



# **DCM365 Document Dashboard**

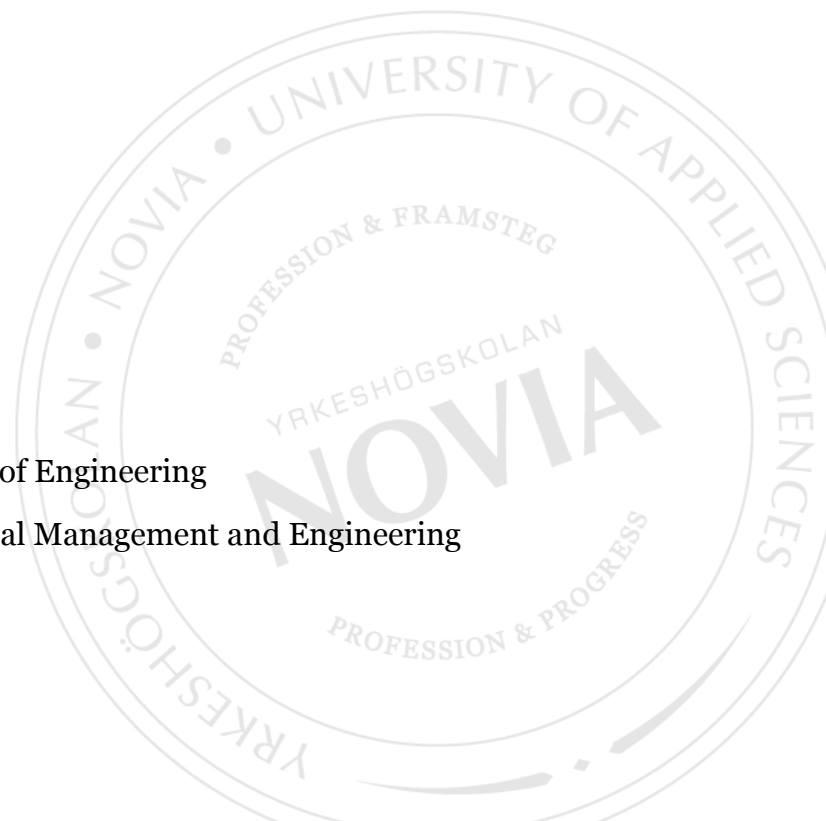
## **Controlling Distribution of Project Documentation**

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Degree Thesis for Bachelor of Engineering

Degree program in Industrial Management and Engineering

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## BACHELOR'S THESIS

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### Summary

This thesis is made on behalf of Wärtsilä Energy Solutions at the department Project Documentation. The purpose with this thesis was to develop a tool that shall present current revision status of project documentation within the cloud platform Document Control Module 365 (DCM365).

DCM365 is utilized to share project documentation with different stakeholders during the whole project lifecycle. Earlier it was very complicated and time consuming to quickly get an overview of which documents are shared and in what revision. This tool has simplified this procedure considerably, now a days it is only by a few button clicks possible to get a status report of the whole project documentation.

The theory chapter of this thesis describes how a company will manage to successfully succeed with product development and what kind of product development a company can realise. The theory chapter also describes what knowledge management is and how it can be utilized within companies.

In the result chapter I describe how the decision of platform was done, methods that I used to build the tool and finally a visual walkthrough of the tool.

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## EXAMENSARBETE

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Titel: DCM365 dokument informationsbord  
Kontrollerande av distributionen för projekt dokumentation

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### Abstrakt

Detta examensarbete är gjort på uppdrag av Wärtsilä Energy Solutions vid avdelningen Project Documentation. Syftet med arbetet var att utveckla ett verktyg som ska presentera aktuell revisionsstatus av projektdokumentation i Energy Solutions molnplattform Document Control Module 365 (DCM365).

DCM365 används för att dela projektdokumentation med olika intressenter under hela projektets gång. Tidigare har det varit komplicerat och tidskrävande att snabbt få reda på vilka dokument som är delade och i vilken revision. Detta verktyg har förenklat denna procedur avsevärt, numera kan man genom några enkla knapptryck snabbt få reda på status av hela projektets dokumentation.

Teoridelen i detta examensarbete beskriver hur man skall gå till väga för att lyckas med en produktutveckling samt vilka typer av produktutveckling ett företag kan genomföra. I teoridelen beskrivs också kunskapshantering samt hur det anammas på olika sätt i företag.

I examensarbetets resultatdel beskriver jag hur valet av plattform genomfördes, vilka metoder som användes för att bygga verktyget och slutligen en visuell genomgång av hela verktyget.

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Språk: Engelska

Nyckelord: Dokumentation av kraftverk, DCM365,  
Revisionskontroll

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# 1 INTRODUCTION

This thesis is made for Wärtsilä Energy solutions, which is part of the Wärtsilä corporation. The mission with this thesis is to develop a tool for Energy Solutions online collaboration system named DCM365, the tool will compare current document statuses within the DCM365. The tool is needed to get live reports from the different document libraries within DCM365.

Online document collaboration is used in all EPC projects and also in more advanced and complex projects with many different external stakeholders. This tool will be used in all projects within Wärtsilä Energy Solutions that are utilizing DCM365. The main focuses when developing this tool will be to see how Energy Solutions can cut down time wasting processes and find documents that for different matters need some review. The tool will be developed in such a way that it does not need any changes to be utilized in any other project within Energy Solution.

## 1.1 Background

This tool will be needed to simplify the process of identifying project documentation revisions transmitted towards a projects different stakeholders. The tool gives an instant and updated report of all document revisions and statuses. The method to identify these statuses that was used before was complicated and time consuming for the project team. The new tool doesn't require any prework done by the project team.

Keeping track of document revisions and statuses is an essential part of the whole project documentation. This will ensure that the building site and suppliers always designs and manufacturer by the latest available drawing or information.

I have worked within Wärtsilä for more than four years. During these years I have been involved in the development of the DCM365 all the time. This is a huge benefit when working with this thesis, I know the reason why this tool is a useful and needful tool. Most of the specifications and requirements of the tool is obvious for me. The huge background information that I have concerning DCM365, such as platform structure, way of working and implementation of DCM365 is very valuable when working with this thesis.

## **1.2 Purpose**

The purpose for this thesis is to investigate, find and build the best solution to compare revisions in a shared document collaboration environment, that environment is called DCM365. The revision control tool will help project teams to easily find documents that needs to be issued towards stakeholders. This solution will save time and also prevent that the building site uses old revisions for construction.

Figure 1 Typical document distribution shows a typical distribution of a document in the initial phase of a project. The document might be distributed towards different stakeholders in different revisions. It is complicated to keep track of which document in what revision is sent to whom. This example only shows one document, in a typical project within Energy Solutions there are thousands documents distributed.



