and update requests have been 71% to 29%. This shows the increasing amount of new spare part kits and the importance that these will be documented properly and kept up to date, later in their life cycle.

69% of the spare part kit requests have the information available that is needed to either create or update the kit. **In 31% of the spare part kit requests, the information is not available, and the assigned documentation engineer must find this information on his own by working closely with these mentioned subject expertise organizations**. These will be defined from the interviews and presented in the next sub-chapter.

The distribution between Wärtsilä kit and sub-supplier kit, could not be found out by studying this Polarion data. Since this information depends completely on the request, and if this information is filled in. In some cases, it could be found out by opening the material number in Wärtsiläs PLM systems, but in most cases the information was not accessible, even via this route. Using only the accessible information in some cases, would have given a false outcome and result, so this question was left unexamined.

Since new spart part kits are increasing and the update process for these have the most question marks, we decided to study these update requests more thoroughly. After a more detailed inspection of these requests, it was well noticed that these could be separated in two different categories. The requests were done either with a proactive or reactive approach. The pare part kit updates that were done with a reactive approach, were usually resulted from a problem that has been noticed directly in the field by the customer. This information then comes to Polarion as a change request from Technical Service or the CR teams. Like mentioned in Chapter 3.3.3, in a scenario where the customer orders the wrong part, due to the service manual not being up to date, it results in extending customer downtime due to secondary service visits. Also, this can be seen by the customer as errors in the product itself and the trust between Wärtsilä and the customer can be disturbed. This obviously should be avoided in the future by making sure the product has up to date information, before approving the documents for service manual use.

The majority of the update requests that are done proactive are initiated from Content Management, these can be further divided in two different categories. A missing structure is a common outcome of a spare part kit update. These turn up in the process of managing new spare part pages, which leads to reviews of structures and possible revisions. The other category consists of SP kits that turn up in the quality control by processing new spare part

catalogues. With the duplicate rapport function, that is used in Wärtsiläs PLM systems, conflicts between engine structures and kit structures are found. This furthermore results in finding design changes in these kits, that require updates. Technical Information should strive to find these SP kit updates with this proactive approach, rather than directly from the field with the reactive appeal. Examples of how this could be achieved, will be discussed in Chapter 5.3 development solutions.

