NOVIA
UNIVERSITY OF APPLIED SCIENCES

Wärtsilä

Smart Spare Part Numbering: case Wärtsilä

Nicklas Hartvik

Bachelor's Thesis

Information Technology

Vasa 2014

BACHELOR'S THESIS

Author:	Nicklas Hartvik
Degree programme:	Information Technology
Supervisor:	Mikael Jakas
Title:	Smart Spare Part Numbering: case Wärtsilä

Date: 06.06.2014 Number of pages: 28

Abstract

This Bachelor's thesis was done at the request of Wärtsilä services TI-SPCM, an organisation within the Wärtsilä Corporation. The task was to investigate what it would mean if Wärtsilä changed their current way of naming and coding their spare parts. I was to conduct a pre-study of different concepts of how to create, name, store, manage, publish and maintain spare part related data in several different IT systems.

Due to a global Product Data Management (PDM) update Wärtsilä has the possibility to alter their current way of working.

The result of the thesis is to combine Wärtsilä's current way of working with both existing systems today and make a semi-significant numbering system suitable for their demands and needs.

Language: English Key words: Wärtsilä; SPN; WSHS; WDMS

EXAMENSARBETE

Författare:	Nicklas Hartvik
Utbildningsprogram:	Informationsteknik
Handledare:	Mikael Jakas
Titel:	Intelligent reservdelsnumrering: fall Wärtsilä

Datum: 06.06.2014 Sidantal: 28

Abstrakt

Detta ingenjörsarbete är gjort på begäran av Wärtsilä services TI-SPCM, en organisation inom Wärtsilä. Uppdraget var att undersöka vad det skulle innebära för Wärtsilä om de skulle ändra sitt nuvarande sätt att namnge och numrera reservdelar. Jag utförde en förundersökning om olika koncept på hur man skapar, namnger, sparar, hanterar publicerar och underhåller reservdelar och relaterat data inom flera olika IT system idag.

Det sker som bäst en global Product Data Management (PDM) uppdatering och det betyder att de nu har möjligheten att ändra sitt nuvarande sätt att arbeta.

Kortfattat om resultatet är att det möjligen går att kombinera deras nuvarande sätt att arbeta med dagens existerande system och skapa ett så kallat semi-significant numrerings system som ska täcka deras framtida behov.

Språk: Engelska Nyckelord: Wärtsilä; SPN; WSHS; WDMS

Contents

ABBREVIATIONS

Abbreviation	Description
WDMS	Wärtsilä Document Management System
WSHS	Wärtsilä Specification Handling System
TI	Technical Information
SPIS	Spare Part Information Systems
SPCM	Spare Part Content Management
PDM	Product Data Management
PLM	Product Lifecycle Management
WOW	Way of Working
ECO	Engineering Change Order
ERP	Enterprise Resource Planning
BOM	Bill of Materials
D-message	Design Message
Section	Spare part information sheets created in WSHS
E-process	Engineering information modules and loading them into database.

FOREWORD

I want to thank my colleagues at Wärtsilä services TI-SPCM for all their help during my work on this thesis. A special thanks goes to Tommy Rodas, my supervisor and mentor at Wärtsilä, and Mikael Jakas, my mentor and contact person at Novia. I also want to say thanks to Tommy Wester, Stefan Sjöholm and Arto Nikula for providing information, help and support at Wärtsilä.

23.05.2014

Nicklas Hartvik

1 Introduction

The result of Wärtsilä's transition from engine manufacturer to solution provider is that the current spare part coding system doesn't fully support the new product lines. The system is also partly seen as too resource-consuming to use and maintain.

1.1 Work process

The work consisted of:

• gathering information on different spare part related systems today.

• mapping the current situation and the current way of working.

• collecting information from different internal stakeholders by means of informal interviews.

• Making a conclusion of the study with pros and cons of naming and managing data according to the different concepts that have been investigated in this thesis and making recommendations for how Wärtsilä TI should proceed in order to have an effective and suitable future system.

1.2 The goal

The goal of my thesis was to list the different possibilities and systems and ultimately make objective recommendations based on my research.

2 The company

The strategy of Wärtsilä is that they aim to be the leader in complete lifecycle power solutions for the global marine markets and selected energy markets worldwide. They provide lifecycle power solutions to enhance the business of their customers.

Wärtsilä creates better technologies that benefit both their customers and the environment. They have the vision to be the most valued business partner of all their customers. The Wärtsilä values are illustrated in figure 1. (Wärtsilä, 2013a)

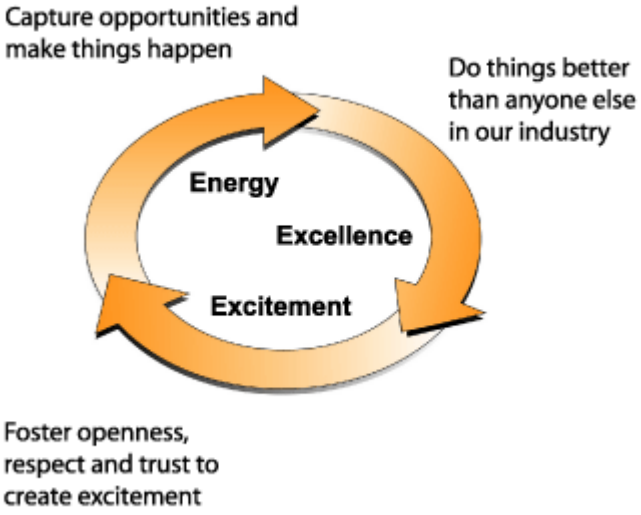


Figure 1. Wärtsilä's values. (Wärtsilä, 2013b)

2.1 Wärtsilä history

Wärtsilä was established in 1834 when the governor of the county of Karelia approved the construction of a saw mill, by the rapids in the municipality of Tohmajärvi on 12th April. In 1851 the Wärtsilä iron mill was built next to the saw mill in Tohmajärvi. In 1898 the sawmill and ironworks were renamed Wärtsilä Ab, which then became a new company called Ab Wärtsilä Oy in 1907. One year later the power station by Saario rapids started operating. Wärtsilä had at this point become a modern smelting plant and steel mill, running on electricity generated by the rapids. In 1936 Wärtsilä acquired the Onkilahti engineering workshop in Vaasa and one year later the Pietarsaari workshop in the town of Pietarsaari. The diesel era began in 1938, when Wärtsilä signed an agreement with Friedrich Krupp Germania Werft AG. The first diesel saw the light of day in Turku in November 1942. In 2004 Wärtsilä announced that the production in Turku would be discontinued. The production was moved to Trieste, Italy. The only remaining factory in Finland carrying the Wärtsilä brand is now located in Vaasa. (Wärtsilä, 2013c)

3 Background and purpose

The first summer I was at Wärtsilä, which was the summer of 2011, was actually the first time I came into contact with questions regarding numbering systems and the possibility to write a thesis about them.

I applied for a summer job at Wärtsilä during my second year at Novia and my application was accepted. I started my work in Runsor, at Services TI-SPIS (Technical Information-Spare Part Information Systems), later named TI-SPCM (Spare Part Content Management), which is an organisation within the Wärtsilä Corporation.

