

Bachelor's thesis

Mechanical and Production Engineering

Product Development

2014

Lasse Lehtilä

# A REVIEW OF AUXILIARY SPARE PARTS DOCUMENTATION IN A POWER PLANT INSTALLATION

– the current situation and development solutions



TURUN AMMATTIKORKEAKOULU  
TURKU UNIVERSITY OF APPLIED SCIENCES

OPINNÄYTETYÖ (AMK) | TIIVISTELMÄ

TURUN AMMATTIKORKEAKOULU

Kone- ja tuotantotekniikka | Tuotekehitys

2014 | 36

Ohjaajat Paavo Riski, Matti Riitto (Wärtsilä)

Lasse Lehtilä

# A REVIEW OF AUXILIARY SPARE PARTS DOCUMENTATION IN A POWER PLANT INSTALLATION

Työ tehtiin toimeksiantona Wärtsilälle. Työn tarkoituksena oli tarkastella ja analysoida apulaiteosien dokumentaation tilaa ja tuoda esille parannusehdotuksia. Tarkastelu tehtiin sekä asiakkaan että Wärtsilän työntekijöiden näkökulmasta. Tarkoitus oli löytää parannuksia, joiden kautta asiakasta pystyttäisiin palvelemaan paremmin ja helpottamaan Wärtsilän myynnintukihenkilöstön työkuormaa.

Työn teoriaosuus käsittelee tuotetiedonhallintaa ja jälkimarkkinointipalveluja sekä näiden vaikutusta toisiinsa. Käytännön osuudessa tarkastellaan ja arvioidaan dokumentaation nykytilaa ja dokumentointijärjestelmiä ja tuodaan esille parannusehdotuksia. Tietoa kerättiin aiheeseen liittyvistä dokumenteista, jotka löytyy Wärtsilän tietokannasta. Tietoa hankittiin myös kyselyillä, joihin vastasivat asianosaiset Wärtsilän työntekijät.

Dokumentaation tarkastelussa löydettiin paljon hyviä ja huonoja puolia. Useisiin kohtiin pystyttiin löytämään parannusehdotuksia, joilla dokumentaatiota pystyttäisiin kehittämään. Aikaa, joka menee asiakkaan kyselyyn vastaamiseen, pystyttäisiin lyhentämään näillä parannuksilla. Tämä parantaisi asiakastytyvääisyyttä ja sitä kautta myynti saattaisi lisääntyä. Myös Wärtsilän myynnintukihenkilöstön työkuorma vähentyisi.

Työ sai hyvää palautetta toimeksiantajalta. Työn tavoitteet saavutettiin ja tulokset ovat mielenkiintoisia ja käyttökelpoisia. Tuloksia pidettiin luotettavina ja kattavina. Tuloksista saattaa olla hyötyä myös tulevaisuudessa. Jos apulaiteosien dokumentaatiota päätetään myöhemmin kehittää, työn tuloksia voi käyttää lähtötilanteen määrittämiseen.

## ASIASANAT:

PDM, tuotetiedonhallinta, jälkimarkkinat, dokumentaatio, kehittäminen, varaosamynti, voimalaitos

BACHELOR'S THESIS | ABSTRACT

TURKU UNIVERSITY OF APPLIED SCIENCES

Mechanical and Production Engineering | Product Development

2014 | 38

Instructors Paavo Riski, Matti Riitto (Wärtsilä)

Lasse Lehtilä

# A REVIEW OF AUXILIARY SPARE PARTS DOCUMENTATION IN A POWER PLANT INSTALLATION

This thesis was commissioned by Wärtsilä. The purpose of the thesis was to review and analyze the current situation of auxiliary parts documentation and suggest solutions for improving the documentation. The idea was to analyze the documentation and improvements both in view of the customer and Wärtsilä employee. The aim was to provide improvements which would serve customers better in the after sales and enhance the work of Wärtsilä's sales support personnel.

The theoretical framework deals with product data management and aftersales services and their affect on each other. The practical part analyzes and reviews documentation situation and systems. Information for the practical part was gathered from documents and files found from Wärtsilä database. A lot of information was also gathered with surveys answered by related Wärtsilä's employees.

A lot of pros and cons were found as a result of the review. Development solutions were found for most of the issues. These solutions would improve the documentation. Response time to customer's inquiries could be reduced with improved documentation. This would increase customer satisfaction and sales. The work load of Wärtsilä's sales support personnel would also decrease.

The thesis received good feedback from the company. The Targets set for the thesis were reached and the results were both interesting and useful. The results were considered reliable and comprehensive and could be useful in the future as well. The results could be used as a starting reference if documentation of auxiliary spare parts is decided to be improved.

## KEYWORDS:

PDM, Product Data Management, aftersales, documentation, development, spare part sales, power plant

# SISÄLTÖ

<b>ABBREVIATIONS USED</b>	<b>6</b>
<b>1 IMPORTANCE OF DOCUMENTATION IN AFTERSALES</b>	<b>7</b>
<b>2 DATA MANAGEMENT AND AFTERMARKETS</b>	<b>8</b>
2.1 PDM - Product data management	8
2.1.1 PDM as a concept	8
2.1.2 PDM System	9
2.1.3 Product structure	10
2.1.4 Benefits of PDM-system in product data management	12
2.1.5 Improving product data management	14
2.2 Aftersales, value added service and life cycle approach	16
<b>3 REVIEW OF DOCUMENTATION</b>	<b>18</b>
3.1 Power Plant process of coding	18
3.2 Review of auxiliary code resolution	19
3.2.1 General characteristics and usage	19
3.2.2 Evaluation and development solutions	21
3.3 Review of IDM – integrated document management	23
3.3.1 General characteristics and usage	23
3.3.2 Evaluation and development solutions	26
3.4 Review of AMS	27
3.4.1 General characteristics and usage	27
3.4.2 Evaluation and development solutions	28
3.5 Review of tablet application	29
3.5.1 General characteristics and usage	29
3.5.2 Evaluation and development solutions	30
3.6 Documentation and utilizing of documentation in network companies	32
<b>4 CONCLUSIONS</b>	<b>34</b>
4.1 Results	34
4.2 Further analyzing of the results	35
<b>REFERENCES</b>	<b>36</b>

## PICTURES

Picture 1. Structure for process of coding .....	19
Picture 2. Example of auxiliary code resolution .....	20
Picture 3. Finding the correct spare part in the CR.....	21
Picture 4 Basic structure of IDM.....	24
Picture 5. IDM Interface .....	25
Picture 6. Exploded view of a unit in AMS catalogue (Wärtsilä 2014).....	27
Picture 7. Example interface of the tablet application (Wärtsilä 2014).....	29
Picture 8. Example interface of the tablet application (Wärtsilä 2014).....	30

## **ABBREVIATIONS USED**

PDM	Product Data Management (Lähdeviite)
AUX CR	Auxiliary Code Resolution
AMS	Auxiliary Module Structure
RFID	Radio Frequency Identification
EQP	Equipment part
IDM	Integrated Document Management
SPN	Spare Part Number
R&D	Research and development
NC	Network company
PC	Part company

# 1 IMPORTANCE OF DOCUMENTATION IN AFTERSALES

Lately the importance of aftersales and services has increased significantly. Customers are requesting better, faster and cheaper solutions to service and spare part inquiries. Products and solutions develop quickly and new products and versions enter the market constantly. These factors set great demands for efficient and functioning service and spare part operations especially when competing in global markets. Product data management offers good solutions and methods for these ever increasing demands in aftermarkets. (Sääksvuori & Immonen 2002, 44).