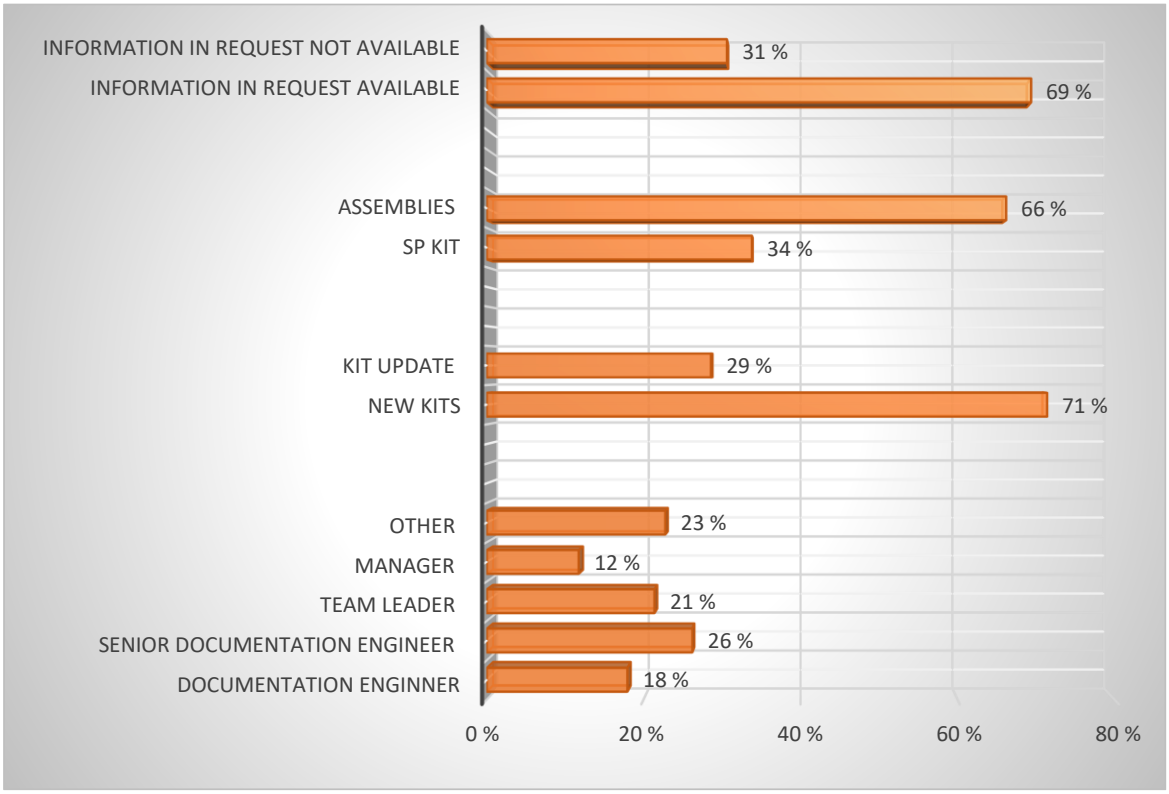


Figure 10. Polarion study results

5.2 How Information is Maintained for Spare Part Kits

This sub-chapter will present what was found out from the interview with the documentation engineer. The main questions asked during the interview are presented in bold, followed by the conclusions.

How specific spare part kit information is found out, that is not available in the SP BoM request in Polarion?

The few documentation engineers that work daily with the production and maintenance of spare part kits, usually do not get the first input from Polarion. Technical Service is usually in contact with these engineers when a new design, that requires a new kit, has occurred. The request can also come from the production (factory), regarding engine delivery since service

kits are sent out with the engines. These engineers then fill the Polarion request themselves to have it documented in Wärtsiläs PLM systems.

In a case where the parts and material numbers are not available in the Polarion request, they can be found out in several different ways. For example, if a new kit is needed in a new engine design. The previous version of the kit, that was used in the old engine can be used as reference. In the end, the kit should still be checked and approved by Technical Service. Also, in a completely new engine type the parts and material numbers cannot be determined within Technical Information, again this must be consulted from Technical Service. Correct parts and material numbers regarding kit updates, can also be found using Wärtsiläs PLM systems, with different approaching methods, (detailed instructions are left out). Replacement chains in SAP can also be checked. Are there material numbers that are replaced in the kit that is being produced.

Which internal departments does documentation engineers have to cooperate with, regarding spare part kit information?

Technical Service is mainly responsible for the correct information in these spare part kits. This department gives the technical aspect of the product, which parts wear and what sealings need to be changed. Product Management can give the commercial features, is the expected sales big enough? When a new kit has been finalized in Wärtsiläs ERP- and PDM systems, a strategic purchaser must be informed, who then contacts the third-party supplier who manages the assembly of the spare part kits. In conclusion, three main internal department that engineers cooperate with. Technical Service, Product Management, and Strategic Purchasing.

Do either Wärtsilä kit or sub-supplier kit have more problem areas concerning the documentation?

Sub-supplier kit may have more problems because of poor communication. It is certainly common that suppliers do not mention what different kits contain, or Technical Information does not receive the pictures showing the parts. This makes it impossible for documentation engineers to create the illustrations. Another problem might occur if the supplier gives wrongful information about the kit content, or the supplier updates the kit without informing Technical Information. This is something that has happened before and should be avoided in the future. Wärtsilä kit seems to be easier to maintain since a Bill of Material (BoM) must

be updated, this way changes are better documented, and engineers are better kept up to date. Sub-supplier kits are sold separately without maintaining a BoM.

What are the main challenges concerning the production and maintenance of spare part kits?

Concerning sub-supplier kit, the lack of communication in some cases might come with challenges, since critical information regarding kit content, does not reach Wärtsilä Technical Information. Also, if the engineer for some reason do not inform Strategic Purchasing about a finished sealing kit, then the third-party supplier does not have this information available. Anyhow, the supplier will notice after an order that a new revision has been released and will then ask Strategic Purchasing for a part list. Something that can be mentioned, for completely new kits the whole BoM information is sent to Strategic Purchasing, while in updates the kit content is informed written manually.

Wärtsilä kit might come in different design versions, and sometimes only one kit is used for the particular engine type. This means that one spare part number (SPN) can have two different material numbers, and the customer needs to know exactly what part is needed. This can obviously be fixed by creating alternative kits that only suit one installation, but this might come with additional challenges for Wärtsilä, delivering the right kit for the customer in the future. A problem mentioned that is out of Technical Information's reach, is regarding kit updates. What happens to existing kits in stock, if a new design or revision is released? Are these remade or can the old version still be used? This question was left unexamined.

5.3 Development Solutions

As previously mentioned, and found out from the Polarion study, the spare part kit updates at Technical Information are generally done with either a proactive or reactive approach. This chapter will moreover explain different methods of how Technical Information could find these SP kit updates with the proactive approach rather than finding them too late from the field with the reactive appeal. The explained methods in this chapter are focused on communication improvements and noticed flaws and imperfections in the process that require changes, and rather not concrete examples of potential solutions. This would generally need further research and perhaps new PDM & PLM improvements within Technical Information as well as other external organizations and suppliers.