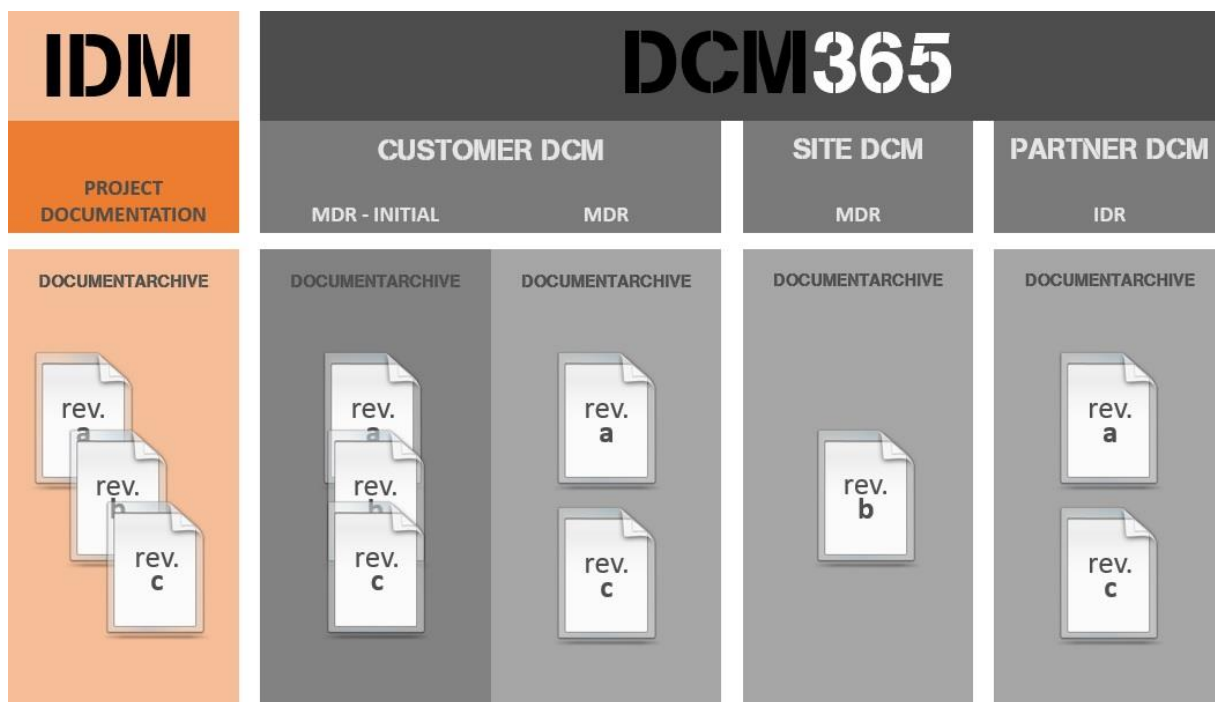


Figure 1 Typical document distribution

As it is today, the method used to find old revisions and to get a good overview of the situation is to copy document metadata into an excel sheet and create functions that highlights the rows of interests. This takes too much time and is not an efficient way of working, another huge drawback from this method is that in the same moment that you copy data from DCM365 it is already old data.

The solution that this is about have to be a totally dynamic environment; it should be adaptable in any project setup within Wärtsilä Energy Solutions.

Potential cost savings by just using correct revision for construction can be several hundred thousand euros. Another concrete cost saving will be the replacement from earlier work done by humans in the manner of copying and compiling data.

## **1.3 Disposition**

### **First chapter**

Chapter one introduces the reader to the background and the subject of this thesis.

### **Second chapter**

Chapter two explains Wärtsilä in brief and also includes a short description of the department Project Documentation, which have commissioned this thesis.

### **Third chapter**

Chapter three contains information about the underlying theory behind this thesis. This gives a short description about the different coding languages that I have used and also some basics about knowledge management and product development.

### **Fourth chapter**

Chapter four explains how the application named DCM365 works, and what it is used for within Wärtsilä. This chapter will also explain how the document lifecycle works on a normal project within Energy Solutions.

### **Fifth chapter**

Chapter five includes the thesis result. All the functions within the script are explained. Here are also descriptions and specifications of the application.

### **Sixth chapter**

Chapter six contains a short conclusion, my own thoughts about this thesis and some ideas for further development.

## 1.4 Definitions and abbreviations

**EPC** - Engineering, procurement, and construction is contract arrangement for large projects within the infrastructure, mining and energy businesses. The EPC contractor takes responsibility for engineering, procurement and site constructions.

**DCM365** – Document Control Module 365. DCM365 is a SharePoint Online document management tool which keeps track of issued documents towards customers/stakeholders.

**JavaScript** – JavaScript is a scripting language developed by Netscape Communications designed for developing client and server applications. (Microsoft Support 2015)

**jQuery** – jQuery is a JavaScript library that allows web developers to add extra functionality to their websites. It is open source and provided for free under the MIT license. (Techterms 2015)

**SPServices** - SPServices is a jQuery library which abstracts SharePoint's Web Services and makes them easier to use. It also includes functions which use the various Web Service operations to provide more useful capabilities. (SPServices 2015)

**SharePoint Designer** – Microsoft SharePoint Designer 2010 is a Web and application design program used to build and customize SharePoint sites and applications. (Microsoft Support 2015)

**IDM** – Wärtsilä Integrated Document management system. IDM is the internal document management system used by Wärtsilä

## 2 WÄRTSILÄ IN BRIEF

Wärtsilä is a Finnish company which was founded 1834 in Wärtsilä. They started as a small milling company and has changed markets many times since that. Today Wärtsilä provides power solutions towards the marine and energy markets globally. Wärtsilä ensures profitable growth by providing advanced technology and high quality products towards their customers. By a wide product portfolio they are well positioned to respond to the need for energy efficient and flexible solutions. Wärtsilä sees an increasing demand for gas based solutions such as LNG. They put huge focus on development of their portfolio to ensure and supply that market.

Growth is achieved by offering customers new and innovative technologies, this due to the fact that Wärtsilä puts huge focus on engineering competences and project management.

Net sales for 2015 was 5,029 million EUR and the total amount of employees was 17,700 globally. Wärtsilä operates in 70 countries and have more than 200 locations around the world. Wärtsilä is listed on the NASDAQ OMX Helsinki, Finland. (Wärtsilä 2015)

### NET SALES BY BUSINESS AREA

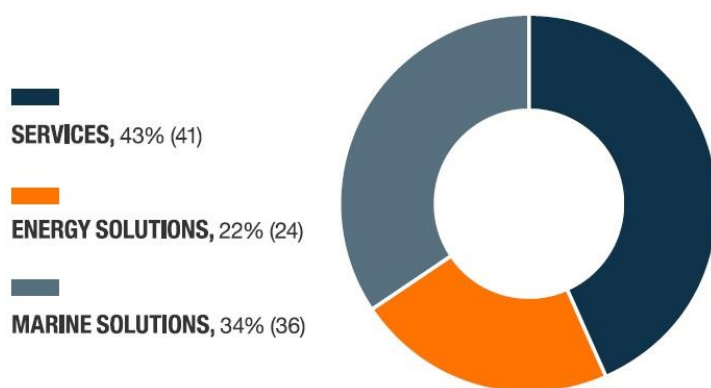


Figure 2 Net sales by business area 2015

## **2.1 Wärtsilä Energy Solutions**

Wärtsilä Energy Solutions is a global supplier of complete energy solutions up to 600 MW. Their product portfolio includes solutions that can utilize various gaseous and liquid fuels. It also includes unique solutions for load following power generation, peaking power and for balancing intermittent power production. Wärtsilä Energy Solutions also provides LNG terminals and distribution systems.

As of 2015, Wärtsilä has 58 GW of installed power plant capacity in 175 countries around the world. (Wärtsilä 2015)

## **2.2 Wärtsilä Marine Solutions**

Wärtsilä Marine Solutions provides innovative products and integrated solutions towards the marine, oil and gas industry. Marine solutions focuses on solutions that are safe, efficient, flexible and environmentally sustainable. They are a global provider of ship machinery, propulsion and maneuvering solutions. (Wärtsilä 2015)

## **2.3 Wärtsilä Services**

Wärtsilä Services is the supporting company towards customers with their installations done by either Energy Solutions or Marine Solutions. Wärtsilä Services is not only serving products that are broken, they are also optimizing products operational and lifecycle performance. (Wärtsilä 2015)

## **2.4 Project documentation**

Project documentation main tasks is to support sales with complex sales projects, project teams with tools and competent resources and site by providing an online documentation environment. Project documentation are the documentation expertise pool within Wärtsilä Energy Solutions by providing documentation processes, related tools and information products. Project documentation are continuously improving all the documentation services and translations together with engineering partner.