My task was to help with the making of spare part catalogues and the documentation of Wärtsilä engines, mainly W20 engines. It was a demanding but interesting task and I got to know their way of working and their system structure. Their way of working was a series of steps, starting with an internal program named Wärtsilä Document Management System (WDMS), which is their internal database that contains almost everything about their engines and parts. Figure 2 below shows the program when it starts. In the upper left corner there is the main menu drop down list, which is used to enter the needed article, drawing or design message for the task.

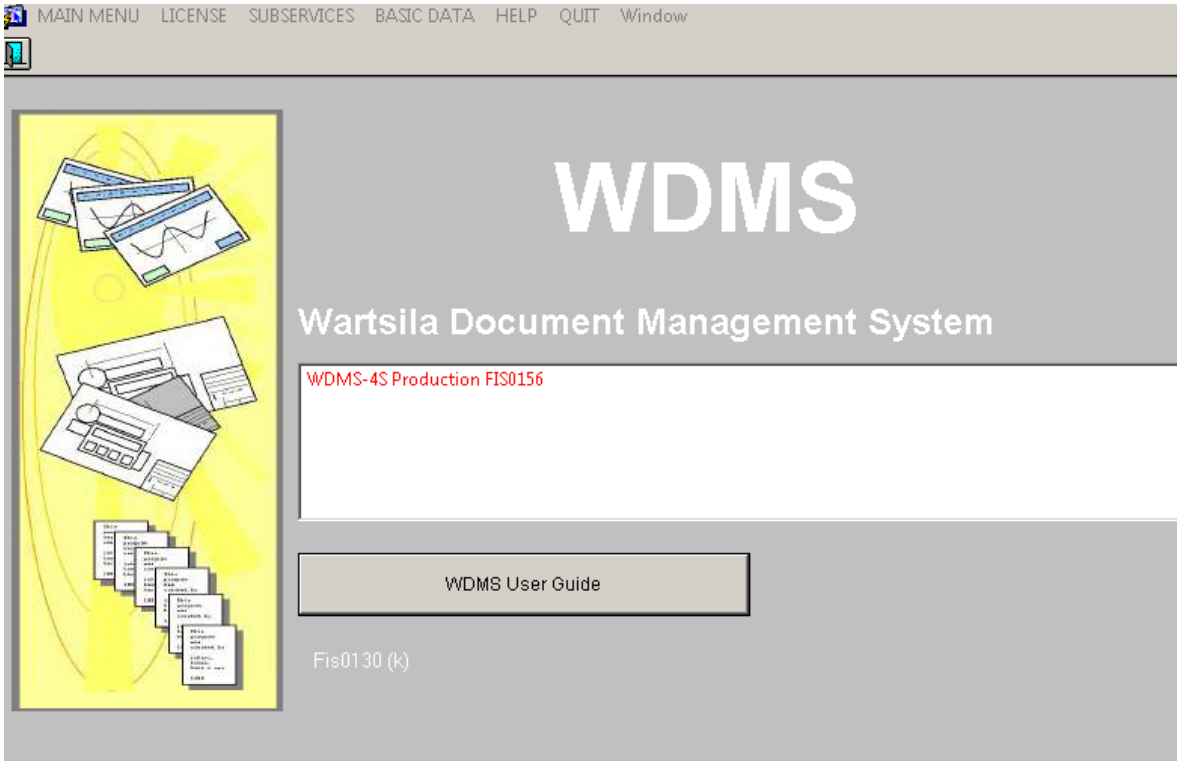


Figure 2. Snapshot of the start-up screen in WDMS. (Wärtsilä WDMS, 2013)

My supervisor Tommy Rodas gave me a number, also called design message number, which was connected to a document. The design message contained information about things that have changed or been replaced for a certain part of the Wärtsilä engine. This change was then to be applied to a new section. A section is pages in the spare part catalogue describing different parts of a Wärtsilä engine that the customer can order.

Figure 3 below shows a design message and explains if something has been changed or replaced. The new section was then made as a revision of the previous section or as a completely new section, depending on the explanation in the design message. The next step was searching through their database for previously made sections to find a similar section to the one that is supposed to be made in order to find the necessary corresponding spare part number. In order to find a suitable section, everything depends on the function and location of the parts.

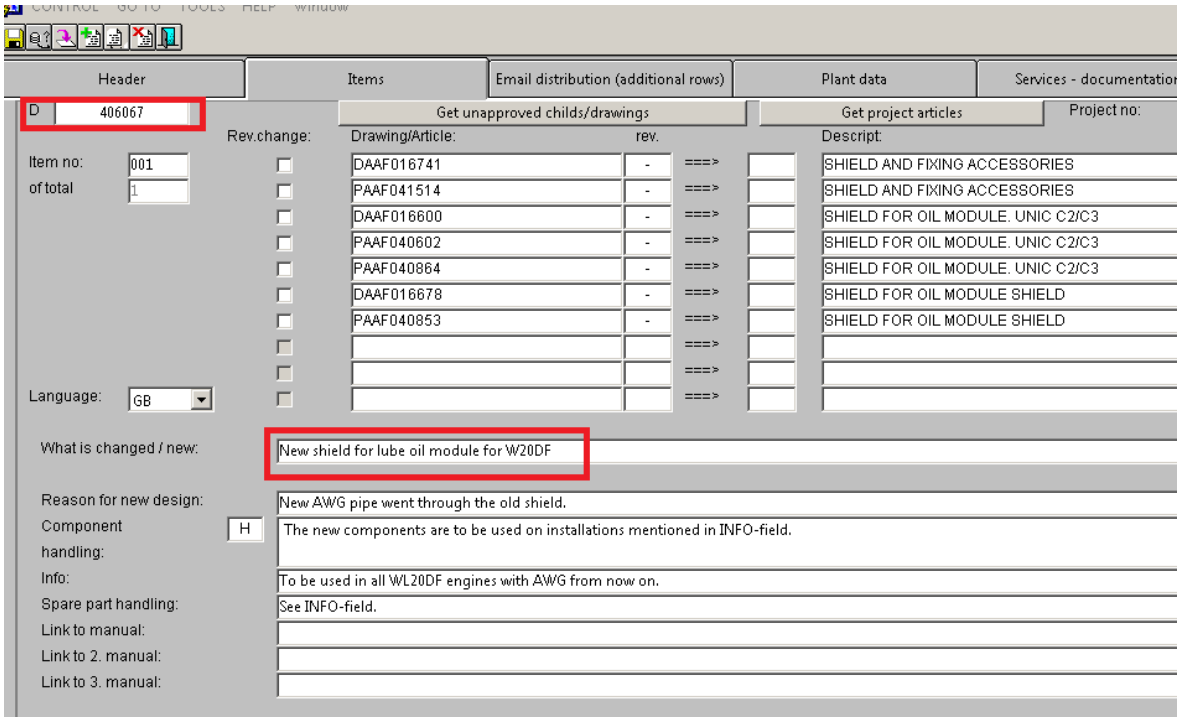


Figure 3. The D-message and the change that has been made. (Wärtsilä WDMS, 2013)

When comparing the section that appeared to be similar with the one in the design message, it was necessary to write down the part numbers corresponding to the new section, assuming the part numbers had a similar location and function of the corresponding part. The spare part numbers then needed to be entered into the database of the article that was in progress, in this case article PAAF041514.