5.3.1 Strengthen External Communication between Suppliers.

Improving external communication between suppliers is an effective and effortless solution to gain an advantage of competitors and to make sure documentation data is up to date for both partners. It is rather common that when suppliers make changes to a product, in form of design changes or other modifications that affect the spare part documentation at TI, the information is not further transferred to Technical Information or it arrives to late, as a customer complaint. This provides additional work for internal stakeholders at TI, who work with the documentation of spare part kits, since this information needs to be found in alternative methods. Anyhow, Technical Information cannot do much about this problem since this is occurred outside of Wärtsilä. There should be a corresponding automated process from the supplier's part that sends these crucial design changes to Technical Information. TI can obviously not regularly ask suppliers if new changes has occurred, this information should be transferred seamlessly.

5.3.2 Improve Revision Handling and Data Transfer within Internal Departments.

Improving the transfer of data and information between internal departments at Wärtsilä can make it easier for documentation engineers to find updates and design changes that require updates in the spare part catalogue. Usually when design changes occur, this information comes to R&D and the designers straight from the suppliers. When new revisions are made for spare part modules/kits, a change notice is usually written on important details that has changed. If the information that is changed, does not have any significant importance to the engine production, it is too often left out from the change notice, even though it would have meaning for the spare part documentation. In summary, the revision handling may have faults in some cases which leads to important information not reaching Technical Information. As mentioned in Chapter 3.2.3, companies with highly effective communication within different engineering teams and departments, are more likely to succeed compared to their competitors. Since SP kits are meant to increase in the future, this communication improvement should be taken seriously. A considerable solution for this could be for Content Management teams to set regular meetings with R&D and the product designers. This could help team leaders and documentation engineers to be more up to date on design changes and revisions that typically would not reach TI, contributing to maintaining the spare part catalogue up to date in the future.

5.3.3 SP Kit Update and Production RACI

Since there has not been a clear division of responsibilities in producing spare part kits within Technical Information, we decided to make a responsibility assignment matrix (RACI) for the SP kit update and production. Technical Information process site on Compass has several RACI matrixes on different process variants, but for some reason this one is not in existing. This matrix should help new, as well as existing employees to clarify and define roles and responsibilities within Technical Information and other departments, who work with the production of spare part kits. The definition of the roles is presented below, followed by the RACI matrix in (Table 3).

Responsible The individual who completes the task or is responsible for the action and implementation of the specific duty. This responsibility can be shared and is determined mainly by the person who is accountable. (Smith & Erwin, n.d.)

Accountable The individual who is answerable of the task. This person ensures the requirements are met and further delegates the task to the responsible. Only one accountable can be signed to an action. (Smith & Erwin, n.d.)

Consulted This role usually consists of subject matter experts who can be consulted for details or additional information by the responsible during the task. Two-way communication between the responsible is required. (Smith & Erwin, n.d.) (Montgomery & Kumar, 2020)

Informed This individual needs to be informed after major updates or decisions are taken. This can be senior leadership. Only one-way communication between the responsible is required. (Montgomery & Kumar, 2020) (Smith & Erwin, n.d.)

Table 3. SP kit update and production RACI matrix

Process name	Process Variant	Responsible	Accountable	Consulted	Informed
SP Kit update and production	Spare Part BOM creation	TI Documentation Engineer	TI (Internal) Stakeholder	Technical Service, Product Management or Supplier	TI Team Leaders

Documentation engineer at Technical Information is responsible for the action and implementation of the task. This contains the production of the BoM and the update process for spare part kit. As described, the accountable ensures the requirements are met and further delegates the task to the responsible. This part will be handled by the internal stakeholder at Technical Information. This is the same individual who makes the SP BoM request in Polarion for the specific kit. This individual is the author for the request and further delegates the task to the assignee/responsible. If the responsible needs additional information and details, which is not presented in the request, a technical service expert can be consulted. In some cases, the responsible can also be straight in contact with the supplier. TI team leaders are informed during the process after major updates.

5.3.4 SP Kit Information RACI

Since Technical Information is mainly responsible for the update and production of the spare part kit BoM, and the information within these kits (parts, quantities, material numbers) are consulted from other departments, a RACI matrix was also conducted for this. (Table 4). The individual responsible for the correct information in these kits are personal from Technical Service and Product Management. Technical Service gives the technical aspect, which parts wear and what sealing need to be changed after something is disassembled. Product Management gives the commercial features, is the expected sales big enough? While these departments are mainly responsible for the accurate information in these kits, Technical Information can give input if the information is manageable in our PDM & PLM systems. This corresponds to a complete cooperation between these departments. Design experts and suppliers can be consulted for additional information. TI documentation engineer is accountable of the task since this process variant is managed within Technical Information, team leaders are informed and kept up to date after major updates.