All power plant documentation services are purchased from an engineering partner. By purchasing documentation services Wärtsilä can more quickly react to fluctuations in power plant markets and more clearly focus on its main activities. (Wärtsilä Intranet)

## **3 THEORY**

### **3.1 Knowledge management**

DCM365 can be seen as a knowledge management system, as its essential task is to capture and storage information, knowledge and lessons learned. I will shortly present some basics about knowledge management and how to succeed with such a system.

Knowledge management is not a new thing, managing knowledge and using it to manufacturer things better, more efficiency, better looking or to a lower price has been a continuous feature of companies and humanity all the time. (Brelade & Harman 2003 p. 1)

Organizations are more and more knowledge intensive, they are investing more in minds than hands, and the requirement for leveraging the value of knowledge are increasing. (Emerald Insight Staff 2005 p. 4)

Knowledge management is how companies' captures, distributing and developing internal organizational knowledge. Knowledge management has a long history but it became more and more popular since the utilization of computers began in the early 90's. The most important of a knowledge management system is to capture and share the intellectual capital. (Rus & Lindvall 2012 p. 3)

#### **3.1.1 Knowledge management perspectives**

One of the most common and best definition of knowledge management for the purpose of managing knowledge resources is the product versus process view. When talking about product view, it implies that all knowledge is a thing that can be threatened as an independent object. That based on managing structural capital, document management systems, data bases and lessons learned. It is also about sharing standard operating

procedures, best practices and storage and retrieval. The product view within knowledge management tries to separate the knowledge from the knower.

The process view is places focus on motivating, encouraging and promoting the process of knowing. It abrogates the idea of capturing and distributing knowledge. Process view describes knowledge management as a social communication process facilitated by collaboration and supporting tools. This perspective of knowledge management doesn't separates the knowledge from the knower. (Massingham 2014)

### 3.1.2 Knowledge in organizations

Knowledge within companies can take many different varieties. It includes all employee's personal knowledge and competences. It also includes the companies own knowledge about their customers and suppliers and their know-how about delivering specific processes. For companies' knowledge is a valuable resource, an intangible asset and shapes a bit of the intellectual capital. (North & Kumta 2014, p. 31-32)

By utilizing a knowledge management system and capturing knowledge a company can expect that important information flows through the whole organizational hierarchy. They can also avoid that unnecessary iterations occur, less superfluous work and decreases educational time for new employees. (Wikipedia 2016)

	COLLECTING & CODIFICATION	CONNECTING & PERSONALIZATION
<b>EXPLOIT</b> DIRECTED INFORMATION & KNOWLEDGE SEARCH	<b>HARVEST</b> <ul style="list-style-type: none"> <li>• Databases, external &amp; internal</li> <li>• Content Architecture</li> <li>• Information Service Support (training required)</li> <li>• Data mining best practices / Lessons learned / After action analysis</li> </ul>	<b>HARNESS</b> <ul style="list-style-type: none"> <li>• Community &amp; learning</li> <li>• Directories, "yellow pages" (expertise locators)</li> <li>• Findings &amp; facilitating tools, groupware</li> <li>• Response teams</li> </ul>
<b>EXPLORE</b> SERENDIPITY & BROWSING	<b>HUNTING</b> <ul style="list-style-type: none"> <li>• Cultural support</li> <li>• Current awareness profiles and databases</li> <li>• Selection of items for alerting purposes / push</li> <li>• Data mining best practices</li> </ul>	<b>HYPOTHESIZE</b> <ul style="list-style-type: none"> <li>• Cultural support</li> <li>• Spaces - libraries, lounges, cultural support, groupware</li> <li>• Travel &amp; meeting attendance</li> </ul>

Figure 3 Different ways to utilize knowledge management



### **3.1.3 DCM365 as a Knowledge management system**

As it is today, DCM365 can be seen as a knowledge management system which mainly focuses on information sharing but in the future it could expand to cover much more features. By sharing live information between project sites, Energy Solutions could quickly respond to design failures, equipment errors and best practices. By collecting lessons learned through a global system that all site personnel accesses, the previous mistakes that have been done could easily be avoided.

## **3.2 Product development**

In the result chapter of this thesis it is presented how a new application is built as a plugin to an existing system. To accomplish this, an internal product development project was initiated. For this reason I had to study how a new product should be developed, what kind of product development there are and how to get started with it.

Successful companies that operate in the business world always have to be innovative and renewing in their business to keep up with their competitors. They frequently have to introduce new products or keep improving and modifying existing products and services that keeps the customers satisfied and likely to choose the same product/company/service provider again. The overall process of conceptualizing a product and designing, producing, and selling it is known by a generalized and comprehensive process called product development. Product development is the general process that covers the timeline from idea to a new product.

It can be divided into four main categories, conceptualizing a product, then designing, producing and finally selling it. Before a successful product can be produced and

developed, someone have to come up with the idea. That idea must then be evaluated and discussed to see if there really are a need on the market for such a product. (A Mital, A Desai & A Subramanian 2011 p. 17)

According to (A Mital, A Desai & A Subramanian 2011 p. 18) there are four important attributes that has to be considered when starting to develop a new product.

- Cost
- Quality
- Development time
- Development know-how

It is important to budget and plan the predicted costs to produce and manufacturer the finished product. The development costs are also an important attribute, this includes all costs it will take until the first product can be sold. The amount of money that the business spends on development of a new product, from concept to prototype determines the future profitability. The product won't become profitable before the development costs are fully recovered.

Another important attribute to consider before starting the development of a new product is to set up a goal for the finished product regarding the quality. If the newly developed product won't fulfill the customers' requirements and expectation, it will not succeed on the market. Due to that fact, the quality is an essential part of product development.

The development time has huge impact and allocates the economic payback from the investment done in development of a new product. It can also be used as a measurement on how successfully the development effort has been. It is important to not let the development time affect the future quality of the product too much.

For every new product development a business does the more know-how is acquired. This can be used to make next product development more efficiently, effectively and economically.

### **3.2.1 Types of product development**

When a company develops a new product it can be for several different reasons. According to (M Annacchino 2011 p. 4-6) these reasons can be divided into six types. The following are a common list of these six different product development types and their attributes and contributions.

#### **1. New to the world products**

These products are totally new for consumers and revolutionary for the market. It might be that the market only have seen such products from a concept before, and then these concepts have been materialized by some company or inventor. This product development type is often a door opener for a totally new market. The newly invented product/service often needs some accessories or service providers.

#### **2. New product lines**

This type of product development allows companies to participate in a new market where the company previously not have had any market share. By adding this type of product development, companies must be careful to not compete with their existing products on the market. Their existing products on the market is still generating the existing business. The new product lines is destined to benefit the revenue by leveraging the market's acquaintance with the manufacturer into new products.

#### **3. Additions to existing product lines**

These type of additions to an existing product is meant to extend the products market share, influence the original product brand or reach a wider audience. The addition to an existing product lines effects the company's revenue in a very similar way as a new

product line does. It engenders the incremental revenue by leveraging the familiarity to the company's existing products.