Wärtsilä is one of the leading companies providing power generation solutions worldwide. The Main industrial fields for Wärtsilä are power plant, ship power and offshore. Effective aftersales services and spare part sales are very important in these industrial fields. Functioning documentation and product data management is one of the most important factors in after sales. Therefore also Wärtsilä needs to develop documentation in order to able to compete in aftermarkets.

The purpose of the thesis was to review and analyse the current situation of auxiliary parts documentation in Wärtsilä and suggest solutions for improving the documentation. The idea was to analyse the documentation and improvements in view of both the customer and a Wärtsilä employee. The target was to provide improvement solutions which would serve customers better in the aftermarkets and enhance the work of Wärtsilä's sales support personnel.

The findings of the thesis are based on information gathered from Wärtsilä's files concerning the subject. A lot of information is also gathered with surveys answered by Wärtsilä's employees. Topic supporting theory has also been included.

## 2 DATA MANAGEMENT AND AFTERMARKETS

### 2.1 PDM - Product data management

#### 2.1.1 PDM as a concept

PDM (Product data management) is not just a single computer program or method. It is an extensive functional system, a systematic method which controls product data. This consists of data creation, processing, sharing and downloading. (Sääksvuori & Immonen 2002, 18)

Competition is becoming harder all the time. This causes constant pressure for change in companies. The speed of changes is incredible and life cycles of products are becoming shorter. The number of variations in product categories is increasing when products are manufactured increasingly according to the needs of customers. All this requires ability to change constantly and renew products and processes in a corporation. These are the factors which lead to product data management. (Sääksvuori & Immonen 2002, 97)

There are typically two concrete problems in product data management in common everyday functions of a company:

1. There are many different data processing and downloading formats in use. Data has been produced for a variety of use. But it should be possible to use the data in different functions of the company.
2. Integrity and non-contradiction of data created in different units and departments of a company cannot be assured. This causes problems when data is restored in various data systems, even on paper. Problems are also caused by different data protection and processing methods between different departments. (Sääksvuori & Immonen 2002, 18)

Currently product data management is usually implemented by using a data program or system. This is not always the only option. Corporations can improve their product data management without any program or system. Rules

and standards can be agreed for data management and processing. Creating a mutual way of working is a key to better data creation and management. Even if a company decides to implement a PDM program, it still needs to have a mutual way of working in product data management. (Sääksvuori & Immonen 2002, 18-19)

Developing and using different product data management systems is based on a functional nomenclature (items). An Item is a systematic and standard way to identify, encode and name a product, part or component of product, material or service. Also documents are identified by items. Items should be uniform and according to either company's own standard or a common standard. The structure of the items groups them in different categories and subcategories according to suitable coarseness. Clear and logical categorizing of items helps to manage them and identify them. Hierarchies between items and item categories should also be considered. There are many standards for creating and uniting nomenclature. (Sääksvuori & Immonen 2002, 19)

On the other hand, many companies are large and global and they have several business departments around the world. Nomenclature can be very different between these departments. In this case uniting the nomenclature is not always the best solution. (Sääksvuori & Immonen 2002, 19-20)

### 2.1.2 PDM System

The PDM-system is a system or software which integrates and manages all business processes of a company. This is the ideal situation. However, the PDM-system is still usually used only to manage single business processes, for example R&D. (Sääksvuori & Immonen 2002, 20)

The implementation of the PDM-system always aims for significant benefits in business developing. Due this the expectations for system projects are high. How well the results meet the expectations depends mostly on how well the company has been able to set the targets and adjust the system to the targets. (Sääksvuori & Immonen 2002, 33)

The PDM-system is usually a large software with many functions and features. These functions and features support data creation, downloading, updating, sharing, utilizing and searching. Typical features of a PDM-system are:

- a) nomenclature managing
- b) managing and maintaining of the product structure
- c) license managing
- d) maintaining status of documents and items
- e) data searching
- f) modifications managing
- g) configuration managing
- h) message managing
- i) file/document managing
- j) preventing data loss
- k) backup file managing
- l) log book
- m) electronic vault, file vault (Sääksvuori & Immonen 2002, 21-23).

The PDM-system is implemented for different reasons in different companies. This depends on the field of industry, manufactured products and above all the objectives which should be reached. The PDM-system offers very useful solutions and tools for different problems. It is, however, wrong to expect that the system itself fixes the actual problem. For one company it can be a tool for more efficient common day working. For another company it can be an investment for the future which helps to take over global markets. (Sääksvuori & Immonen 2002, 28)

### 2.1.3 Product structure

Product structure forms the basis for the PDM-system. Items (parts or components, documents and assemblies) are attached to each other and each product with product structure. Product structure together with nomenclature creates a layout for most features of a PDM-system. Object-oriented featuring

methods are usually used to present the product structure. An Object is a data item which presents a certain part or component, subsystem or assembly. (Sääksvuori & Immonen 2002, 51)

Objects in the structure have different relations between one another. This can be, for example, functionality or compositionality. The structure itself with different levels consists of hierarchies between these objects. Subcategories have the same features than the upper one plus different additional features. For example, switch sensor and analog sensor can be subcategories to sensor. The features of objects can be described with different attributes. Examples of these can be weight, power, item number, cost and drawing number. (Sääksvuori & Immonen 2002, 51)

Here is an example of a product structure of a ship:

1. Product level, only one object:
  - ship
2. System level which divides the product into different systems:
  - area systems – areas
  - hull systems – steel blocks
  - technical systems – HVAC, sprinklers, machinery systems
3. Subsystem level which divides systems into smaller logical entities:
  - room – area can consist of many rooms
  - sub-block – steel blocks consist of sub-blocks
  - subsystem – is a functioning part of the whole system
4. Component level the parts of which are usually very concrete:
  - areas and rooms – include interior components
  - subassembly – is an assembly of sub-block
  - technical systems – are built of components are accessories
5. Object or part level consists of very simple items:
  - for example, a part/material which is a cut shape steel plate or a cut profile pipe in some subassembly

- item can also be an interior component for example a hinge of a cabin door. (Sääksvuori & Immonen 2002, 52-53)

#### 2.1.4 Benefits of the PDM-system in product data management

Today many companies are networked and many different data systems are used in network companies. There can be many specialized CAD-systems, ERP-systems, etc. in use. This creates a huge demand for integration of the systems and data transferring. On the other hand, the most considerable advantages of the PDM-system can be reached in this environment. This also works when a company has many different stakeholder groups with different cultures around the world. Great physical distances and differences between stakeholder groups fade when product data management is applied wisely. (Sääksvuori & Immonen 2002, 99)

The PDM-system is a great tool to improve communications in a company and between companies. This may be the single most important feature of a functional PDM-system. Direct data transmission, document transferring and conversion of different data downloading formats can be improved with the PDM-system. This is very important when data creation programs – CAD for example - are used. Improving communications brings significant benefits. The quality of functions, efficiency and speed can be significantly improved. This is because poor communications and false data decrease in result of the PDM. (Sääksvuori & Immonen 2002, 99)

As a result of better communications and data managing, it is possible to decrease the amount of useless labor. High-quality work which is already conducted can be better utilized, data searching is more efficient and existing system applications can be utilized better. Many researches – for example Coopers & Lybrand in 1994 – have shown that a fairly small part of an engineer's time goes to the actual engineering. About 30 percent of the time goes to data searching, sharing and maintaining. 20 percent of the time is used

for tasks goes to doing something which have already been done. (Sääksvuori & Immonen 2002, 99)

Below is an example of concrete instant benefits achieved with the PDM-system in a certain company:

#### 1. Saving in time

- Time is saved because existing data is easy to use.
- The amount of double work is reduced.
- Part lists are according to the latest updates and available for everyone.
- Correcting data afterwards is decreased.
- History information of parts and drawings can be found.
- Design data is easier to reach: information concerning parts, products, assemblies, etc. can be found easily.