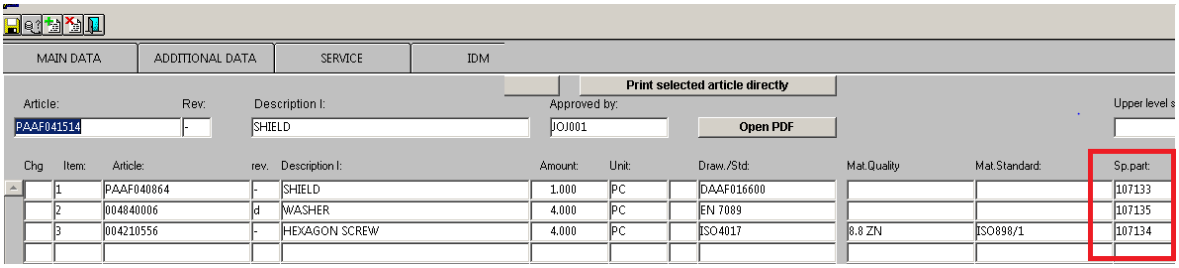


Figure 4. Compressed snapshot of the entered spare part numbers in WDMS. (Wärtsilä WDMS, 2013)

After this was completed, the next step to complete the new section was to make a spare part picture, which was taken from the drawings of the engines. This was made in Adobe CS3 Illustrator. The first step was to clean out unnecessary lines and markers to make it more like a spare part picture than a drawing. After all this was done the complete picture was moved to a location on a server. Figure 5 shows a snapshot of a drawing, before the clean-up process.

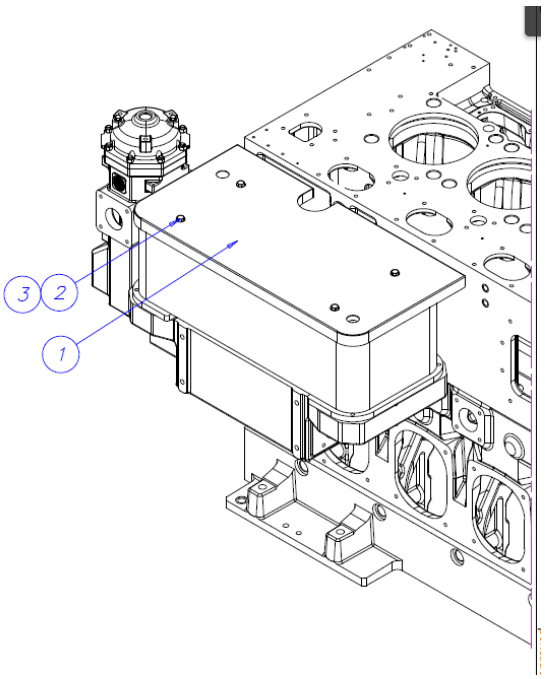


Figure 5. Part of a drawing, before clean-up. (Wärtsilä Drawing, 2013)

The next step to make this section complete was made in a different program called Wärtsilä Specification Handling System (WSHS) which is a database in Microsoft Access as shown in figure 6. Here the active section and engine type were entered.

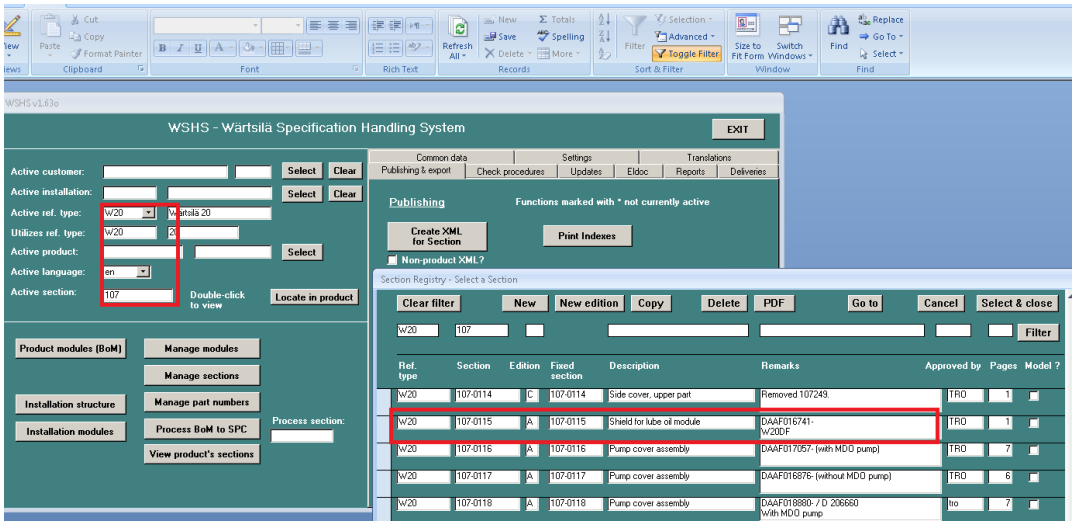
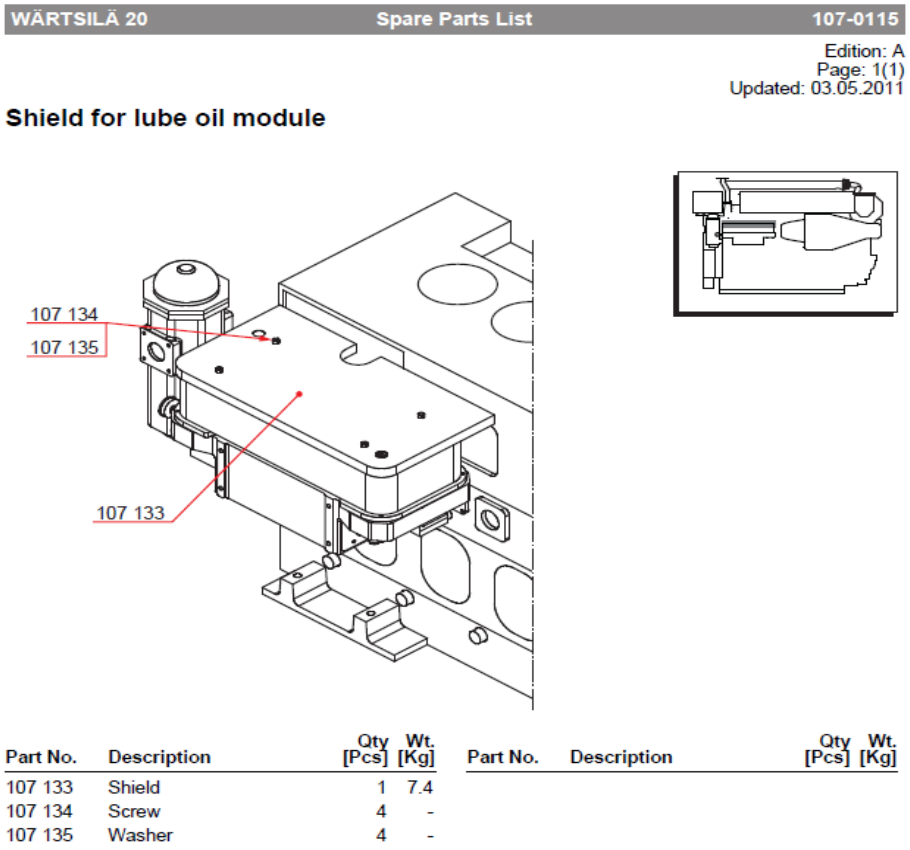