#### **4. Improvements and revisions of existing products**

As products gets older on the market, customers gets higher expectations on the product. Companies can in such cases just make some minor changes or upgrades to ensure that customers still uses their products. This product development type is relative cheap to achieve and will make a positive contribute to the revenue. This type do have some limitations though, it won't last forever to just do some minor changes to an existing product to keep market share.

#### **5. Repositioning**

Another way to increase or keep current market share is to reposition the product. By repositioning a company's product on the market, the essential is to change customer's comprehension towards the product. Repositioning is more of a marketing action rather than a product development. This will generate revenue out of an already existing product.

#### **6. Cost reductions**

By cost reductions companies can reduce costs and still offer same value to the customers. A cost reductions type of product development is meant to manufacturer a product to a lower price or increase the unit volume to the same price as before. Cost reductions will result in an increased additional margin to an existing product.

Type of development	Time to introduce	Potential revenue contribution to economy	Revenue contribution to company	Company positioning strategy	Potential margin impact
New to the world	Longest	Highest potential	Highest potential	Market development	Highest
New product lines	Long	High potential	High potential	Market development	High
Add to existing	Medium	Medium potential	Medium potential	Line complete	Medium
Improve or revise	Short	Little potential	Medium potential	Market share	Medium
Repositioning	Shortest	Little potential	Medium potential	Market share	Medium
Cost reduction	Shorter	Little potential	Medium potential	Raise margin	Medium

*Figure 4 Table of product development types*

Development of the document dashboard plugin to DCM365 is a mix from several points explained previous depending on how the measurement is done. It is a new to the world product but the main idea behind the product is taken from a previous method.

### **3.2.2 Practice for software development**

To manage and succeed with a software development there are several important aspects to concern before the project is started. Most common reason for failure is bad comprehension for the customer's necessity, inability to manage requirement changes or future extensions are impossible/difficult. With these facts in mind during the development phase, most of the common mistakes can be avoided. (P Kruchten 2002 p. 7-16)

By concerning these aspects, I would say that the document dashboard is exactly what the customers (internal project teams) wanted. The application is easy to integrate to an existing system and further requirements are easy to implement.

### 3.3 Programming languages

The tool that is developed and coded within this thesis is utilizing three different programming languages. These three are often combined together in modern web development. SpServices is also mentioned here despite it is a jQuery library. SpServices is an essential part within this thesis due to the heavy data traffic between different SharePoint lists.

#### 3.3.1 JavaScript

JavaScript is a untyped programming language that enables more functionality to web applications. Functions that enables by JavaScript can be everything between validating data, executing complex functions or changing visual content on a webpage. It works side by side with HTML and CSS, meaning that all three coding languages might be needed to get the web application to work properly. JavaScript is client side scripting language and works on all modern web browsers. (P Wilton & J McPeak 2010 p.3-4)

```
1 function myFunction() {  
2     var x, text;  
3  
4     // Get the value of the input field with id="numb"  
5     x = document.getElementById("numb").value;  
6  
7     // If x is Not a Number or less than one or greater than 10  
8     if (isNaN(x) || x < 1 || x > 10) {  
9         text = "Input not valid";  
10    } else {  
11        text = "Input OK";  
12    }  
13    document.getElementById("demo").innerHTML = text;  
14 }
```

Figure 5 JavaScript example

Figure 5 shows a simple example of JavaScript code, it is a functions that validates data from a user input field. The functions takes the submitted data into a variable called “x” and checks if the variable contains any text, is higher than 1 and lower than 10.

There are no specific tools needed to write JavaScript, but there are many tools available to make it easier to find and spot errors while typing the code. For simple code a regular notetaking programs such as Microsoft Notepad is enough. In this thesis all JavaScript code is written in SharePoint designer 2014. (P Wilton & J McPeak 2010 p.5)

All code that should be concerned when loading a webpage can either be included in script tags within the HTML page or loaded separately by a .js file referred in the HTML page. Best practice is to link it to a separate file. This enables the developer to reuse some functions in other webpages. (P Wilton & J McPeak 2010 p.7-8)

### **3.3.2 jQuery**

jQuery is a JavaScript library that was written to simplify and extend JavaScript, it makes it a lot easier to write and understand the code. It is the most popular extension to JavaScript as it is today, jQuery is used in 65% of the top 10 million most trafficked websites. It is free, open sourced and under the MIT license.

Everything that jQuery does can also be done by plain JavaScript. But it is easier to use jQuery and in many cases less code is needed. jQuery can be preferred when building dynamic and interactive websites that reacts on user input and actions. A very powerful feature with jQuery is that the developer can use regular CSS selectors to access and interact with HTML elements. This comes very handy when one likes to change some elements based on other elements interactions.

```

1  function myFunction() {
2      var x, text;
3
4      // Get the value of the input field with id="numb"
5      x = $("#numb").value();
6
7      // If x is Not a Number or less than one or greater than 10
8      if (isNaN(x) || x < 1 || x > 10) {
9          text = "Input not valid";
10     } else {
11         text = "Input OK";
12     }
13     $("#demo").text(text);
14 }

```

Figure 6 jQuery example

Figure 6 shows the same example as shown in Figure 5, the difference is that the HTML elements are selected with jQuery instead of JavaScript.

jQuery is referred to the webpage by using <script> tags, the source code can either be on the same server as the webpage, or be linked from public servers that supplies hosting services. (jQuery 2016)

### 3.3.3 CSS – Cascading style sheet

Cascading style sheet shortened to CSS is a style sheet language which defines how a webpage should be rendered in the browser. CSS enables web developers to set styling rules to one or several HTML elements that appears in a webpage. Cascading style sheets has a huge effect on the amount of written code in complex webpages. Instead of writing styles for every element that should appear similar all over the webpage, with CSS just define that type of element with a class and then apply a style to the class. CSS uses selectors to find elements in the webpages, these selectors can be elements of specific type. Selectors specified by an attribute in the element, such as class or id. CSS can also select



specific elements depending on how these elements are placed relative to other elements on the webpage. (J Duckett & R Larsen 2013 p.192-195)

```
1 <!DOCTYPE html>
2 <html>
3   <head>
4     <style>
5       p {
6         text-align: center;
7         color: red;
8       }
9     </style>
10  </head>
11  <body>
12    <p>Every paragraph will be affected by the style.</p>
13    <p id="para1">Me too!</p>
14    <p>And me!</p>
15  </body>
16 </html>
```

Figure 7 CSS example

Figure 7 is a CSS example which shows how three different paragraph tags is effected by CSS. In the rendered webpage all three paragraphs will be shown as red and text is centered.