#### 2. Improvement of quality

- Changes in documents can be approved electronically.
- Sharing of change information is faster and more certain.
- Certificates and records can be attached to a product.
- Standards are available for everyone.
- Data protection is improved.
- Flexibility of functions is increased.

#### 3. Decreasing of restricted capital

- Nomenclature is reduced and standardized.
- Stocks are reduced because due the product structure it is known exactly which parts are required in stock.
- Managing of the total load becomes easier due the correct product structures.

None of the above-mentioned benefits are achieved by implementing a PDM-system only. These are typical results of successful change in the way of working in an organization. The same basics are used in many management guides of industrial corporations. Therefore it is important to understand that the PDM-system itself does not automatically improve the efficiency of any

corporation. The system is only a tool which can be used to increase efficiency, break different barrier layers, remove physical distances and overcome difficulties in every-day work. In other words, these benefits can be achieved without using any PDM-system. (Sääksvuori & Immonen 2002, 100-101)

### 2.1.5 Improving product data management

Realizing and understanding the need for change is the first step in improving the PDM in an organization. The impulse for the need for change can be received in many ways, for example, sudden change in the field of industry or competitive situation. These could be, for example, a new owner, fusion or company acquisition. The need for change can also be gradual. Problems in the PDM can cause trouble for a long time before the threshold breaks. But at some point it must be that the present ways of working and tools are not sufficient anymore. (Sääksvuori & Immonen 2002, 76)

A good start for developing the PDM is to represent a vision for the whole organization. This vision determines the needs for development and clear, simple and understandable targets. The actual change occurs only when a new way of working, new processes and systems with reasons are adopted by the employees. Usually one of the greatest risks is insufficient participation by the organization and poor communications. Ignoring the parts of the organization which are affected the most by the changes can cause trouble. In this case one of the most essential factor has been forgotten and the risk for change resistance has increased significantly. (Sääksvuori & Immonen 2002, 89)

The following old competitive elements still affect product management in companies and business strategy in the manufacturing industry:

- Time needed to bring a new product to market (Time to Market)
- Time needed to start mass production of a product (Time to Volume)
- Time needed to implement changes required by customers and markets (Time to Respond)

In addition a new very important the competitiveness element has appeared:

- Response time to service inquiry sent by a customer (Time to Service)

Following conclusion can be made from the above mentioned elements: time talks. ABB's former CEO Percy Barnevik has said that the future doesn't belong to the big, it belongs to the agile. Time to Service is in the topic of this report so here is example of it: (Sääksvuori & Immonen 2002, 162)

### **Response time to service inquiry sent by a customer**

Problem:

A company is losing customers to competitors which have a better ability to produce aftermarket services. Competitors are able to serve customers faster and with shorter response time. Also the availability and quality of the services are better.

Cause:

1. The availability of product documentation is poor at the customer interface. Searching and transferring of product data is very time consuming and difficult.
2. Uncontrollable changes in the life-cycles of products cause contradictions in versions and documents which are out of date.

Indicators:

- delivery cycle from an inquiry to a delivery
- required time to fulfill customer's request
- customer's feedback on services
- ability to keep the promised delivery time
- having new customers in the after sale markets
- turnover of customers.

Development possibilities of the PDM in this section:

- improving the availability of data in customer interface, data searching up-to-date and data available in one place
- decreasing of direct work in searching and transferring of data
- improved ability to serve customers. (Sääksvuori & Immonen 2002, 165-166)

As mentioned earlier, the PDM-project is not primarily an IT-project or system project. Primarily it is a change project. It is a change process which usually affects a large part of personnel of a company. The process requires an overall change in an organization, a new way to think, work and share information and expertise. (Sääksvuori & Immonen 2002, 89)

According to Helin (1998), along with development of information society, information has become one of the four factors of production. Information may be the most important of the four factors others being work, raw materials and capital. Companies are evaluated by their information capital in stock markets. Information has become the most important success factor. (Sääksvuori & Immonen 2002, 89)

## 2.2 Aftersales, value-added service and life-cycle approach

Lately the importance of aftersales and services has increased significantly. Products develop quickly and new product versions enter the market all the time. These factors set huge demands for efficient and functioning service and spare part operations especially when competing in global markets. For these reasons the use of PDM-systems in aftersales has increased a lot. (Sääksvuori & Immonen 2002, 44)

Managing of documents, product structures and nomenclature is very important in aftersales. Data of required spare parts and versions of the manufactured products can be found quickly in a PDM-system. In addition, PDM-systems

using Internet enable complete access to documentations of a product on service site. (Sääksvuori & Immonen 2002, 44)

Local joint contractors are often used to handle service and spare part sales in global markets. Data sharing and availability for these contractors has to be ensured. This way inquiries coming from customer do not overload the main company, the owner of the information. PULL-method can be supported very well with the PDM-system. In PULL-method the customer can search for the required information himself as well. Also managing customers' service information documents, maintaining customer structure and managing nomenclature are easy with a PDM-system. (Sääksvuori & Immonen 2002, 44)

Lately the interest to offer a variety of aftermarket services has increased. Especially traditional manufacturing companies have started to offer value-added services. The target is to cover the entire life-cycle of a product with services which can be up to 30 years for certain capital goods. In this connection reference is often made to Life Time Service and PLM (Product Life Cycle Management). Managing the entire life-cycle of a product and related services has become very important in some branches of industry. The goal is to offer better, further productized and more customized services to customers. Bearing these in mind, companies try to create new business activities, increase sales and maintain steady cash flow. A goal is also to have better predictability of businesses and sales, independence from cyclicity and better managing of customerships. Along with Life Time Service and PLM the term Extended product is used. A good example of this is a component manufacturer which delivers a product to the customer with almost zero percent profit only to have a 10-year service contract. (Sääksvuori & Immonen 2002, 115)

## 3 REVIEW OF DOCUMENTATION

Several systems are used to document auxiliary systems and parts in Wärtsilä. IDM (integrated document management) and CR (code resolution) are in full everyday use in the services business sector. IDM is the most important system for data downloading, maintaining and searching. AMS (auxiliary module system) and tablet application are new solutions. These are still under development and are not yet in full scale use in the services business sector. Process coding forms the product structure and hierarchy for the systems and units. Documentation state in network companies is also reviewed in addition to the systems.