Figure 6. The new section needed for completion of my spare part picture. (Wärtsilä WSHS, 2013)

WSHS was then used to complete the whole section, combining names, numbers and pictures together into a printable PDF. Figure 7 shows the complete spare part picture and section when the numbers are merged and the drawing has been cleaned.



WÄRTSILÄ 20 Spare Parts List 107-0115

Edition: A
Page: 1(1)
Updated: 03.05.2011

Shield for lube oil module

Part No.	Description	Qty [Pcs]	Wt. [Kg]
107 133	Shield	1	7.4
107 134	Screw	4	-
107 135	Washer	4	-

Part No.	Description	Qty [Pcs]	Wt. [Kg]

Figure 7. Complete and cleaned spare part picture. (Wärtsilä SPP, 2013)

Today this work process and these steps to create a new section in a spare part catalogue are very time consuming. According to people that work with this on a daily basis there is room for changes to their current system and their current way of working, which could then result in a more effective, time saving and most of all cost saving solution.

4 Approach

My first contact with this subject of the thesis was in the summer of 2012 when I was working as a summer trainee at Wärtsilä TI-SPCM. My supervisor and I started looking at different problems and different work processes that could become the subject of a thesis. We started the discussion about the numbering of the parts and the system today, as I was told that the current system and the current way of working are over 30 years old.

4.1 First meeting

We agreed to sit down and have monthly meetings to discuss the current situation and a possible subject for my thesis. We had our first kickoff meeting in September, after my summer trainee contract ended. The overall process was discussed and we kept a short brainstorming session. The initial topic was preliminary set to "Significant vs. non-significant spare part numbering systems". We also had a discussion regarding the appropriate approach, deductive vs. inductive approach and came to the conclusion that the deductive approach would be suitable for this type of work.

During our first meeting we also discussed some action points that are listed below in a bullet list.

- Start by mapping the current situation, search relevant literature and document.
- Create an initial action plan / road map of the overall project.
- Search for similar types of papers in order to get a wide and proper list of available references and literature.
- The purpose and target of this study are to investigate what it would mean if Wärtsilä changed their current way of naming and coding their spare parts.
- The big picture of the study will follow the "normal" process, introduction, information about Wärtsilä, literature study (theory), empirical study current way or working(wow), results and recommendations.

4.2 Second meeting

We had another meeting at Wärtsilä and we discussed the current situation. I was to make better arguments and better explanations of my thesis. I didn't realize at the point the complexity of this thesis and could not explain it correctly to my mentor at school. After the discussion of the problem they proposed that we create a rough high-level draft of the end-to-end process along with fine tuning the purpose and goal of the study.

After the second meeting, more action points surfaced which are listed below in a bullet list.

- The purpose of the study was corrected and written as: "To conduct a pre-study of different concepts of how to create, name, manage, publish and maintain spare part related information in several IT systems such as PDM, PLM, ERP and other internal specification management systems."

- The goal of the study was corrected and written as: "I am to conclude my study with pros and cons of managing data according to the different concepts and make recommendations for how Wärtsilä TI should proceed in order to be successful in the future."

- The following important note also came up: "Wärtsilä's current system is 30 years old. However, due to the upcoming global PDM system upgrade, we now have the possibility to alter the current way of working according to a new system and concept that should last for at least another 30 years."

4.3 First interview

During our meetings we agreed that I should conduct personal interviews with people working for Wärtsilä that have had something to do with their current way of working, spare part numbering and such. In March 2013 the first interviews were booked.

The interviews started with Stefan Sjöholm, who is the General Manager of Process Development & Quality Management at Wärtsilä Finland OYJ. Tommy Rodas was also there for his assistance. Stefan was to give some business input and different views on how the system works today and what he thinks could be done to improve the current situation.

There were some questions that were brought up during the interview. The questions are listed below in a bullet list.

Wärtsilä's Way of Working (WOW) today?

- How it all started, the idea of the current WOW?
- Wärtsilä's current spare part numbering system?
- Vision of the future and strategy and what point of views do you have?
- Transition from engine manufacturer to solution provider?
- What is your opinion on significant vs. non-significant numbering?
- Which system would work best at Wärtsilä, considering the constant change?
- What about the semi-significant also called hybrid system?
- Most optimal length of the spare part number?
- What about the human factor, mistakes considering the length of the number?
- Cost reduction, saving time and maintenance when considering a new system?

The current WOW was started based on the SAP Coder Solution, which is their Sales Enabler. It is at the moment their only spare part selling system and the current WOW was a political decision that Wärtsilä made some time ago. Wärtsilä as an engine manufacturer and as a company serving engines has always been around, but as time passes Wärtsilä needs to expand and wants other solutions and products. The SAP Coder Solution has not quite followed along at the same pace as the coding system.

4.3.1 SAP Coder Solution

The SAP Coder Solution ties together the product number with the spare part number, which is the number that is both significant and insignificant. The number is not bound to any item. It can mean twenty different items, and has no real meaning except function and

location. The real meaning comes when putting together spare part number and the product number, which then produce the correct material number that describes the exact part.

4.3.2 Current spare part numbering

The advantage of the current system and numberings is of course that if needed, it is possible to change the combination, or the engine number, or make other small changes, and there is no need to notify the customer if not necessary.

When looking at a spare part picture, one can see that the spare part numbers are today divided into two parts. The first part has three numbers and the second part has four numbers with a space between them. The first three numbers have a logical meaning also called significant part number. The meaning of the numbers can be found in a list made by Wärtsilä. The second part of four numbers is just a series of dummy numbers, also called non-significant numbers, which are consecutive numbers that have no meaning at all. The current system really becomes a hybrid spare part numbering system, also called a semi-significant spare part numbering system.

The problem with today's system is that it demands a lot of resources, because the spare part number is inserted in the illustration. The part numbers today have a reuse function, which means that you have to manually find and locate the correct number for the part in need of this number. Take for example a big module that has many spare parts and many pages that need coding. It can take hours to find them all and in a worst case scenario even days. Of course it should not take days and, if that is the case, people can become somewhat lazy and easily open a new spare part number. As soon as people notice how easy it is to open a new number, they become lazier and may do this more frequently and when doing so they create more unnecessary part numbers and duplicates, which is not good for the database.