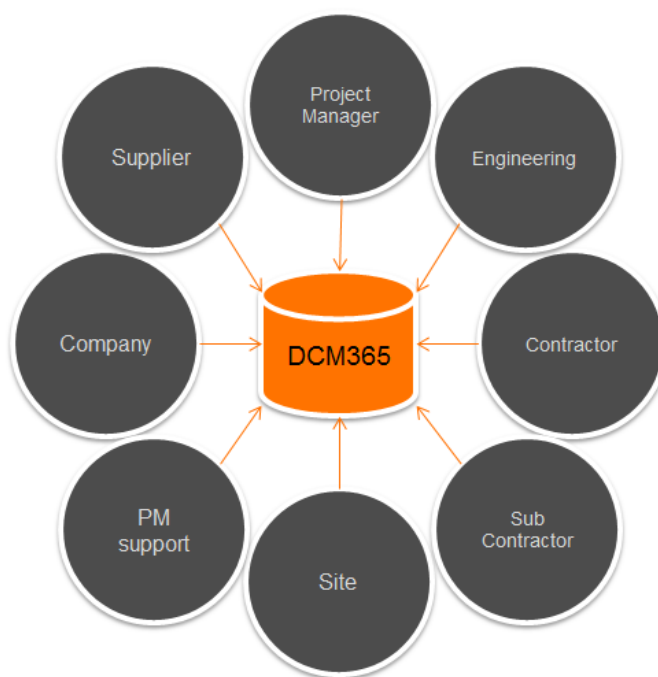
### 3.3.4 SpServices

SpServices is a jQuery library which communicates with SharePoint's web services and makes them easier to access and work with. It has several functions that is very useful when working with SharePoint lists and libraries. It enables custom search through list and it will return raw XML data back to the browser. This data can then be parsed and modified by using jQuery. SpServices comes very handy when you like to combine data from several lists into one. SpServices is developed by Marc D Anderson and is under the MIT license. (SpService 2016)

## 4 DOCUMENT CONTROL MODULE 365

### 4.1 Application description

The DCM365 is a document control platform which ensures that documentation transmittals towards the customer and other stakeholders are following the time schedule set. DCM365 also keeps track of all transmitted document and their belonging comments and approval status. The platform is designed in a way to make it easy to modify to fulfill all the special requirements that a project might have on documents and their deliveries.



*Figure 8 DCM365's stakeholders*

DCM365 is an evolution of the Document Control Module previously used at Wärtsilä. By taking it online to Office 365 SharePoint Online (SPO) external collaboration is enabled.

The basic principal is that the site collection is divided into two different areas one with customer access and one initial one with only internal access. This allows for full

synchronization of design folders from IDM to the initial side due to the limited access provided by the system (visualized in Figure 9, horizontal blocks represents different access profiles). The web application is branded to fit the visual guidelines used by Wärtsilä and it is also designed to replicate the appearance from the official web page [www.wartsila.com](http://www.wartsila.com).

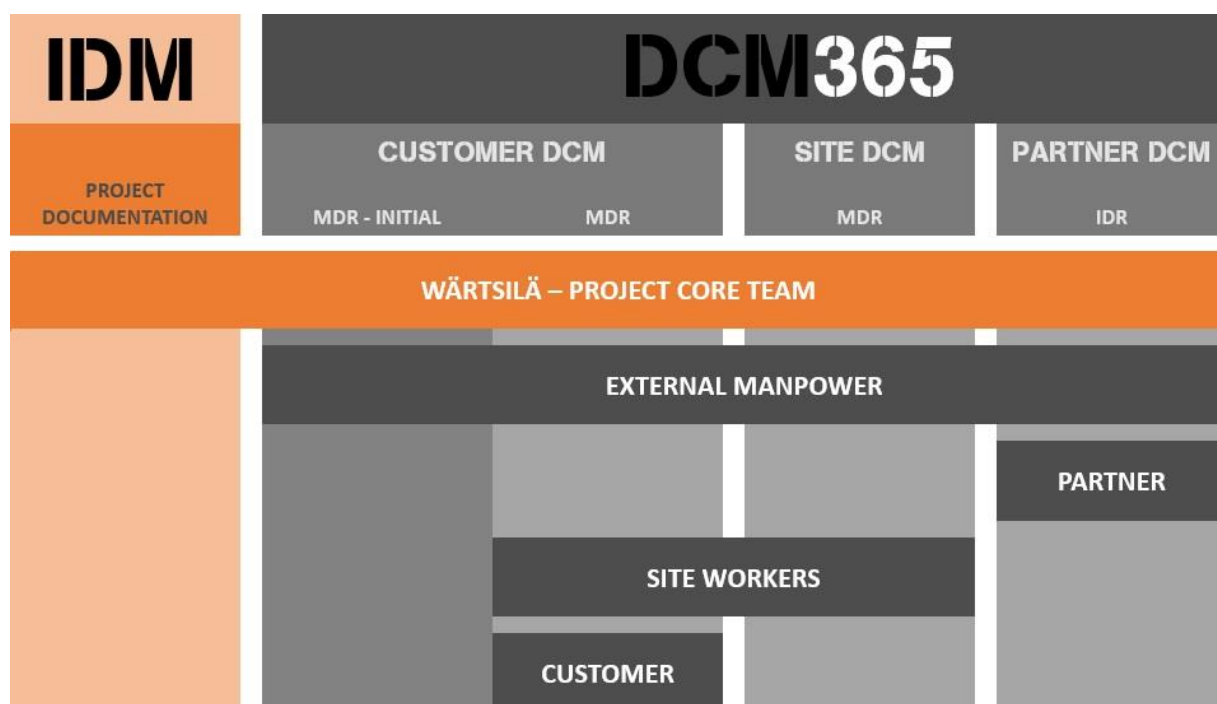


Figure 9 System accesses over the different document archives

DCM365 is developed within Wärtsilä Energy Solutions by the team Project Documentation, within this team there are three developers which has developed the DCM365 on a period of four years.

## 4.2 SharePoint Online

SharePoint Online is a collaboration platform which is very flexible and easy to modify to fulfill different needs in different business areas. Microsoft has developed SharePoint in a way that makes it easy to utilize and there are no requirements in server management. SharePoint can also be used by any software such as iPhone, Android and Windows. All you need is an internet connection. Everything within SharePoint online can have specific access profiles, this means that it is very easy to collaborate with external users and manage the access. (Microsoft 2015)

SharePoint can be bought in two variants. You can choose to buy the software and host the servers by yourself or you can buy licenses for your organization and use SharePoint Online that is hosted by Microsoft on the cloud.

SharePoint can be used for many different purposes, many companies that have utilized office 365 also build their intranet on the SharePoint platform. It can also be used as personal cloud to store and share files over internet. Another useful application for SharePoint is as an extranet and web content management. The last mentioned purpose is what DCM365 is used for, it enables a web-facing collaboration platform which is considered as a very secure way to collaborate over internet. Companies do not have to pay extra to provide access to SharePoint online sites for external users. This is done by creating a free Microsoft outlook login, and then provide these accounts to the external users. If the access profiles changes during the project, it is very easy to remove access from the site. (SharePoint 2015)

### **4.3 Sending documents towards customers or other stakeholders**

All documents that is issued towards the customer or other stakeholders has to be approved within Wärtsilä IDM. After internal approval they will be synchronized to DCM365 with files and document metadata. Then somebody within in the project team has to decide which documents to issue further to the actual receiver. The tool developed in this thesis will do notable difference on how to quickly recognize those documents. After the synchronization between IDM and DCM is done, the user which will make a decision on whether to issue or not towards customer or stakeholder will by only a few mouse clicks get information about those documents that needs some attention.

Normally there are a document controller that takes documents lists from IDM with internal statuses and compares these with exports from DCM. Then the document controller will send these lists to somebody within the project team to check and mark those documents that needs to be issued. This comparison is done by using Microsoft Excel, by using this method, the data that is imported will always be old data since all data is exported from a system that is constantly live. The new tool that I have done will always use latest data and it will be presented to the user with an attractive design which will directly point out documents which might be interesting.

#### 4.4 Document approval workflow in DCM365

All issued documents towards customers or other stakeholders in DCM365 follows the document approval workflow. The receiver does a document review and depending on that review status the issued document will automatically receive a MDR status.