### 3.1 Power plant process of coding

Documentation systems of auxiliary spare parts in Wärtsilä are based on the process of coding. The process of coding is used to present how a hierarchy is built and grouped. Coding shows the place of a certain spare part in the hierarchy. The process hierarchy consists of engines, components, mechanical equipment, modules and signals used in the process and the electrical systems. (Wärtsilä 2014)

The code gives two meanings:

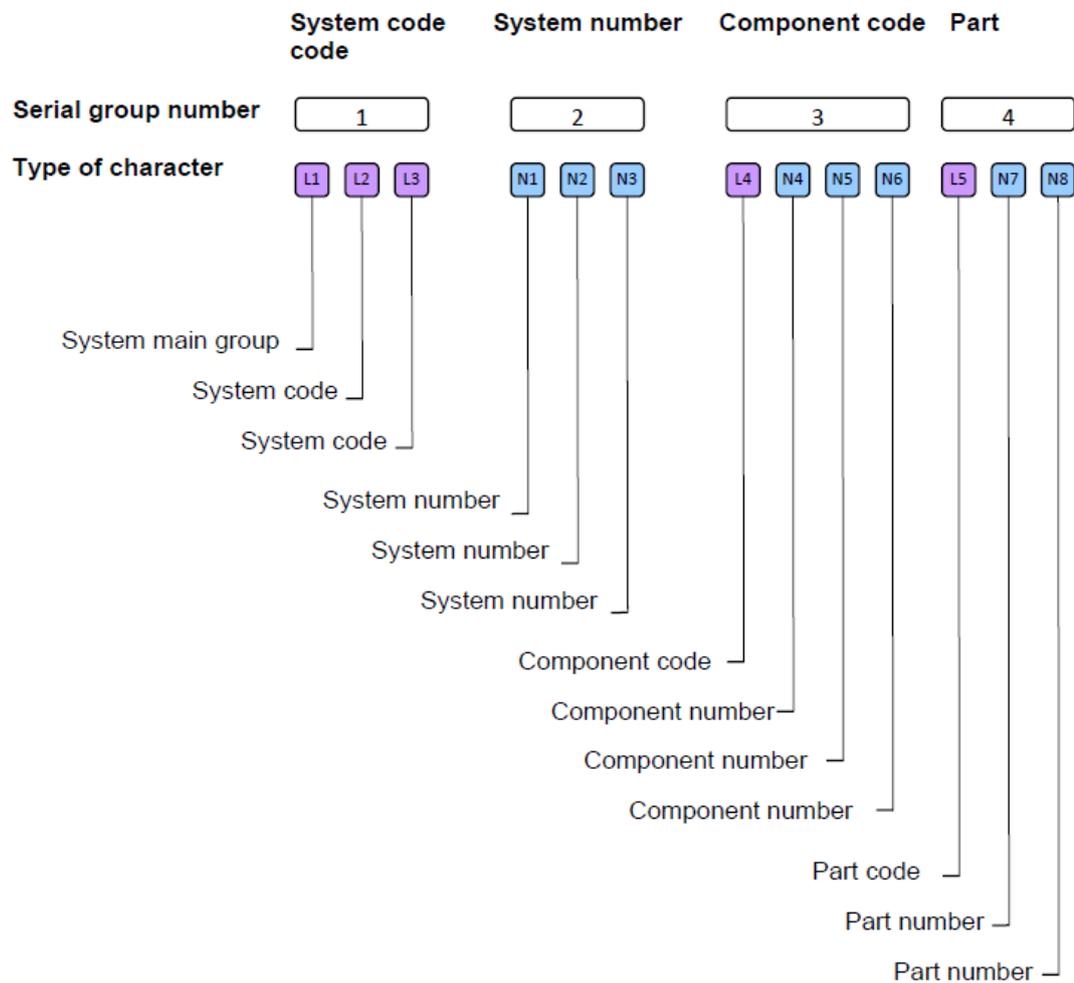
- where the spare part is in the hierarchy
- where in the process the spare part is located.

The structure is coded in two different ways:

1. for engine components and signals
2. for modules and components.

The code for modules and components includes auxiliary parts. Codes consist of specified letters (L) and numbers (N). These identify the functionality of modules and components in the process and electrical systems. Each code is

divided into four groups: system code, system number, component code and part code. (Wärtsilä 2014)



Picture 1. Structure for process of coding

(Wärtsilä 2014)

### 3.2 Review of auxiliary code resolution

#### 3.2.1 General characteristics and usage

Auxiliary code resolution (CR) has similar structure to the one that is already in use for the engine parts. It contains auxiliary systems and parts installed to a

certain power plant. The purpose for aux CR is to change the way of working with equipment parts closer to that of engine parts. With the CR it is possible to create and maintain a structured and consistent database for the auxiliary spares. (Wärtsilä 2014)

Auxiliary code resolution needs to be updated continuously. This is the best way to help identification and sales. Everybody working with the auxiliary CR is responsible for informing about changes and updates. (Wärtsilä 2014)

The CR has its own section for every system in the structure. Systems are coded according to power plant process of coding system. For example AAC refers to compressed air system. (Wärtsilä 2014)

100038569 NISHAT CHUNIAN POWER LTD	
FL38569IS	FL38569IS Engine auxiliaries
AAA	Intake air system
AAC	Compressed air system
AAD	Water supply system
AAE	Exhaust gas system
AAFH	Heavy fuel oil system
AAFLL	Light fuel oil/Marine Diesel Fuel system
AAL	Lube oil system
AAM	Auxiliary Configurations
AAS	Oily water and Sludge system
AAWH	HT cooling water system
AAWL	LT cooling water system
AAWR	Raw water (RW) system
ACP	Process control system
ADR	Engine related equipment
AEG	System grounding
AEP	Power transmission system
AES	Station service system
AHS	Steam generation system
APD	SO2 removal system
APM	Continuous emission monitoring system
BAC	Inlet Ventilation system

Picture 2. Example of auxiliary code resolution

The spare part number can be Wärtsilä's own spare part code, for example C40001002, or manufacturer's spare part code, for example 7938. Both of these can be used when placing offers of the parts. The other code, for example PAAE084717, is Wärtsilä's material number.