4.3.3 Future solutions

One thought in the future vision of the spare part system is that you could only have the positions in the picture and the codes in the database. One other thing that came up is the combination of the old system with a new system, in other words to keep the main groups that already exist, which are the numbers of the whole section, for example 350-, and then combine them with a new system. This system could work together with the part list from the drawing, in other words the item number in the list of the spare part section and the

numbers in the spare part picture could be connected to the drawing picture which the designers make. When the documentation engineers make the spare part section you could easily have for example a check box for each item in the drawing. If one only wants numbers 1, 2, 3, 5 and 7 from the drawing, one would then easily transfer them to the section one is working on and in the spare part picture it could say 01, 02, 03, 05 and 07, and in the list of the spare part section there could be the same numbering. The customer that places the order from the spare part catalogue could easily give the product number and the section number and then which spare part he would like, for example 01, 02, and 05.

There are of course customers that tend to make errors even though the instruction is very clear as to what number they need to give Wärtsilä when ordering their spare parts. One way to maybe avoid this is to have the whole number in the list of the spare part section and only the last numbers in the picture. For example the section name is 352-0001 and in the picture there are numbers 01, 02, 03 etc. and in the list it could say 352-0001-01, 352-0001-02, 352-0001-03 etc. In other words, the customer who places the orders only needs to provide the product number and the number in the spare part list of the section that the customer need, for example PAAE01 for the product number and 352-0001-02 for the part number.

This solution means that the PDM system which is currently under construction needs to work perfectly. The designer that creates the drawing has filled in the correct description of all the items in the list, so that the documentation engineers only need to put everything together without unnecessary problems. There are of course times when the designers and the documentation engineers have the same descriptions or names for the spare parts in question, This could be done with some kind of priority check so that the documentation engineers could easily change the description to what they think is suitable but this is only done if they feel it is necessary. The designers' description is of course always set as default, which means that the designer always has to type in the description for the item when making the drawing. A function like this has to be integrated in the PDM system so the designer is not even allowed to make the item unless he puts in the description for the item.

The system today is very likely to have human errors. Every section and every number that are made today are picked and entered by the documentation engineers and this increases

the risk for errors. The new system on the other hand would be better at preventing this risk because of the integrated automatic functions and it would also have a great re-usability.

4.4 Second interview

This interview was done with Arto Nikula who is the General Manager of Services, PDM. Tommy Rodas and Tommy Wester were also present during this interview. The systems and solutions that came up during this interview are meant to work as guidelines for a possible future system solution.

During this interview we spoke a lot about ISO standards and many other systems which companies use worldwide. The standard and the kind of system that may be used were taken from a document called International Standard IEC 81346-2 and this document or system is similar to what Wärtsilä uses today except that it uses both the head classes of objects and subclasses.

Classes of objects according to their intended purpose or task
(Codes A to D)

Code	Intended purpose or task of object	Examples of terms describing the intended purpose or task of objects	Examples of typical mechanical/fluid components	Examples of typical electrical components
A	Two or more purposes or tasks NOTE This class is only for objects for which no main intended purpose or task can be identified.			
B	Converting an input variable (physical property, condition or event) into a signal for further processing	Detecting Measuring (picking-up of values) Monitoring Sensing Weighing (picking-up of values)	Orifice plate (for measuring) Sensor	Buchholz relay Current transformer Flame detector Measuring relay Measuring shunt (resistance) Microphone Movement detector Overload relay Photocell Position switch Proximity sensor Proximity switch Smoke sensor Tachometer Temperature sensor Video camera Voltage transformer

Figure 8. International Standard classes of objects. (IS, 2013)

Main class E Providing radiant or thermal energy		
Code	**Definition of subclass based on generated output and method for generation**	**Examples of components**
EA	Generation of electromagnetic radiation for lighting purposes using electrical energy	Fluorescent lamp, fluorescent tube, incandescent lamp, lamp, lamp bulb, laser, LED lamp, maser, UV radiator
EB	Generation of heat by conversion of electrical energy	Electrical boiler, electrical furnace, electrical heater, electrical radiator, electrode steam boiler, heating rod, heating wire, infrared heating element
EC	Generation of cooling energy by conversion of electrical energy	Compression chiller, cooling unit, freezer, freezing unit, Peltier element, refrigerator, turbine-driven chiller
ED	*Not used*	
EE	Generation of other electromagnetic radiation by means of electrical energy	

Figure 9. International Standard, main class E with its subclasses. (IS, 2013)

One other system we went through was Spare Part Segment Commodity (SPSC). SPSC, which is a large list or database companies use as their part numbering system. The system covered all from animals to computers and engines. It has a spare part length of eight numbers and that covers more than a large company needs over its entire lifetime. If the spare part number has the length of seven numbers, it covers around 10 million items and, with one more number the items increases with three more numbers from the 10 million. This is similar to what was discussed in the first interview, regarding a possible new system.

UNSPSC Codeset — Commodity — V13.1201

Segment	Segment Title	Family	Family Title	Class	Class Title	Commodity	Commodity Title	Definition
23000000	Industrial Manufacturing and Processing Machinery and Accessories	23270000	Welding and soldering and brazing machinery and accessories and supplies	23271400	Welding machinery	23271404	Plasma arc welding machine	Plasma-arc welding machines use a concentrated stream of plasma, and ionized hot gas, composed of nearly equal numbers of electrons and ions. Plasma-arc welds create deeper and narrower welds on a variety of metals.
23000000	Industrial Manufacturing and Processing Machinery and Accessories	23270000	Welding and soldering and brazing machinery and accessories and supplies	23271400	Welding machinery	23271405	Laser welding machine	Laser beam welding utilizes a high-power laser beam as the source of heat to produce a fusion weld.

Figure 10. UNSPSC. Codeset (SPSC, 2013)

The last system that was brought up during this interview was a document called Product Life Cycle Support (PLCS), and this is an international standard ISO 10303. This system is used by many companies such as the Finnish Defence Forces, the Department of defence, SAAB and Rolls-Royce etc.

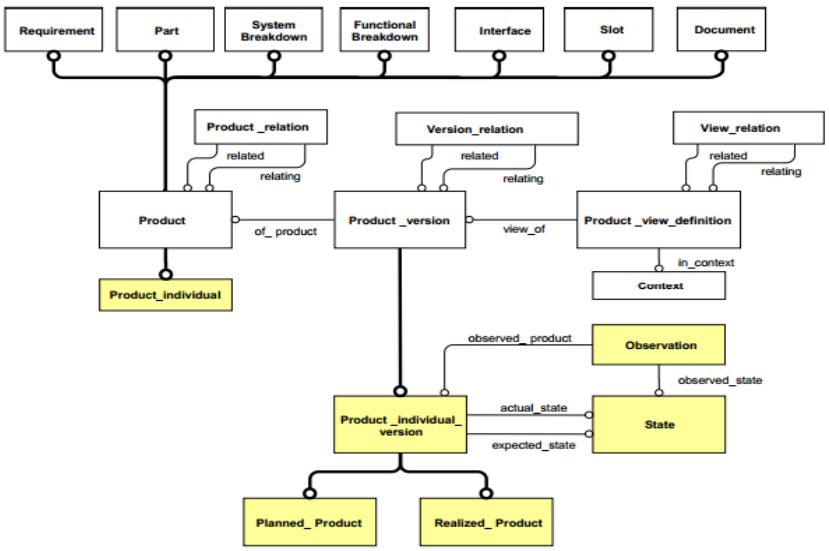


Figure 11. Product individual state. (ES, 2013)

5 Current way of working

A short explanation will be presented below to get a better understanding of the process when creating spare part data. Figure 12 below shows a simplified overview of the processes behind the creation of spare part data.