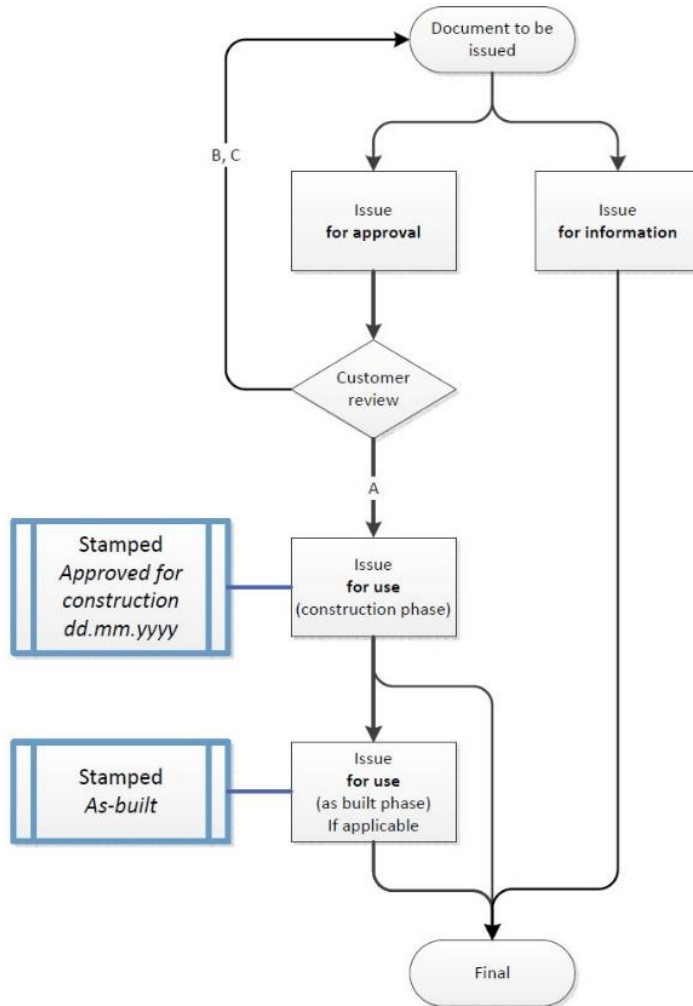


Figure 10 DCM365's different issue purposes towards project stakeholders

Release purpose	Project phase				
	Conceptual	Basic	Detailed	Construction	As-built
For information	X	X	X		
For review/approval	X	X	X		
For use				X	X

### 4.5 Document statuses in DCM365

All documents that is passed through the document approval workflow explained in previous chapter gets different statuses depending on the response. DCM365 will automatically update these statuses when response is set.

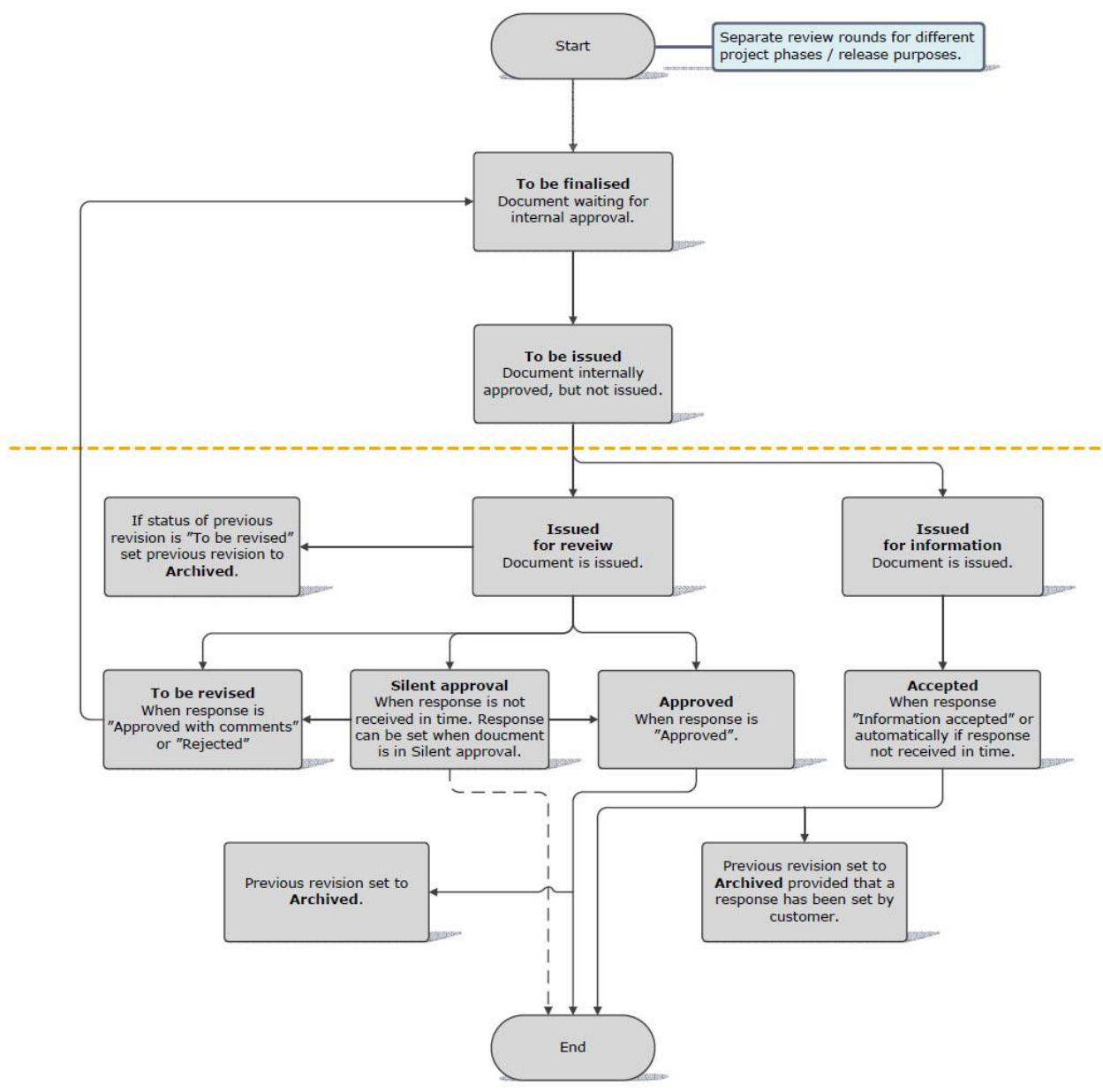


Figure 11 Different document statuses in DCM365

## 4.6 Document control

DCM365 gives Wärtsilä total control of all documentation sent towards customers, building site, suppliers and other stakeholders during the whole project lifecycle.

DCM365 will help Wärtsilä to retrieve the correct information within a reasonable period of time, meaning that there will be no wasted time in searching for a specific document or general project information. By getting control of the documentation the whole project will benefit from that in both time and money. This due to the fact that all information that is available is always the latest in the manner of revisions.

Information security is taken care of in DCM365 by giving rules to the application about who can access certain information. These rules prevent uncontrolled changes on documents and unauthorized access to documents. The platform is also very secure, meaning that nobody outside the project can access the information.

Document traceability is an important key factor within project management, this is ensured within DCM365. Every document within the application is tracked, it logs information about which persons or user groups have had access and who have seen the document. It also logs comment history and revision history.

DCM365 will enable stakeholders to know, at any point in time, the status of projects deliverables.

Implementing document control is a good way to protect project documentation and ensuring accessibility, retrievability, control and security for the project information.



## **5 RESULTS**

### **5.1 Designation of platform**

In the determinant process of choosing correct platform to build this tool on I had a few options on what kind of platform to be used for this tool.

- Normal Microsoft Excel sheet with prefilled columns and functions.
- A SharePoint web part called joined sub view.
- Use JavaScript/jQuery to load content to a HTML page.