100038569		NISHAT CHUNIAN POWER LTD	
FL38569IS		FL38569IS Engine auxiliaries	
AAA	Intake air system		
AAC	Compressed air system		
TCA-1001A	Control air compression system		
TCC-1001A	Control air treatment system		
TSA-1001A	Starting air compression system		
16 191 65	GEN	SPERR1619165	0 1619165 FUSE 2A
16 191 67	GEN	SPERR1619167	0 1619167 FUSE 4A
3034	GEN	PAAE084715	0 OVERHAUL KIT - LP VALVE
3035	GEN	PAAE084717	0 OVERHAUL KIT - HP VALVE
322 H	GEN	009482404	0 SOLENOID VALVE SPERRE 322H7506
3299	GEN	009481744	0 GUIDE FOR AIR COMPRESSOR
3455	GEN	009481703	0 GUDGEON PIN FOR AIR COMPRESSOR
3808	GEN	009481688	0 RETAINER RING FOR AIR COMPRESSOR
3914	GEN	009481743	0 3914 COPPER GASKET HP
3915	GEN	009481745	0 3915 COPPER GASKET
4081	GEN	009481699	0 GASKET FOR AIR COMPRESSOR
4098	GEN	009481704	0 GASKET FOR AIR COMPRESSOR
41 754 31	GEN	007210356	0 CONTACTOR
4100	GEN	009481697	0 GASKET FOR AIR COMPRESSOR
4200	GEN	009482888	0 BOLT FOR SPERRE COMPRESSOR
4238	GEN	009482884	0 NUT FOR SPERRE COMPRESSOR
4240	GEN	PAAE136512	0 NUT
43 004 01	GEN	PAAE137919	0 PUSH BUTTON
43 030 02	GEN	ESCAR0044	0 INDICATOR LIGHT
43 030 04	GEN	VENG4810	0 INDICATION LAMP XB4-BVG4 RED
43 032 64	GEN	007720053	0 PUSH BUTTON XB4-BA21
43 032 88	GEN	PAAE017987	0 BUSH BUTTON
43 033 23	GEN	007200077	0 CONTROL SWITCH
43 033-2	GEN	PAAG135886	0 SWITCH
43 204 57	GEN	PAAE124037	0 CIRCUIT BREAKER
4400	GEN	PAAE028302	0 FLEX TUBE
45 103 75	GEN	PAAE051141	0 PROGR. LOGIC CONTROLLER (PLC)
45 103 79	GEN	PAAE064773	0 EXPANSION MODULE
4516	GEN	009481762	0 COUPLING LAMELLA 4516
6209-Z/C3	GEN	LATU6209ZC3	0 6209-Z/C3 BEARING
6210-C3	GEN	005120254	0 BALL BEARING
6312-C3	GEN	005120253	0 BALL BEARING
66 673-3	GEN	SPERR0018	0 TRANSFORMER
7340	GEN	PAAG169800	0 ABB ELECTRIC MOTOR, 34KW
7938	GEN	PAAG142204	0 OVERHAUL KIT
7968	GEN	PAAE083668	0 SERVICE KIT 10000H
80 502 77	GEN	SPERR8050277	0 8050277 HOUR COUNTER 110V 50HZ
89756089	GEN	PAAE077645	0 LUBRICATION/COOLANT OIL
C40001001	GEN	009481686	0 COMPRESSION RING FOR AIR COMPRESSOR
C40001002	GEN	009481687	0 OIL SCRAPER RING FOR AIR COMPRESSOR
C40001005	GEN	009481690	0 PISTON FOR AIR COMPRESSOR

Picture 3. Finding the correct spare part in the CR

(Wärtsilä 2014)

### 3.2.2 Evaluation and development solutions

The current aux CR improves the way of working with auxiliary spares quite significantly. A structured way of working makes the identification of the spare parts easier and faster. Network companies can use the CR to identify spare parts themselves. This saves time for both network companies and PC

personnel. The structure is maintained constantly which ensures smooth processing in the future as well. The old auxiliary EQP CR could not be used when placing offers. The new CR can be used also when placing offers. However, the CR has not been created from every power plant and, therefore, it does not cover all units provided by Wärtsilä. (Wärtsilä 2014)

The Previous EQP CR was not maintained on regular basis and, therefore, it was not up to date. Due to this reason the information in the previous EQP CR was not completely reliable. The new structure (ref. type Z\_IS) can be used and maintained on installation-specific basis. This is a way to further utilize “work already completed”. This means that the units and parts which are sold and installed to a power plant will be filled in the power plant CR. This information can be easily used in the future when spare parts are required. (Wärtsilä 2014; Riitto 2014)

The CR is not a very flexible system. Pictures and drawings cannot be attached in the structure although they would make the structure much more informative and useful. The CR has to be updated manually item by item and only certain personnel are allowed to do the updating. In other words, maintaining the CR requires considerable effort. Even with considerable effort it is impossible to create and maintain a perfect CR for auxiliary parts. There will always be parts which are not downloaded or updated correctly in the CR structure. (Wärtsilä 201; Riitto 2014)

The CR is created by using a safety and consumable spare part list compiled for a power plant specific basis. These are large lists and it takes a lot of time and effort to compile a complete part list. This is why it would take a lot of resources to compile a CR for all the power plants. Even though this type of CR is very extensive, there should be an easier way. A Recently started simplified CR is a good step to this direction. The idea in a simplified CR is that when a spare part has been identified according to the serial number of a certain unit and material number is opened, it will be downloaded to the power plant's simplified CR. This way the CR will be created without having to compile the massive safety and consumable list. (Wärtsilä 2014; Riitto 2014)

Parts are not categorized by systems in the simplified CR yet. All the new materials are downloaded without unit reference into the CR. There is discussion on the categorization of the items in the future. This would make the simplified CR even more useful because parts would be easier to identify. (Wärtsilä 2014; Riitto 2014)

### 3.3 Review of IDM – integrated document management

#### 3.3.1 General characteristics and usage

The IDM is a global data base for sharing documents and information of all sectors of business.

The IDM is used to share and manage the following information:

- mature business critical documents
- documents that may be used as evidence in court
- information that needs revision control
- information that needs global unique Ids
- information that needs global availability with structured access rights
- information that needs key document risk management.

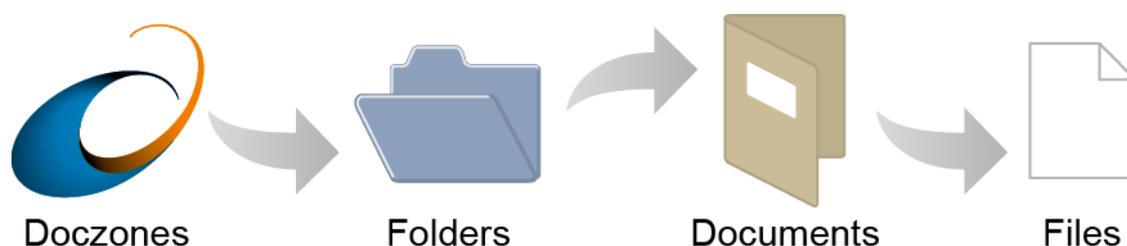
The role of the IDM is to:

- provide official documentation
- manage records
- control revisions of the documents
- publish documents
- provide open access (not always applicable).

In the IDM the information is stored on four levels:

- in doczones
- in folders

- in documents
- in files.



Picture 4. Basic structure of IDM

(Wärtsilä 2014)

The IDM consists of doczones. Each doczone is unique and has its own folder structure and document properties. Access profiles are different too and employees from different teams and responsibilities have different access rights. This means employees are able to access only the doczones they really in their job. (Wärtsilä 2014)