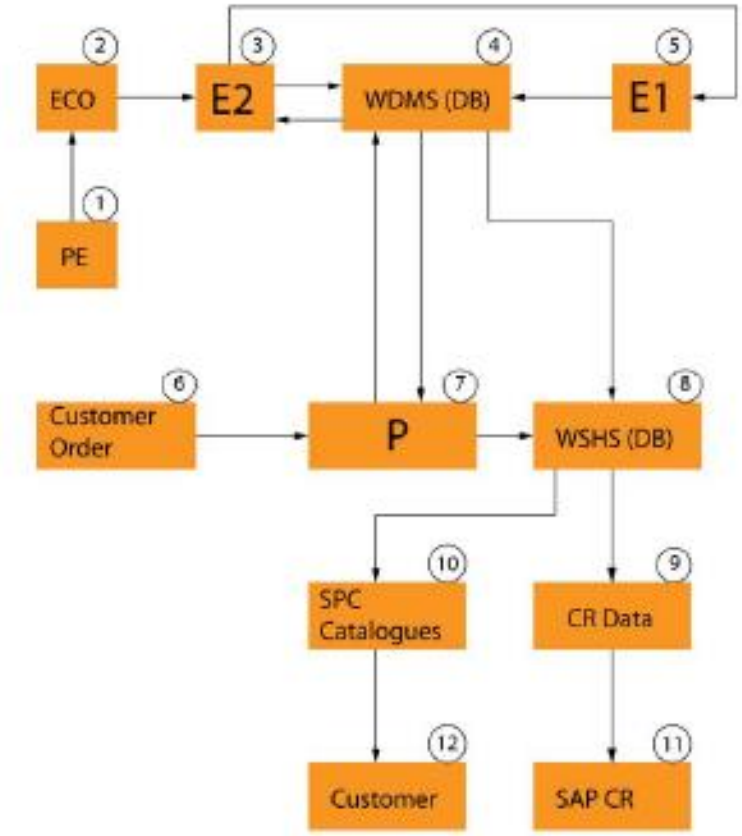


Figure 12. A general overview of the three core processes contributing to the creation and delivery of spare part related information within TI Finland. (Rodas, T., 2010, 62-66)

First step: Product Engineering (PE)

The first step PE, also called product engineering organisation, is the stakeholder that owns the design of the product. When a design change is made that is related to a Wärtsilä product, like a new or updated drawing, material number, component or assembly, the product engineering department issues an engineering change order, also known as an ECO, which represents the design change within the entire Wärtsilä organisation. The ECO can contain information about material numbers, drawings, components, or assemblies. If it has not been released by a change order, the material, component or drawing does not exist within Wärtsilä. (Rodas, T., 2010, 62-66)

Second step: Engineering Change Order (ECO)

The change order contains all information which is relevant regarding the design change, for example the reason for the change, precisely what has been changed and why it has changed. The ECO also consists of information that tells which products it is related to. (Rodas, T., 2010, 62-66)

Third step: The E2 process

Within TI, the E2 process logs every change order that is related to TI's area of product responsibility. The E2 process is split up into separate product groups which reflect the organisational setup of the owner of the products. Within TI, each product group has its own dedicated team of senior documentation engineers and documentation engineers. The senior documentation engineer has the responsibility to log and identify change orders that affect the product he is responsible for. When the senior documentation engineer identifies a new change order, he must decide and check if the change will affect the spare part information. The senior documentation engineer must also do a preliminary check, to see that the change order is complete and that it contains all the needed information so that the documentation engineer will be able to complete the information modules related to the changer order and also verify if a new external component that has been released is required. This then means that in the change order all the basic data must be specified: the product type, affected systems, possible new modules, drawings and material numbers.

If a new external component is identified, a deeper analysis is required to verify if the component requires an additional spare part structure. External components which are used in every module and assembly and that lack the spare part structure can't be completed or approved by the E2 process. A request for the structure is to be issued to the E1 process, if external components that are lacking the spare part structure are identified. The request is for the E1 process to retrieve, create and attach the spare part structure. When the senior documentation engineer has done the preliminary check and all the relevant information is correct, the senior documentation engineer then estimates the time that he thinks is required for the E2 process's documentation engineer to create and attach a new or updated spare part list and then to link the spare part numbers to the correct and corresponding material numbers in the PDM system's assembly structure.

When all data has been created and attached, the spare part information module is then created and complete.

The last thing and the final step to take is to transfer the information module to the Wärtsilä specification handling system, also known as WHSH, so that the information can be used by the delivery process, also called the P-process.

The tasks are being communicated via the Microsoft project through the PDM system, to both the senior documentation engineers and the documentation engineers. The tasks are being engineered and then reported back according to the senior documentation engineer's schedule. The tasks are then picked out by the documentation engineers from the Microsoft project's work list and the ECO is then marked as "in process" in the PDM system. When all is complete and the information module is done it is marked as "completed" in the ECO. The senior documentation engineer then evaluates the attached spare part information as soon as it is marked as "complete". If everything is in order and all the spare part information is accurate the information modules and the change order are approved. This is done in the PDM system, whose change order's status is set to "approved". After all of this is done, the status is changed in the Microsoft project's work list to completed. (Rodas, T., 2010, 62-66)

Fourth step: Wärtsilä Document Management System (WDMS)

WDMS is used as an engineering tool when creating product structures, modules, system structures, assemblies and new material numbers. It is used internally by several product engineering organisations. Drawings that are relevant are also released and linked in WDMS to its corresponding material numbers. (Rodas, T., 2010, 62-66)

Fifth step: The El process

To create and maintain spare part related material structures is the main duty of the E1 process. The major part of the input in the E1 process is coming from the E2 process. The required spare part information from internal and external vendors and other third party stakeholders is retrieved when the E1 process is initiated, depending on the component in question. The E1 process creates and adds the spare part structure to the component's material number based on the information which is received. (Rodas, T., 2010, 62-66)

Sixth step: Customer Order

Power Plants, Ship Power and Services are the three internal business units that Wärtsilä consists of. When one of the business units has sold a Wärtsilä product, it issues one order to the factory and another to Technical Information for the mandatory product documentation. (Rodas, T., 2010, 62-66)