After some investigation and consideration in the options above I chose to go with the last platform i.e. the JavaScript and HTML solution. This due to the big advantages in building a totally dynamic environment, which was one of the specifications.

Since all information on DCM365 is stored on a Microsoft hosted SharePoint server this is also the best and fastest way to receive the information. Another big advantage of using JavaScript is the independent of devices and platforms used by the users. This means that this tool will work whether it is used on a Macintosh, Windows based PC, tablet or mobile phone. Only thing that is required is that the platform need to have a modern browser installed.

### **5.2 Specifications of the tool**

This tool is developed and designed with focus on timesaving and to prevent timewasting manual work. To achieve this, I had to create a 100 percent dynamic script. This means

that the script should be adaptable to any project within Wärtsilä Energy Solutions without any modifications.

It is possible to achieve this if the tool only uses project disciplines, and then links the documents with their unique document id and revision.

The user should see straight away which documents that hasn't been issued towards the projects different stakeholders. User should also be able to quickly see those documents that have newer revision within IDM than in DCM.

In some case it is not only interesting to just get the current revision status, it might be that the user wants to get information about what status the document got or to know in what phase it was sent. Also the issue purpose could be interesting.

### **5.3 Building a dynamic environment**

To meet the requirement regarding dynamic environment I had to see what kind of tools I should use to achieve this. I could quickly eliminate Microsoft Excel; it could have been used but not in the sentence of a dynamic platform. To create a web part application within SharePoint was also one possibility, in this case that wouldn't have been so easy to modify for further use in other projects. That should also require a very static environment in DCM.

I chose to go with JavaScript, jQuery and a jQuery plugin called SPServices. By using script, I can make the tool to suit all projects using DCM365 within Energy solutions. There are only a few requirements regarding the DCM setup that is needed. This script requires that two lists (see below) exists on DCM365. When a new project site is created these lists are required to fill in. Other functionalities are also depending on the information on these lists.

- SiteStructure – This list contains information about how the project DCM setup is built. It provides information such as partners, site hierarchy and document lists.
- Sync\_struct – This list contains information about all disciplines that is synchronized from IDM towards DCM365.

## 5.4 Description of the script

The script can be divided into three sections even though it is the same file. In this chapter I will explain what the script does and how I managed to create a dynamic environment by using jQuery.

**First section** is what the script will do during document load. This is nothing that the user can effect on.

**Second section** is what kind of view the user wants to see, as it is today the user can choose between all revisions and latest revisions.

**Third section** is filtering and actions alerting. Depending on what kind of information the user likes to see, I have included several ways to filter down the list.

### 5.4.1 Section one – Triggered on document load.

The script is loaded when the site page is loaded, it's first task is to get information from the list called SiteStructure. This list contains information about the project setup, it includes all stakeholders within the project. The information that was loaded from site structure is then used to append the list headings. Five columns per stakeholder is presented. These columns are revision, issue purpose, phase, MDR status and response.

Then the script gets information from a list called `sync_struct`, this includes information about current disciplines used in the project.

The filtering options is built on the information from `sync_struct`, all disciplines with filtering options is presented in the left margin. The script creates the table structure dynamically depending on the project setup. This part of the script is always executed and the user can't affect this in any way.

#### **5.4.2 Section two – Get document lists**

This part of the script is triggered by the user. There are two options on how to see the documents. The user can choose to get only latest revision or all revisions. There is no difference between the query when users choose all documents or latest documents. It is presented on different way by using jQuery. When all documents are loaded into the HTML table, there is another jQuery function that will start to group these documents. That function will go through each row and check whether current row have same document as previous row, if there is a match it will group them by color. This function does not apply when only latest revisions is loaded since all document rows are unique then.

The tool always tries to keep irrelevant information not visible and also tries to keep the list of documents as short as possible, therefore documents are always discipline wise.

### 5.4.3 Section three – Filtering options

To make this tool easy to use and to keep the learning level as low as possible I created several useful filters. All filters are jQuery functions and these filter will trigger upon user commands. It is possible to filter/hide the columns including information about Issue purpose, phase, Status and Response. It is highly probable that some user like to hide away irrelevant information for just them, and keep the list as short as possible.

Another good filter is the “Alert documents” which can be used both for all documents and latest documents. This function goes through every row and checks if latest revision is issued. Sections three with filtering options will be further developed as more user feedback is collected.

## 5.5 Visual design of the document dashboard

How people interacts with data and lists is very individually and therefore it is quite difficult to design a software that suits everybody. I have used classic colors, red and green, to point out “good” things and “bad” things. I have also stripped the list with unnecessary information to keep it simple, easy to read and understandable.

The application is designed by Wärtsilä’s internal branding image, and the list design focuses on capacious rows and columns. Very important data such as document ID and revision is highlighted by bolder text. To apply focus on documents (rows) that isn’t in latest revision, the application will on demand point them out with light red color. Documents (rows) that doesn’t need any attention is painted in light green color.

## 5.6 Visualizations

Figure 12 shows a general overview of the document dashboard, above the orange ribbon is all menus and options for DCM365. Below the same ribbon is all options for the dashboard, some options are selected and they are clarified with orange background color.

The screenshot shows the Wartsila application interface. At the top, there is a navigation bar with the Wartsila logo and links for Home, Planned submittals, Project MDR, Transmittal sheets, Comment sheet, Calendar, Tools, Contacts, Site, and Search. Below this is an orange ribbon with the word "Options" and several buttons: "Hide issue purpose", "Hide phase", "Hide status", "Hide response", "Remove empty rows", "Alert documents", and "Select another discipline?". The main content area is titled "MDR - Initial - Mechanical" and displays a table of document revisions.

Latest revisions		CUS MDR					STE MDR				
Document ID	Rev.	Rev.	Issue purp.	Phase	Status	Response	Rev.	Issue purp.	Phase	Status	Response
3V76C1241	h	h	For approval	Basic	Approved	Approved	h	For information	undefined	Issued	No response yet
3V76C2789	g	g	For approval	Basic	Approved	Approved	g	For information	undefined	Issued	No response yet
3V76L4769	e	d	For approval	Basic	Approved	Approved	d	For information	undefined	Issued	No response yet
4V75L0112	v	v	For approval	Basic	Issued	Approved with comments					
9076C1227	g	g	For approval	Basic	Silent Approval	Information accepted	g	For information	undefined	Issued	No response yet
9076C1622	j	i	For approval	Basic	Silent Approval	Information accepted	i	For information	undefined	Issued	No response yet
DAAB435101	h	h	For approval	Basic	Accepted	Information accepted	d	For information	undefined	Issued	No response yet

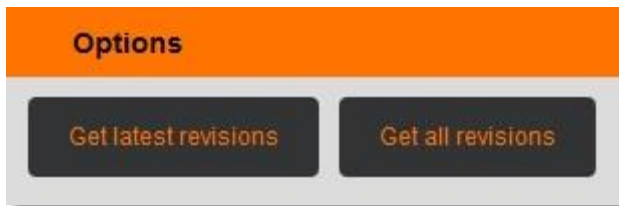
Figure 12 Application overview

When the tool is loaded this is the first option that the user will see. The user have to select the discipline that is in his/hers interest. These disciplines are loaded from a prefilled list within the site and are therefore fully dynamic.



Figure 13 Discipline options

After a discipline is selected, this is the next option that the user needs to define. All revisions option will load the list with every revision of a document within the selected discipline. This view is more interesting when looking into history and backtracking. It is easily detectable if a document hasn't been issued in a certain revision. The latest revision view is handier when the user would like to ensure that all partners are working with the latest available revision.