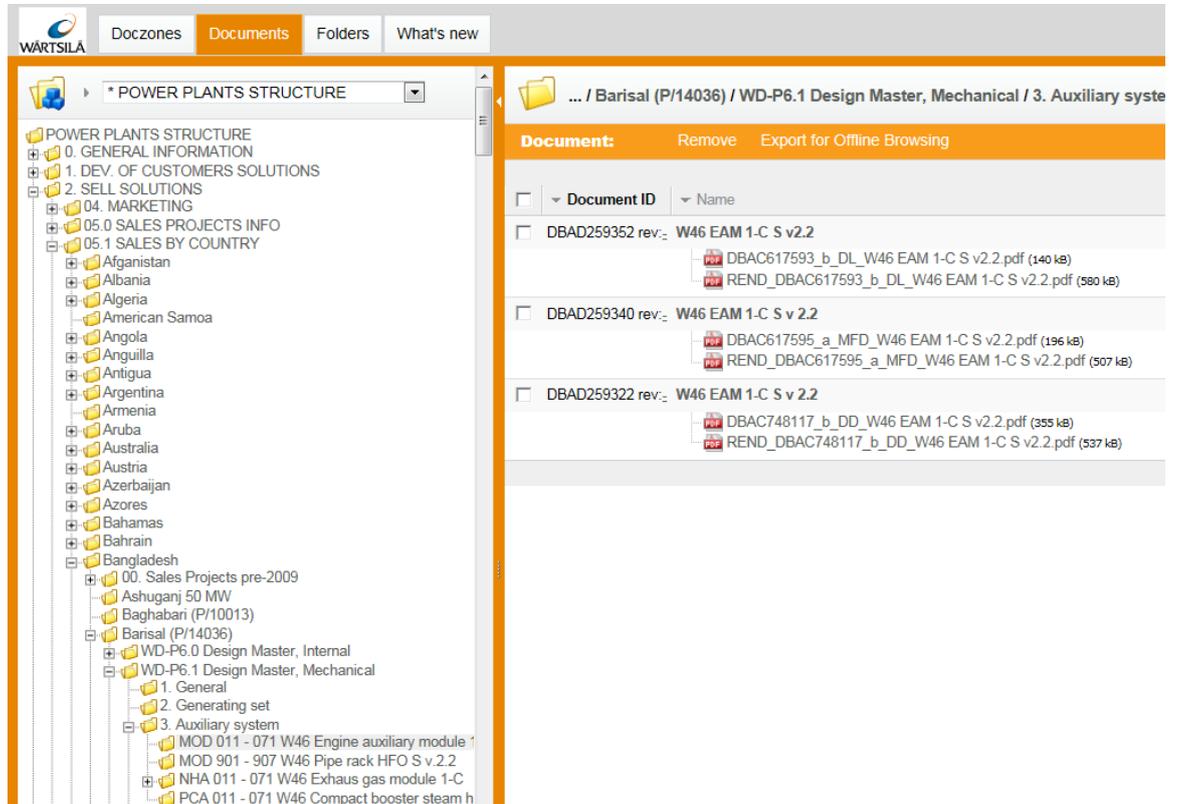
Doczones are divided into folders. Folders contain other folders (subfolders) and documents. The folders can have different properties. They can be of different folder types or have different status depending on their purpose and usage. (Wärtsilä 2014)

Documents are located in folders. Documents contain files, web links and links to other documents. All documents have general properties such as author information, document number and date when the document was created. (Wärtsilä 2014)

The documents can be of different document types such as contracts, offers, complaints, tasks, events or reports. Documents also have different status such as draft, checked, approved. Documents are divided by business area (Power Plants, Ship Power business area etc.). (Wärtsilä 2014)

Files are attached to documents. Documents can contain multiple files of different type and size. All attached files have the same properties as their

parent document. The only way to give different properties (e.g. access profiles) to two different files is to attach them to two different documents. (Wärtsilä 2014)



Picture 5. IDM Interface

Some documentation is also stored in Compass which is used alongside of the IDM. Compass is Wärtsilä's intranet system. Whereas the IDM is used to share official documentation, the Compass workspaces

- store unofficial documentation
- provide no history review or traceability
- include e.g. time management, calendars, discussion boards
- usually provide restricted access.

(Wärtsilä 2014)

### 3.3.2 Evaluation and development solutions

The IDM supports a common way of working and enables secure sharing of information. It improves productivity and the use of knowledge in every business sector. User rights can be modified and, therefore, everybody can have access to every business sector in the IDM. Downloading space is almost limitless and many different data formats can be downloaded in the IDM. Data searching is fast when it is downloaded in the right place systematically. Also naming the files and documents logically helps and enhances data searching. (Wärtsilä 2014; Riitto 2014)

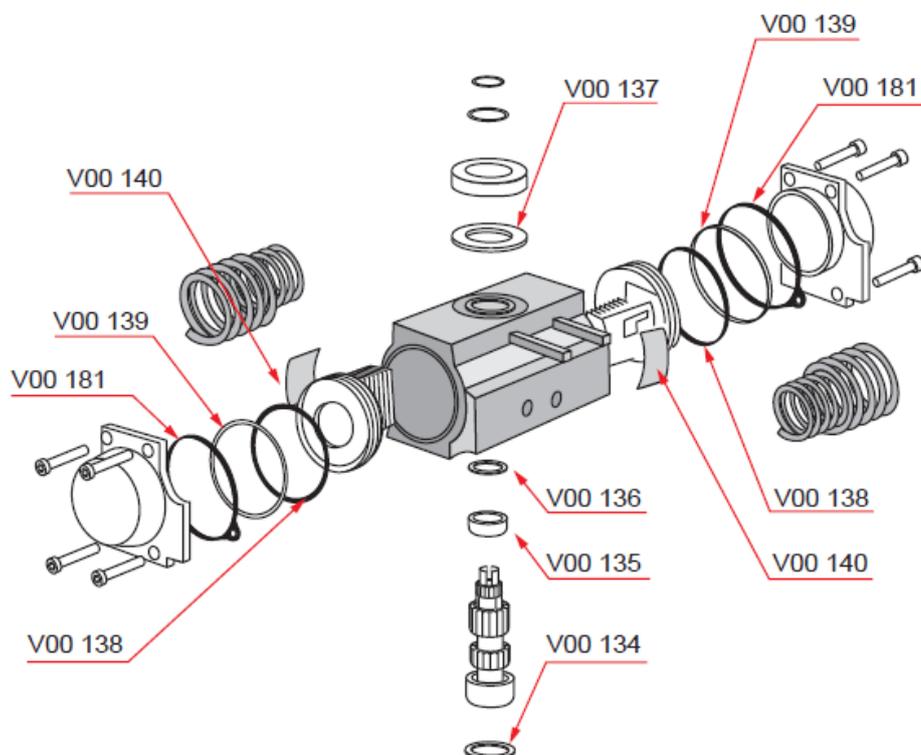
Probably the greatest problem with the IDM is different documentation habits between users from different business sectors. Files, folders and documents are very often named differently between different installations. Sometimes the name does not even tell what the file, folder or document contains. Also the trail to similar documents under different installations is very often completely different. These issues make the data searching from the IDM significantly harder and slower. A solution for this would be common instructions and standards for downloading documentation in the IDM. This way the IDM would be logical and names of files, etc. would be more informative. This would significantly help finding the required data a lot. (Wärtsilä 2014; Riitto 2014)

Even though it is possible for network company personnel to access the files in the IDM to search for information of auxiliary parts and units, they usually do not do this. At the moment many spare part inquiries sent to the sales support in Finland do not contain enough information of the requested parts for proper identification. A lot of this required information could be found in the IDM by network personnel also. Networks should be guided and encouraged to use the IDM for data searching. Many network employees do not know how to use the IDM. They should be trained and accustomed to use the IDM on everyday basis. (Wärtsilä 2014; Riitto 2014)

### 3.4 Review of AMS

#### 3.4.1 General characteristics and usage

The AMS is a spare part catalog which is created for every new power plant installation, so the old plants do not have it. The AMS catalog covers all the systems and units designed by Wärtsilä. Spare parts of the units which should be sold to the customers are marked in the catalog. Each spare part receives its own spare part code. Some parts which are not wanted to be sold, for example screws and pipes, are not coded in the catalog. The catalog is delivered to the customer with the Power Plant station manual package. In addition to spare part ordering customers use the AMS catalog as a guide to assemble the units. (Wärtsilä 2014; Pärus 2014)



Picture 6. Exploded view of a unit in AMS catalogue (Wärtsilä 2014)

The CR structure is also created for every new installation. The CR contains all the parts which are in the AMS catalog. After the requested parts are checked with the AMS the sales department makes an offer to the customer by using the CR. The catalog is also used by Wärtsilä's own employees, not only the customer. The AMS is still quite a new system. Therefore, not much sales have been made so far by using the AMS. Customers have already sent positive feedback and, therefore, it seems to be useful. (Wärtsilä 2014; Pärus 2014)