Seventh step: the P process

In Wärtsilä's ERP system, called SAP, documentation orders are being created by the help of a notification. The P process is used to identify an order. When it has identified an order for documentation, the next step is that the P process starts to crosscheck the product engineering made product structure and try to verify that the spare part related information module created by the E2 process is engineered and linked to the product structures' every module. This is done by the help of a tool that is integrated in the PDM system for crosschecking purposes. If any of the information modules are incomplete, the E2 process is initiated by a claim that requests the P process to deliver the missing information modules that are required for the product in question. As soon as all the necessary information modules are engineered and linked to the product's structure, the P process can start to compile the spare part related information modules into complete serial numbers that are specific customer-oriented spare part catalogues and internal code resolution packages required by the spare part sales process. This is also done by tools that are integrated in WSHS based on the structure of the products that are transferred to WHSH from the PDM system. (Rodas, T., 2010, 62-66)

Eighth step: Wärtsilä Specification Handling System (WSHS)

WSHS is a system that is only used by organisations that are dealing with the creation of spare part related information. WSHS is the master register for spare part numbers, lists and spare part related information modules. It is also used when transferring spare part related information modules to WSHS from the PDM system and then eventually into the ERP system. (Rodas, T., 2010, 62-66)

Ninth step: SAP CR data

The system called SAP CR maintains the product structure throughout the product's lifecycle. The P process transfers the "as built" product structure from WDMS to WSHS and then to SAP CR. SAP CR data with the spare part numbers and the corresponding

spare part catalogue is what Services' spare part business is based upon. (Rodas, T., 2010, 62-66)

Tenth step: Spare Part Catalogue (SPC)

The spare part catalogue contains all the information needed by the customer in order to identify and order spare parts. The spare part catalogue also contains information that explains how to use, read and interpret the spare part catalogue. The product's serial number is always stated at the beginning of the catalogue. When customers order spare parts, Wärtsilä requires the product's serial number along with the spare part number. The rest of the information is automatically handled by the help of the spare part data, which is created by Technical Information and transferred to SAP CR. (Rodas, T., 2010, 62-66)

Eleventh step: SAP CR

Every Wärtsilä product that Wärtsilä wants to support throughout its entire lifecycle must be transferred to SAP CR. The product's lifecycle management (PLM) is initiated in SAP CR. The product's structure is also maintained and updated in this environment. When a product that belongs to any customer's installation is updated or modified, the same modification must be made to the product's structure in SAP CR. The electronic product structure in SAP CR has to reflect the current product structure of the product in the customer's installation. If this is not correctly performed, the customer could end up with the wrong spare parts, because the combination of the serial number and the spare part number may point towards a material number that is no longer correct and in use. (Rodas, T., 2010, 62-66)

Twelfth step: Customer

In the spare part catalogue that the customers have, each available spare part is coded behind a Wärtsilä-based spare part number. When a customer puts in an order for a spare part the customer is to give the serial number and the spare part number of the product. Then the Wärtsilä service personnel enter this information into SAP CR. The actual code is then unlocked and they can read the actual material number of the coded part behind the spare part number. This then tells the service personnel exactly which material number to dispatch to the customer. (Rodas, T., 2010, 62-66)

6 Part numbers

Within companies, part numbers are used to assign a unique identity to different components, which are approved for specific applications when the items are tracked within the company. Correct and consistent part identification is essential for correct product assembly, maintenance and testing. The numbers are assigned for tracking purposes and referencing records etc. In many companies part numbers can become a source of money wasting and time spending if used unwisely and with the wrong system.

The first thing to consider is how part numbers should be assigned to things. Some people believe that a part number should have some unique intelligence built into it, or some significance, to describe what part has that specific part number. By looking at the part number, one should be able to have an idea of what the item is. In this case the part number really becomes the description of the particular part and usually each digit in the part number has a specific meaning. But then some people say that a part number should just be a number, any number, which is just unique to an item and doesn't tell you anything about the parts. These two approaches are usually referred to as significant part numbers and insignificant part numbers. (Clement et al. 1992, 1-45 ; Watts, 2008, 51-133)

6.1 Insignificant or non-significant part number system

In companies, usually everything has numbers and names, even the employees have numbers. I have never really cared about the employee number of a co-worker, more about his/her name. It is quite similar when talking about the insignificant part numbering system. When you have a part number for a particular part, the number alone is not important in an insignificant part numbering system, but the description is. That is the whole idea with insignificant part numbers, also called non-significant part numbers.

In an insignificant part numbering system, numbers are assigned in any order, with any number, to any part or assembly. With an insignificant part numbering system it is possible to create as many part numbers that are needed, for a design purpose or when specifying something. One can give each item any number in any order because the number has no relationship to the thing that is being designed. For example if the first thing that is assigned a part number is a washer and the second number is assigned to a hose, everything will work just fine in an insignificant part number system. (Clement et al. 1992, 1-45 ; Watts, 2008, 51-133)

The advantages of non-significant part numbers are usually:

- Assignment is faster.
- Remembering is easier.
- Human errors are less likely to occur.
- It is faster to enter into systems.

6.2 Significant part number system

Significant part numbers are numbers that are assigned to a part based on what that part is, or other things like where it is used. With significant part numbers you have to know what the thing is you are assigning the number to, before you search for the number or create a new number. The part number is in fact created by the part that you are assigning it to, based on things like what the part is, where it is in use, what product it is used for or even when the part was created.

Significant part numbers are more complicated than insignificant part numbers, and usually much longer. Companies that use significant part numbers have rules and procedures when creating part numbers, for example Wärtsilä has their own design and a list for the procedure too. Significant part number systems are sometimes referred to as intelligent part number systems. (Clement et al. 1992, 1-45 ; Watts, 2008, 51-133)

6.3 Semi-significant or hybrid systems

A hybrid part numbering system is a combination of the two above. The first significant class code numbers can be used as a prefix separated from the rest of the insignificant part numbers by a dash. For example a three-digit class code of 100 might be an engine block and 400 might be exhaust devices. This comes in handy when you search and quickly need to find what type of group and significant number that specific part begins with.

> **"An item number identifier that uses a small portion of the number, normally the first few characters, to categorize it as part of a group and random characters for the rest." (PLM, 2013)**

6.4 Part number length

A well working part numbering system design should take into account the limits of short-term memory. The know limit is typically considered to be 7 digits. I have also experienced when working that data entry errors increase as the length of the number you are supposed to memorize increases. Take for example a phone number that usually starts with 050 or similar, which are then followed by seven numbers.

Any numbers longer than seven, most users are required to write down rather than remembering the number for short-term memory usage. This increases the likelihood of data-entry errors. (PLM, 2013)

6.5 Part number characters

Part numbers are usually used as the filename when importing bills of materials (BOM). That's why it is good practice to avoid using characters that are commonly incompatible with filenames on a computer, such as / and * symbols. Also avoid underscores, where for example 20_605_101.pdf becomes 20 605 101.pdf. The safest delimiter character is usually "-" for example 20-605-101.

When creating part numbers with numeric characters, the use of a hyphen as an option for a delimiter will provide a fast data entry for employees constantly working with a wide variety of part numbers.

