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Project Sales Cost Calculation Tool

Case: Wärtsilä Services

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BACHELOR'S THESIS

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Abstract

This thesis work is made for Wärtsilä Services, Area sales, E&A project sales teams. The main objective for this thesis was to produce a fast, accurate and consistent cost calculations tool for electrical and automation project upgrades for the Energy sector. This tool should be easy to use and easy to maintain, there should also be as many pre-set costs as possible.

The execution of this thesis work started out with the planning of the layout and functions for this tool. The pre-set costs were acquired after that, this was done in a few ways; via agreements with sub-suppliers, discussions with product managers internally, meetings with project management and previously done project with known costs for certain items.

The result of this thesis work is a quick and easy to use calculation tool that provides accurate and consistent sales prices for the electrical and automation upgrade project proposals. A few key features are presented in the result chapter of this thesis work, but all the costs and margins have been censored. A few additional features to the calculation tool that were not originally requested have been added to the calculation tool while upon its development. One of these additional features is an automatic preliminary timeline for the project to which the cost has been reserved.

Language: English Key words: project sales, product configurator, Excel

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EXAMENSARBETE

Författare: Benjamin Gripenberg
Utbildning och ort: El- och Automationsteknik, Vasa
Inriktningsalternativ: Automationsteknik
Handledare: Ronnie Sundsten

Titel: Projekt om försäljningskalkyleringsverktyg

Datum 27.11.2018 Sidantal 33

Abstrakt

Detta examensarbete gjordes för Wärtsilä Services, Area sales, E&A project sales. Målet med examensarbetet var att utveckla ett snabbt och noggrant kostnadskalkyleringsverktyg för el- och automationsuppgraderingsprojekt inom energibranschen. Detta verktyg skall vara lättanvänt och lätt att underhålla, verktyget skall vara försett med så många förinsatta kostnader som möjligt.

Utförandet av examensarbete började med att planera layouten och funktionerna. De förinsatta kostnaderna blev samlade därefter. Detta gjordes på några olika sätt, via avtal med underleverantörer, genom möten med projectmanagers och productmanagers och slutligen via tidigare utförda projekt med kända kostnader.

Resultatet av detta examensarbete blev ett snabbt och lättanvänt kalkyleringsverktyg som ger noggranna och jämna försäljningspriser till el- och automationsuppgraderingsprojekt. Några huvudfunktioner presenteras i resultatkapitlet i detta examensarbete, men alla kostnader och marginaler har censurerats. En del tilläggsfunktioner som inte fanns med i de ursprungliga kraven har blivit tillagda i kalkyleringsverktyget. En av dessa är en automatisk preliminär tidslinje för projektet, vilket har planerats i verktyget.

Språk: engelska Nyckelord: projektförsäljning, produktkonfigurator, Excel

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Table of Content

TERMS AND ABBRIVITIATIONS

E&A	Electrical & Automation
PM	Project Management
PLC	Programable Logic Controller
HMI	Human Machine Interface
SCADA	Supervisory Control and Data Acquisition
AVR	Automatic Voltage Regulator
LV	Low-Voltage
MV	Medium-Voltage
OEM	Original Equipment Manufacturer

Foreword

I would like to thank Wärtsilä for the opportunity to write my Bachelor Thesis while working for you. A special thanks to Robert Keisala and the rest of the E&A sales team, Product Managers and Project management team for all the support and feedback.

A big thanks to Novia UAS for the excellent education I have received these last years!

1 Introduction

The Electrical & Automation field is constantly changing and evolving and with it the products and solutions that surround them. This poses an interesting challenge for the project teams; how do you keep the prices at a correct level? Depending on the competitors in a said area overpricing can be a real issue, an equally big worry is under-pricing. Selling a project without a profit is not something many companies does without a clear return later.

The answer is clear, you must use an accurate and up to date calculation tool. I was assigned the task to develop a tool for E&A Project sales, Services Wärtsilä.

Since this work was done for project sales there is also another challenge, no two projects are the same so there is a need for great flexibility when configuring the scope of the project.

1.1 Background

As mentioned above this work was done for the sales team, the teams responsibilities are explained in more detail in Chapter 2.5. In short, their responsibilities are to sell E&A upgrade projects to existing Energy and Marine installations.