### 3.4.2 Evaluation and development solutions

The aim of the AMS is to make the identification and selling of auxiliary parts easier and faster. It is easy to check with the AMS which units are installed in the power plant. It is also easy to check which parts are wanted to be sold and which are not. With the AMS catalogue on site it is easy for the customer to identify and order the required spare parts. This will ease the workload in the sales support caused by unidentified items. Faster identification and sales also increases customer satisfaction. Customer satisfaction should increase sales. (Wärtsilä 2014; Pärus 2014)

With the AMS catalog customers could be committed to buy spare parts from Wärtsilä. The AMS catalog makes spare part ordering easier and faster. Therefore, customers want to buy spare parts from Wärtsilä. This would be the ideal situation. (Wärtsilä 2014; Pärus 2014)

The AMS includes only the modules designed by Wärtsilä. All the modules and units designed by a third party are not in the catalog. This will exclude a great number of systems. It should be studied whether it is beneficial to include all the auxiliary units and configurations into the AMS catalog. This could increase the customer's interest to buy more spare parts from Wärtsilä. (Wärtsilä 2014; Pärus 2014)

The purchasing department does not open the new AMS materials proactively. This means that when new AMS material has been created the purchasing department does not set the price, delivery time, etc. beforehand. These are

updated only when the material is ordered for the first time by a customer. This slows down the spare part sales. If customers start using the AMS significantly more, it would be useful to have the prices and the other necessary information updated immediately after when materials have been opened. This way the customer is able to see the prices immediately without having to wait for an offer. (Wärtsilä 2014; Pärus 2014)

### 3.5 Review of tablet application

#### 3.5.1 General characteristics and usage

The idea in the tablet application is that spare part and unit data of a certain power plant is downloaded from the IDM to the tablet. Basically all the information which is in the IDM could be browsed and used with the tablet. Also all units will include RFID (Radio Frequency Identification) for instant identification of units. The tablet application is still under development and not yet in use in the aftersales. (Wärtsilä 2014; Riitto 2014)

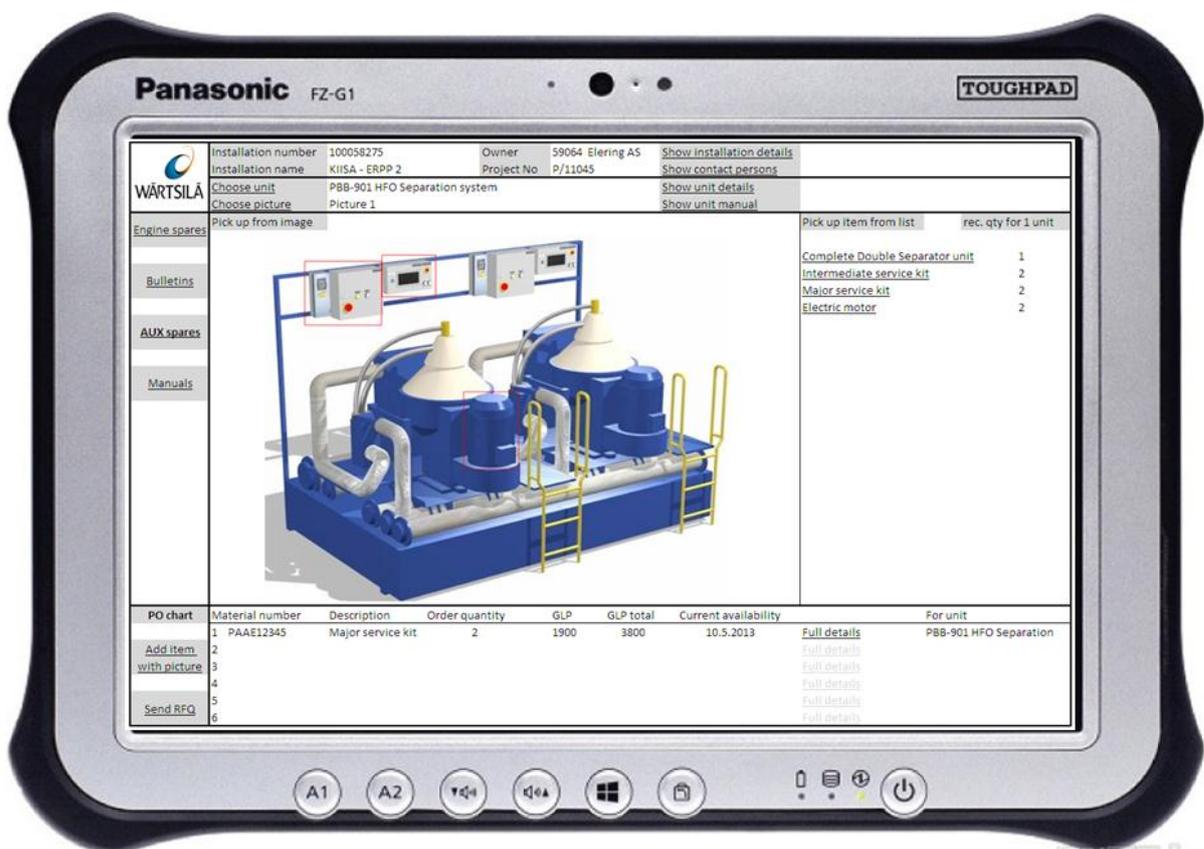
	Installation number	100058275	Owner	59064 Elering AS	<a href="#">Show installation details</a>			
	Installation name	KIISA - ERPP 2	Project No	P/11045	<a href="#">Show contact persons</a>			
	<a href="#">Choose unit</a>	ZAC-901 Gas ramp			<a href="#">Show unit details</a>			
	<a href="#">Choose picture</a>	Picture 1			<a href="#">Show unit manual</a>			
<b>Engine spares</b>	<a href="#">Pick up from image</a>			<a href="#">Pick up item from list</a>	rec. qty for 1 unit			
<b>Bulletins</b>					<a href="#">Complete gas ramp unit</a>			
<b>AUX spares</b>					<a href="#">Safety spare packet</a>			
<b>Manuals</b>					<a href="#">Full set of gaskets</a>			
					<a href="#">Full set of filter elements</a>			
<b>PO chart</b>	Material number	Description	Order quantity	GLP	GLP total	Current availability	For unit	
<a href="#">Add item with picture</a>	1	PAAE12345	Gasket set	1	620	620	10.5.2013	<a href="#">Full details</a>
<a href="#">Send RFQ</a>	2							<a href="#">Full details</a>
	3							<a href="#">Full details</a>
	4							<a href="#">Full details</a>
	5							<a href="#">Full details</a>
	6							<a href="#">Full details</a>

Picture 7. Example interface of the tablet application (Wärtsilä 2014)

Tablet is used by a customer and/or service engineer on site and he can send spare part inquiries directly with it. He can also attach drawings or spare part catalogues to the inquiry. Also markings can be made in the inquiry manually. The tablet updates prices, availability and manuals automatically when it is connected to the Wärtsilä database. If complete units are replaced, an account manager or FS manager will visit the site and update the system. (Wärtsilä 2014; Riitto 2014)