Table 4. SP Kit Information RACI matrix

Process name	Process Variant	Responsible	Accountable	Consulted	Informed
SP Kit Information	Spare Part BOM creation	Technical Service, Product Management	TI Documentation engineer	Design Expert, Suppliers	TI Team Leaders

6 CONCLUSION

This chapter will conclude this thesis with a summary of how the study advanced, as well as the important result that was found out. Also, what challenges I faced during my research, as well as further research ideas and reflections on how this could be achieved.

6.1 Summary

The purpose of this thesis was to find out how information for spare part kits is created and maintained at Wärtsilä Technical Information. Since new SP kits are meant to increase in the future, Wärtsilä wanted to know if there were any problem areas that could affect the spare part documentation and maintenance for these spare part kits. Also, how these are going to be kept up to date in future revisions.

This thesis kicked off in the Autumn of 2020 by having regular meetings with the 3x team leader, where we emphasized the problem areas, and looked closer at earlier spare part kit requests and updates that were handled in Wärtsiläs lifecycle management application, Polarion. This was followed by the Polarion study that was meant to answer some important questions regarding the amount of new kits maintained, as well as who the internal stakeholder was etc. The internal stakeholder that handles most SP BoM requests, were a little confusing at first glance, since the distribution between different titles were so big. Even though senior documentation engineers had made the most SP BoM requests in the previous year, other titles e.g., managers, team leaders as well as documentation engineers were involved in these, just as much. The SP Bom requests handled monthly were approximately 12 submissions, which was a reasonable amount, and leaves room for future growth in new spare part kits, and the ability that these can be maintained by the department. The Polarion study also showed the significant increase in new spare part kits maintained in the PLM systems. The distribution was 71% new kits while 29% were update requests.

After the Polarion study was completed, the focus was set on the interviews with the documentation engineer. The interview was held in the Spring of 2021 with the aim to develop knowledge about how SP kits are maintained on a daily basis, as well as to understand who the subject expertise organizations are, that TI engineers should cooperate with regarding the production of SP kits.

After all the necessary information was collected from the lifecycle management application as well as the interview, the center of attention was set on the RACI matrix. The chart was established together with the 3X team leader and the responsibilities within Technical Information, regarding SP kits and their production should be clearer at this point for all stakeholders.

6.2 Challenges

The subject of this thesis and the discussed process were relatively complex and sometimes hard for me to get a grasp of the bigger picture. This bachelor's thesis was also mainly written for Wärtsiläs internal use, were the language used is understandable for the employees within Technical Information, but maybe not as easily of any other readers. A lot of terms and abbreviations were used that furthermore made it difficult to understand the discussed subject, specifically for people who do not have experience or knowledge in technical documentation.

The Polarion study came with its own challenges as well, since the research was done completely manually by going through all the SP BoM requests made in the year 2020. It was certainly time consuming to go through this data. Since the results from this part of the study relied on whether the requests were documented properly in the lifecycle management application, it was hard to gather the necessary information in some requests, because it was not documented accordingly. This means the results may have small inaccuracies even though we tried to avoid it by studying a big group of requests (145).

I would also like to mention that it was difficult in the beginning to get a grip of the subject. From the get-go we did not have a clear plan on what this thesis should contain, since the subject was so broad and complex. Since the beginning, we took one step at a time and looked where this has gotten us and filled in with more ideas and thoughts during the whole process. In my opinion the results came out much better than expected and we found out a lot of useful information about spare part kits, and how these are maintained at Technical Information.

6.3 Further Research

To further develop the understanding of how spare part kits are maintained at Wärtsilä Technical Information, I propose further research to consult even more people who take part and work with SP kits' production and maintenance. In this thesis, I only interviewed one

documentation engineer from the department. It could have been interesting to hear other people's views and opinions of the process. Also, consulting people from other departments who are involved in the process could give additional insights, departments including Strategic Purchasing, Technical Service, and Product Management could be considered.

Sub-supplier kit and their update process could be researched more, since no engineering BoMs are made for these, and there seems to be more difficulties maintaining these, because revisions are not documented and kit updates from the supplier's part do not reach Technical Information in all cases.

6.4 Discussion

As final words I would like to thank everyone who has participated and cooperated with me in this thesis. Special thanks to Tommy Wester for the countless hours of meetings held regarding the subject, and for supporting me and providing me with new ideas and thoughts.

I would also like to thank Mathias Backman for being part of the interview, as well as providing me with additional information about the subject. Finally, a big thank you to my supervisor Mikael Ehrs at Novia UAS for providing me with helpful feedback during the whole process.

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