The existing installations can range from ten to over thirty years old, hence the technology present at-site will be vastly different, this adds another level of complexity to the project planning stage. There are also a couple of different sub-suppliers that Wärtsilä have been using over the years, hence the technology used at sites that are of the same age may also vary, so the price giving stage is not as easy as it may sound like at first.

1.2 Problem Area

Wärtsilä is continuously developing and introducing innovative solutions for the Energy and Marine section, many of the solutions can be retrofitted. Depending on the age of the installation the technology present may not be sufficient enough for the newer solutions, hence there is a need to upgrade the existing equipment installed.

An equally important issue is to maintain the availability of the equipment installed, commonly known as life cycle management, explained in Chapter 3.1.1.

All this equates to a price giving tool that is flexible and easily updatable, this was the problem area the author was assigned.

1.3 Purpose

The purpose of this thesis work is to develop and produce an accurate and quick cost calculation tool for the E&A sales teams which is part of Area sales in the service unit, the team's responsibilities are described in more detail in Chapter 2.5. The tool will be used in all Energy E&A upgrade projects and will provide more accuracy between the sales price and the actual costs later in the actual project stage. This tool will be used by all four sales areas South Europe and Africa, Middle East and Asia, Americas and finally North Europe. In total there are 14 sales managers and sale support managers.

1.4 Delimitations

This thesis only takes into consideration the Energy side of E&A upgrades responsibility area, the possible improvements for the Marine side is mentions under section 6.2. This thesis work does not analyse or study how accurate the costs that will manually be entered by the user in this tool are, the main purpose of this work is to provide a base to enter all the individual costs and get a sales price out of it. This tool will also not be able to check that there is not a human error in the manual cost insertion by the user, this is solely the responsibility of said user.

1.5 Confidentiality

There is no need for confidentiality for this work, however all the information that is considered sensitive and or internal has been changed to "Item" or a "1".

1.6 Disposition

The disposition of this Thesis is as follows:

Chapter 1. Introduction to the Thesis background, problem area, purpose and delimitation.

Chapter 2. Brief introduction to Wärtsilä and the E&A team.

Chapter 3. Theory regarding this work.

Chapter 4. The methodology used to reach the result.

Chapter 5. A summary of the result reached.

Chapter 6. The conclusion of the thesis work

2 Brief Introduction to Wärtsilä

Wärtsilä was established in 1834 as a sawmill in Wärtsilä Finland, but is now one of the leader in smart technological solutions in the marine and energy sector. Between that Wärtsilä has seen many changes. Everything from a steel mill, powered from the rapids next to the mill in 1908 to an engineering workshop in 1935. In 1938 the company entered the diesel engine market; the first diesel engine saw the light of day 1942 in Turku. Between the years 1947 and 1984 Wärtsilä acquires multiple companies. A ceramic company, a glass factory, a lock factory and most importantly the NOHAB diesel business from Bofors in Sweden. After a couple of mergers and name changes Wärtsilä is registered as Wärtsilä in the Finnish Trade Register in September 2000. (Wärtsilä, 2018a)

Today the technology group Wärtsilä is a leader in smart technological solutions and has a proven track record in complete lifecycle solutions in the energy and marine markets. Today Wärtsilä operates in over 80 countries with over 200 locations. Wartsila's net sales totalled 4.9 billion and had around 18,000 employees in 2017. As of writing this thesis Wärtsilä is composed of three different segments. (Wärtsilä, 2017a)

2.1 Marine Solutions

Thanks to being one of the forerunners in marine industry with a proven track record, know-how, and great engagement by the personnel. Wärtsilä Marine solutions can offer tailor made solutions. Marine solutions offer innovative products and solutions that are ecologically sustainable, safe, efficient, flexible and economically viable. Last year (2017) Marine solutions had a revenue of 1307 million euro and 5845 employees making it the second largest segment of Wärtsilä. (Wärtsilä, 2017a)