There is also one thing to keep in mind. Never start a part number with a "0" (zero) character. A number with a leading 0 has two side effects. Some people write 987 for your part 000987, and some computer applications discard all leading zeroes during import, making a mess for example of the bills of materials. (Clement et al. 1992, 1-45 ; Watts, 2008, 51-133)

> **"Five to seven numeric characters permit a universe of up to 10 million (without leading zero, 9 million) unique parts, far more than most companies will see over their entire lifespan." (PLM, 2013)**

7 Authorities

Many experts give recommendations to use short, numeric-only, non-significant item numbers. Here are some comments I found interesting:

Clement, et al.: ***Manufacturing Data Structures*****, page 20:**

> **"Another important point about item numbers is that they should be as short as possible. Part numbers are keyed, copied and used as verbal identifiers. The shorter the numbers, the more accurate people can be. Obviously, the greater the number of digits in a part number, the greater chance of error. We also recommend that only numeric digits be used." (PLM, 2013 ; Clement et al. 1992, 20)**

Garwood: ***Bills of Materials: Structured for Excellence*****, page 73 (author's emphasis):**

> **"The solution...is to use shorter *non-significant* part numbers. We have found that part numbers of 5 or 6 digits are the most effective." (PLM, 2013)**

Mather: ***Bills of Materials*****, page 100:**

> **"All tests point to numbers alone as being more easily identifiable with far less chance of error... Tests have also shown that smaller numbers are easier to write and remember accurately. Hence, the ideal part number is all numeric with as few characters as possible." (PLM, 2013)**

Monahan: ***Engineering Documentation Control Practices and Procedures*****, page 33:**

> **"I prefer a non-significant number because there is a longer life and less error... Typically, companies run out of numbers in certain categories of a significant number. Also, a non-significant part number is more cost-effective to use than a significant part number." (PLM, 2013)**

Watts: ***Engineering Documentation Control Handbook*****, page 49:**

> **"The most critical of these issues is that, over time, the significant numbering systems tend to break down. ... As time passes, variations arise which were not foreseen. One digit was set aside where two are now needed. Significant numbers thus tend to lose their significance. They no longer do the classification coding function intended by their inventors." (PLM, 2013 ; Watts, 2008, 49)**

8 Conclusion and recommendations

The conclusion of this thesis includes giving some points of view and recommendations about what I found out and how the result of it all would come to help Wärtsilä in the future when choosing and creating a new part numbering system. The new system that Wärtsilä eventually will start to use also needs to be a working and reliable system for many years to come in order to be as cost reducing and time saving as possible.

8.1 Pros and cons

When comparing the information that I found with the old system, there are a lot of things that could result in a better working and more reliable system. The new system will have a fully working automatic function connected with the PDM system, which is still under construction. It all starts from the creation of the drawings. The designers that create the drawings need to have the numbers and the description entered correctly into the database in order for the documentation engineers to proceed with the work as easily as possible.

This could work best with a database that simply binds it all together and that has the needed checkboxes and information from the drawings, and also the possibility to change the priority of descriptions if the documentation engineers have the need to do that. All of the numbers and the descriptions will be connected together in Wärtsilä's hierarchy so that the information system will be as easy and fully working as possible.

When cleaning and putting together the section, everything will work with automatic functions such as the numbers in the part list and in the spare part picture and even the description of the parts. This is something that does not work with today's system and everything is basically entered manually.

The thought of keeping the current system's logic but improving the automatic function in it was one of the things that came up in this thesis. Wärtsilä's own significant list would still be in use and could be improved with a few more numbers and easier logic. Ten numbers could be something like 352-0001-01. The first three numbers would be the section number, which is the significant number from Wärtsilä's own significant list, and the four numbers after that are simply insignificant and continuous with no special

meaning at all. The two last numbers will of course be the numbers from the drawing with the automatic function.

There may be a problem of space in the part list of the section but it will be easier when the customer places orders because he only needs to enter the product number and then the numbers in the part list of the parts that are needed. If only two numbers are chosen for the part list, there is a greater risk of errors made by the customers that places the orders. Choosing only two numbers may also cause confusion if used because the last two numbers which come automatically from the drawings will be used on every section in the spare part catalogue and could then mean that the customers may not receive the correct parts or even create more work for the personnel at Wärtsilä. This will perhaps be the easier system to use when thinking about space in the part list of the section, otherwise it may cause the making of unnecessarily many pages in the spare part catalogue.

As of the beginning of 2014 the customers will start to place the orders online and the second mentioned solution may then work best if only the order system is made so that the customer must enter the correct and needed information so that there is no possible way for the customer to make mistakes when completing the order.

There are still some aspects that could be discussed and worked on but I hope that this thesis will help Wärtsilä when choosing and implementing a new system in the future.

References

Printed sources

Clement, J., Coldrick, A. & Sari, J. 1992. *Manufacturing Data Structures*. United states: Wiley.

Rodas, T. 2010. *Change Management Related To Introducing New Products Within Wärtsilä Finland's Technical Information Unit.* Master's thesis. Novia University of Applied Sciences.

Watts, F.B., 2008. *Engineering Documentation Control Handbook*. Third Edition. United States: Willam Andrew Inc.

Electronic sources

ES, 2013. Eurostep, Enterprise information standards. (Read 15.4.2013)

IS, 2009. International Standard IEC 81346-2, Wärtsilä intranet. (Read 17.4.2013)

PLM, 2013. http://www.buyplm.com/plm-good-practice/part-numbering-system-software.aspx. (Read 15.4.2013)

SPSC, 2013. UNSPSC, Wärtsilä intranet. (Read 16.4.2013)

Wärtsilä WDMS, 2013. Wärtsilä Document Management System. Wärtsilä intranet.

Wärtsilä WSHS, 2013. Wärtsilä Specification Handling System. Wärtsilä intranet.

Wärtsilä Drawing, 2013. Wärtsilä Documentation Drawings. Wärtsilä intranet.

Wärtsilä SPP, 2013. Wärtsilä Documentation Catalogue Spare Part Picture. Wärtsilä intranet.

Wärtsilä, 2013a. http://www.wartsila.com/en/about/company-management/strategy/mission-vision. (Read 23.3.2013)

Wärtsilä, 2013b. http://www.wartsila.com/en/about/company-management/strategy/values. (Read 23.3.2013)

Wärtsilä, 2013c. http://www.wartsila.com/en/about/company-management/history. (Read 23. 3. 2013)

Oral sources

Wärtsilä Finland Oy, Services

Nikula, Arto, Project Manager, Services PDM,

- Informal interview, 12 April 2013

Rodas, Tommy, Manager, Contents Management.

- Continuous informal discussion, September 2012 to May 2013

Sjöholm, Stefan, General Manager, Process Development & Quality Management,

- Informal interview, 22 March 2013

Wester, Tommy, Team Leader, SPCM, 3X team.

- Continuous informal discussion, September 2012 to May 2013

Interviews & Meetings

Meetings held in Wärtsilä in relation to this thesis:

Meeting	27.09.2012
Meeting	23.11.2012
Meeting	15.03.2013
Meeting	22.03.2013
Meeting	12.04.2013