### 3.5.2 Evaluation and development solutions

The purpose of the tablet application is to make the identification of spare parts easier and faster. Slow identification is a result of lack of correct and sufficient details of spare parts and systems. The tablet application will contain enough information for faster identification. For example, the AMS system is valid only for units supplied as “Wärtsilä product”, whereas the tablet application is valid for all units. The problem in the CR is that pictures cannot be attached in the structure. In the tablet application pictures can be added in the application. The



Picture 8. Example interface of the tablet application (Wärtsilä 2014)

application is also much more flexible and easy to use. (Wärtsilä 2014; Riitto 2014)

With the tablet on site, the customer or Wärtsilä service engineer will be able to identify the needed spare parts quickly. In a later phase they would be able to order spare parts directly with the tablet. The aim of the tablet application is to commit customers to purchase spares from Wärtsilä through the entire life-cycle of the installation. The system will follow the standards of Wärtsilä coding and all spare part kits will be marked into the system. A tablet is a small investment compared to the benefits which could be achieved with it. (Wärtsilä 2014; Riitto 2014)

The software of the tablet is still incomplete and not yet suitable for long-scale use in the services business area. It also crashes occasionally. It can take a lot of time and effort to have the software ready for full use in services. A number of benefits could be achieved with the tablet application. If the application works as planned, offering and selling spare parts to the customer will be much easier and faster. This is why the software should be completed as fast as possible so that the tablet application could be taken into long-scale use in the services. (Wärtsilä 2014; Riitto 2014)

Converting of documents from the IDM to a format which is readable for the tablet is slow and hard. This may cause trouble, especially if customers have to do it themselves. All the required data should be downloaded to the tablet before it is sent to the customer, as a turnkey solution. This way the customer does not have to spend time and effort to download the required information. The customer can start using the tablet immediately. This would be a good way to improve user satisfaction and increase the use of the tablet application. (Wärtsilä 2014; Riitto 2014)

All customers should have the tablet on site in the future. It would be good to give the tablet for free to a customer when a new power plant is commissioned. Why not to give it to old power plants as well? Customers are this way bound to buy spare parts from Wärtsilä. Not because they have to but because with the

tablet it would be easy and fast to order spare parts from Wärtsilä. (Wärtsilä 2014; Riitto 2014)

### 3.6 Documentation and utilizing of documentation in network companies

Wärtsilä network companies do not complete any documentation for auxiliary parts. When a customer requires spare parts for auxiliary systems, network forwards the inquiry directly to the sales support in Finland. After the required parts have been identified by the sales support in Finland, the parts are offered to the customer by network. However, no documentation of offered or sold spare parts is made in the network companies. (Wärtsilä 2014; Riitto 2014)

The lack of documenting offered and sold spare parts in the network companies causes extra work later in the offering process. This is because every spare part has to be identified by the sales support in Finland. The response time to inquiries sent by customers is quite long and this increases it even more. (Wärtsilä 2014; Riitto 2014)

The network companies do not use the IDM-documentation or CR almost at all for auxiliary parts. This is mainly because the personnel in the network companies do not know how to find correct data in the IDM, especially when it comes to ship installations. Another reason is that it often takes quite a lot of effort to find the required information. In other words, it has been easier for the network companies to send the inquiry directly to the sales support in Finland. (Wärtsilä 2014; Riitto 2014)

No “work already completed” can now be utilized in the network companies because of lack of documentation. All the spare part inquiries are now forwarded directly to the sales support for identification, even if the same parts have been identified before already. The network companies could download the data of identified spare parts. The simplest way could be to place them in an Excel file under the correct power plant. Also details of the unit or system to which the parts belong should be marked in the file. This way the same spare

part inquiries would not come to the sales support in Finland repeatedly. (Wärtsilä 2014; Riitto 2014)

Increasing documentation in the network companies also increases risks. The risk increases that customers would receive some information that they should not. Examples of this kind of information could be cost prices or too accurate specifications which could be used to order parts from another supplier. Also the risk of delivering wrong spare parts could increase. For example, if a unit in a power plant is changed to another and this is not updated in the network documentation, then there is a risk will deliver spare parts which will not fit to the new unit. (Wärtsilä 2014; Riitto 2014)

These risks could be minimized by training the network personnel to use the documentation correctly and explaining where the risks. Through training and having to document and identify spare parts themselves, the network personnel would understand and learn which information is really required for identification. In other words, the network personnel know which inquiries require more information from the customer and will send them back to the customer with further questions. This would reduce the response time to customer inquiries. It would also reduce the workload in the sales support in Finland. (Wärtsilä 2014; Riitto 2014)

## 4 CONCLUSIONS

### 4.1 Results

The aim of the thesis was to review the current documentation situation of auxiliary spare parts in power plant installation and suggest improvement solutions. The results were based on the information gathered from Wärtsilä's files and surveys answered by employees. The aim set for the thesis was reached very well. The review of the documentation was comprehensive and both pros and cons were found. Also several development solutions were presented for the issues discussed in the review. The results could be useful for future reference also if the documentation of auxiliary spare parts is improved.

The result of the thesis was that the documentation of auxiliary spare parts is relatively good but significant improvements could be made. Several useful systems are used on everyday basis to help the identification and data searching. Also a number of new improved systems are under development and used partially. However, a number of things could be improved in order to have more functional documentation. Documenting systems and the utilizing of documentation could be improved in every business sector and process phase. A number of significant improvements in the present state of documentation could be made by improving the current systems. These changes do not necessarily require a lot of money or effort.

The company was pleased with the thesis. The theoretical part of the thesis was found interesting, relevant and comprehensive. The review of the documentation was found comprehensive and accurate. The results were found interesting, useful and reliable.

## 4.2 Further analysis of the results

Time and effort could be saved significantly in aftersales with the presented these improvements. Responding to customer inquiries would be faster and more accurate. Also with better documentation Wärtsilä could offer more customized auxiliary solutions to better meet the different needs of customers. This kind of improved quality in services could lead to better customer satisfaction and increase spare part sales.

The PDM-system could be one solution to solve the problems in documentation in the future. However, implementing the PDM-system would most likely require a lot of effort, time and money. This kind of project includes risks as well. Most likely the PDM-system would have to be taken into use in the entire company. The change would affect the entire Wärtsilä, not only the auxiliary spare part sales support. On the other hand, the benefits achieved with the PDM-system would be considerable are most likely going to be greatest in this kind of environment.

The importance of aftersales has increased significantly in the global industrial markets. Customers require ever better services. Speed, functionality and reliability are very important competition factors in the global aftersales. Good documentation is one of the most important functions in building and maintaining good aftersales services and spare part sales. Documentation forms the foundation for all functions.

Quality of services affects the brand of the company greatly. Currently brand is very important in the global markets. It is important that customers see Wärtsilä as a provider of good quality services. Effort should be invested in improving the brand and good documentation is one of the key factors in this process.

## REFERENCES

Sääksvuori, A. & Immonen, A. 2002. Tuotetiedonhallinta – PDM. Jyväskylä: Gummerus Kirjapaino Oy.

Wärtsilä, Process of coding & signals. 2014

Wärtsilä, Code Resolution, Auxiliary parts. 2014

Wärtsilä, IDM 4.0 - Basic user guide. 2014

Wärtsilä, AMS Auxiliary module structure. 2014

Wärtsilä, AUX CR Project extended. 2014

Wärtsilä, PAAE271949\_aspcen. 2014

Riitto M. Interview, 31.10.2014. Wärtsilä, Turku

Pärus H. Interview, 11.11.2014. Wärtsilä, Turku