2.2 Energy Solutions

Energy solutions is a leading global energy system integrator that has a wide range of environmentally friendly solutions. A few of these solutions are ultra-flexible powerplants, energy storage and LNG-terminals with distribution systems. At the end of 2017 Wärtsilä had a total of 67 gigawatt installed across the globe in 177 countries. In 2017 Energy

Solutions had a revenue of 1401 million and 1038 employee making at the smallest segment regarding revenue and employees. (Wärtsilä, 2017a)

2.3 Services

Services are as the name suggests the segment that supports the customer under the whole installations life-cycle by optimizing the efficiency and performance of both Marine and Energy installations. Wärtsilä service unit is a one of a kind in the industry, with 11.000 highly competent co-workers all over the world at 160 locations. Services does not only offer everything from spare-parts to complete maintenance- and optimization services but is continually evolving and developing new smart and efficient solutions to make the customers installations not only more useful but also more economical. Services is the largest segments in regard to revenue and employee amount, 2215 million and 10624 employees last year (2017). (Wärtsilä, 2017a)

2.4 E&A Project sales

The team this thesis work was done for is E&A project sales, Area-sales, Services. There are four areas under the Area-sales segment; South Europe and Africa (SEAF), Middle East and Asia (MEA), Americas (AMER) and North Europe (NE).

The sales managers working in E&A project sales responsibility is to prepare and sell E&A upgrade projects to existing energy and marine installations in their respective areas. These upgrades can be anything ranging from Automation upgrades; Engine control system, PLC, HMI, SCADA, to more power related upgrades; AVR, Protection relays, LV & MV cubicles and generators.

2.4.1 Way of working

The way of working varies a bit from case to case, but it is usually as follows: The sales managers receive a request from a customer regarding an upgrade, update or change to the installation. After discussing with the customer, they then start to study what is currently installed at the installation. They check for the lifecycle status, the condition and other relevant information of the installed equipment. After that they come up with a preliminary design and then requests offers for the equipment needed from the correct sub-supplier for the case. They start preparing the proposal itself and start the price giving process, this is where the tool that was developed for them comes into the picture.

3 Theory

This chapter will give the reader a better understanding why there is a need for E&A upgrades and why offering E&A upgrade projects can be very challenging at times. This chapter will also touch on the essential stages of a E&A project and how all these completely different stages calls for a flexible tool to help with the process of reserving the correct cost for them. These chapters will be angled in a way so that they are relevant to the project sales teams, but the principles do apply to other teams.

3.1 Why perform E&A Upgrades?

Someone who has no previous experience or knowledge about E&A systems or equipment can easily overlook the need to ever do any upgrades or updates to their installation. This is a big problem since E&A equipment do degrade over time, equipment gets unsupported, components become unavailable etc. According to R.E. Brown these are a few of the more common reasons to why electrical maintenance and upgrades are necessary. The need for upgrades can be categorized in two main categories: Pro-active upgrades and Re-active upgrades described in more detail below. (Brown, 2009)

3.1.1 Pro-active upgrades

Pro-active upgrades are done to prevent an unwanted event, these events can be of varying severity and priority. One of the reasons for these kinds of upgrades can be that the equipment present is obsolete.

A commonly used product lifecycle model is one with four stages: Active, Supported, Limited and Obsolete. The reasons behind a product being announced obsolete can vary, but usually it is because there is a newly developed solution that will replace the outgoing solution. It could also be that the components that the OEM uses to produce a product is no longer available. Whatever the reasoning behind this change of lifecycle status is, according to the authors the outcome will be the same. The replacement can be a direct replacement with very few needed modifications or changes, this is the preferred way of working. However, with today's rapidly changing technology there are bound to be products where it simply is not possible to design the new product as a direct replacement. Then this upgrade will be classified as an upgrade, see Chapter 3.2. (Immonen, 2004)

3.1.2 Re-active upgrades

These upgrades are done in response to an event that was not anticipated, example given reacting to a breakdown. If the equipment that broke down still is supported by the OEM then a breakdown is not that big of a concern, but if the equipment is no longer available then this will cause major downtime of the affected equipment. (Immonen, 2004)

No Mather what the power plants operation mode or purpose is unexpected downtime is always an issue. How big of an issue depends on the installation and its purpose, for example some power plants have the possibility to have down one or more generation units for maintenance if this is the case then there is some flexibility. A powerplant running in so called island mode is at more risk since these powerplants can be the only major electricity provider for an isolated industry, mine or island. Downtime can also cause the gird company to issue fines to a plant that is not able to produce what has been on beforehand agreed upon.