*Figure 14 Revision options*

After the revision mode is selected the list will be filled according to the previous selected options. This might a few seconds due to the amount of lists that is needed to get all information. When all data is fully loaded the user can start to browse the list. Below is all available filtering options and tools.



*Figure 15 Filtering options and tools*

Below are all available columns visible, these can be hidden if they aren't needed. For every stakeholder in the project, there will initially be five columns. Revision, issue purpose, phase, status and response.

Options											
Hide issue purpose		Hide phase		Hide status		Hide response		Remove empty rows		Alert documents	Select another discipline?
<b>MDR - Initial - Mechanical</b>											
Latest revisions			CUS MDR				STE MDR				
Document ID	Rev.	Rev.	Issue purp.	Phase	Status	Response	Rev.	Issue purp.	Phase	Status	Response
3V76C1241	h	h	For approval	Basic	Approved	Approved	h	For information	undefined	Issued	No response yet
Maintenance water tank VBA 901 6 m³ & 10 m³											

Figure 16 List headings and columns

This is the view of all revision without any filtering options activated. All documents with the same document id is grouped with same background color which gives the user a good overview.

DBAB651680	-										
Frame -											
DBAB876230	b	b	For approval	Basic	To be Revised	Approved with comments	b	For information	undefined	Issued	No response yet
W46 Pipe module 2-C EL QEA 0_1											
DBAB876230	c										
W46 Pipe module 2-C EL QEA 0_1											
DBAB912604	-	-	For approval	Basic	To be Revised	Approved with comments	-	For information	undefined	Issued	No response yet
Pipe module											
DBAB912604	b										
QEA 011 W46 Pipe Module 2-C EL Plan view											
DBAB912604	c										
QEA 011 W46 Pipe Module 2-C EL Plan view											
DBAC535443	c										
Exhaust gas system Flat bar insulation ring For 50mm											
DBAC620804	a	a	For approval	Basic	Silent Approval	Information accepted	a	For information	undefined	Issued	No response yet
QEA 011 W46 Pipe module 2-C EL Device list (60 Hz)											
DBAC692065	-										
Exhaust gas system Flat bar 100mm insulation ring (For silencer Dia 2...											

Figure 17 List example, all revisions and no filtering



This is exactly the same view as above but here is all documents alerted by the script. Those rows that are green are issued and the red rows means that these revisions hasn't yet been issued.

<b>DBAB651680</b> Frame -	-										
<b>DBAB876230</b> W46 Pipe module 2-C EL QEA 0_1	<b>b</b>	<b>b</b>	For approval	Basic	To be Revised	Approved with comments	<b>b</b>	For information	undefined	issued	No response yet
<b>DBAB876230</b> W46 Pipe module 2-C EL QEA 0_1	<b>c</b>										
<b>DBAB912604</b> Pipe module	-	-	For approval	Basic	To be Revised	Approved with comments	-	For information	undefined	issued	No response yet
<b>DBAB912604</b> QEA 011 W46 Pipe Module 2-C EL Plan view	<b>b</b>										
<b>DBAB912604</b> QEA 011 W46 Pipe Module 2-C EL Plan view	<b>c</b>										
<b>DBAC535443</b> Exhaust gas system Flat bar insulation ring For 50mm	<b>c</b>										
<b>DBAC620804</b> QEA 011 W46 Pipe module 2-C EL Device list (50 Hz)	<b>a</b>	<b>a</b>	For approval	Basic	Silent Approval	Information accepted	<b>a</b>	For information	undefined	issued	No response yet
<b>DBAC692065</b> Exhaust gas system Flat bar 100mm insulation ring (For silencer Dia 2...	-										

Figure 18 List example, all revisions with documents alerted

Only latest revisions visible and no filtering options activated.

<b>DBAD442754</b> (D) Oily water system Device list	<b>a</b>	<b>a</b>	For approval	Basic	Approved	Information accepted	<b>a</b>	For information	undefined	issued	No response yet
<b>DBAD442755</b> (D) Oily water system W9L46 UNITS 11 & 12	<b>d</b>	<b>c</b>	For approval	Basic	To be Revised	Approved with comments	<b>b</b>	For information	undefined	issued	No response yet
<b>DBAD444574</b> (T) Compressed air system Device list	<b>c</b>	<b>b</b>	For approval	Basic	Approved	Information accepted	<b>b</b>	For information	undefined	issued	No response yet

Figure 19 List example, latest revisions and no filtering

Same view as above but all rows are alerted by the script. Every documents that is issued in the latest revision will give a green row. If the stakeholder is working on an older revision than are available within DCM365, the row will appear as red.

<b>DBAD442754</b> (D) Oily water system Device list	<b>a</b>	<b>a</b>	For approval	Basic	Approved	Information accepted	<b>a</b>	For information	undefined	Issued	No response yet
<b>DBAD442755</b> (D) Oily water system W9L46 UNITS 11 & 12	<b>d</b>	<b>c</b>	For approval	Basic	To be Revised	Approved with comments	<b>b</b>	For information	undefined	Issued	No response yet
<b>DBAD444574</b> (T) Compressed air system Device list	<b>c</b>	<b>b</b>	For approval	Basic	Approved	Information accepted	<b>b</b>	For information	undefined	Issued	No response yet

Figure 20 List example, latest revisions and documents alerted

Only latest revisions visible and all extra information is hided. This view is handy when the user likes to make some status reports or similar from the system.

<b>DBAD442649</b> (V) Cooling water system 1(2) W9L46 UNITS 11 & 12	<b>b</b>	<b>b</b>	<b>a</b>
<b>DBAD442650</b> (V) Cooling water system Device list	<b>a</b>	<b>a</b>	<b>a</b>
<b>DBAD442712</b> (Q) Lube oil system 1(2) W9L46 UNITS 11 & 12	<b>d</b>	<b>c</b>	<b>b</b>

Figure 21 List example, latest revisions and all extra columns hided

## **6 CONCLUSION**

### **6.1 Summary**

The goal with this thesis was to create a tool which will help all internal users to easily make sure that everybody within the project is working with the latest revisions. According to that goal I would say that I have succeeded very well. The tool is in use in a few projects and the feedback from several users has been positive. Another target with this thesis was the need of a dynamic and adaptable tool. This target was also achieved, there are no modifications needed to adapt this tool to older project sites within Energy Solutions. Hopefully this tool will save some money in the manner of reduced unnecessary work, both in finding old revisions and ensuring that no extra rework on site is needed due to use of old documents.

### **6.2 Further development**

This application will be further developed within Wärtsilä. It should be possible for the project team to make some tags when they see some documents that needs to be issued towards any stakeholder. These tags should then appear in the issue tool within DCM365. When this tagging mechanism is in use, it will save time and make it easy for other users to issue the documents.

The tool will migrate with other features on the DCM365 site in the future.

### **6.3 Potential cost savings for Wärtsilä Energy Solutions**

Due to this tool Wärtsilä Energy Solutions will have a tool that quickly and effectively points out older revision within the project documentation. This will prevent that site and suppliers always has access to the latest information. That in turn can and will generate revenue to the whole project.

If the building site doesn't have the latest available information, it will produce unnecessary costs due to the inadequate building errors.

Instead of savings, unnecessary costs are avoided. Work is done first time right and according to the schedule. Correct amount of material is available at site. Rest deliveries are avoided (delivery of missing parts to site, which were not in planned main delivery).

Another cost saving that can be generated due to this tool is the reduction of working hours earlier spent on finding document statuses. This tool gives an instant report and no special education or IT related knowledge is needed.

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