Best case scenario is that the replacement equipment is, as mentioned in the previous chapter, a direct replacement, but most of the time there are a need for external modifications and this will then be defined as a project. This is where the need for a quick and accurate calculation tool comes into the picture. (Brown, 2009)

3.2 Defining a project

A project has a defined beginning and end, a project is not a routine-based operation, instead a project has a specific set of steps chosen to reach a single goal. A project can have multiple steps, usually it is the following: Initiating, Planning, Executing, Closing and Follow-up. (Pelin, 2011)

The E&A project sales team is primarily active in the project pre-planning phase but since this pre-planning must be done in an accurate and precise way it is in everyone’s best interest that this is done properly. The customer expects the proposal they receive to be accurate to reality. According to Kerzner fault, that costs 100€ to fix during the planning phase can cost thousands of Euros if it is first discovered during the Executing stage.

(Kerzner, 2017)

3.3 Project planning

As stated in the previous chapter a well-planned project will usually be easier to execute than a poorly planned project, there are however always unplannable events, but these can be managed by a thorough risk analysis.

When planning a project, one can ask oneself a few key questions:

- What will be accomplished?
- How will it be accomplished?
- Where will it be accomplished?
- When will it be accomplished?
- Why will it be accomplished?

These few simple questions will force both the buyer and the seller to consider multiple key aspects of the project. The five key aspects are the following and will be discussed in more depth further in this thesis.

- Project requirements
- Project schedules
- Project management
- Logistics
- Manpower

(Kerzner, 2017)

3.3.1 Project Requirements

Project requirements will usually be set by the customer and then it is up to the contractor to fulfil these requirements. Another common way of working is that the customer requests a solution from the contractor and then the contractor will come up with the project requirements. Whichever the way of working is, the key thing is that both the contractor and

buyer agrees on the project requirements before the project begins. These requirements can be anything from functions of the solution to the requirements on the hardware delivered.

(Pelin, 2011)

3.3.2 Project Schedule

Project schedule is also one of the main points of interest, depending on the complexity of the project and what the customer requires, projects schedule can wary in detail quite a lot. Sometimes a simple schedule that includes delivery times and a simple estimation of the works required on-site can be sufficient. More complex projects might require a more in-depth schedule where all the various stages of the work are defined and agreed upon. The biggest point of interest when it comes to powerplants is usually the required downtime.

(Kerzner, 2017)

3.3.3 Project Management

As the name suggest the sales team does not have as their responsibility to make the final plan or to manage the project after it is sold, this is the job for a project manager. A project manager has a predefined goal or goals and must reach it with the costs reserved by the sales team. A project manager does also have costs that must be reserved when planning the project, these costs can be: Project working hours for the project manager and project engineers, traveling costs, possible packaging and marking costs for equipment and documentation costs. All these costs will have a significant impact on the overall success of the project from a business standpoint.

(Kerzner, 2017)

3.3.4 Logistics

Logistics are always something that both the contractor, buyer and sub supplier must pay attention to. The system that is used is called INCOTERMS or also known as the International Commerce Terms is a series of standardized delivery terms. This standard describes how the responsibility of the delivery of equipment’s shall be managed between the contractor and buyer. The most commonly used terms are:

EXW (Ex works) If EXW is used that means that the seller makes the equipment available for the customer at their area, for example their factory or their storage facility. The risk is transferred to the customer when the equipment is pick-up from said place. This term has the least risk for the seller.

FCA (Free Carrier) The seller is responsible for the risk until the equipment reaches the mentioned place, at that point the risk is transferred to the customer.

CPT (Carriage Paid To) The seller is responsible for the delivery and export to the pre-defined place. When delivered at the defined place the customer takes responsibility and deals with the importation of the equipment.

CIP (Carriage and Insurance Paid to) The seller is responsible for the delivery, insurance and export of the equipment to the predefined place. The seller is also responsible for the import of the equipment.

DAP (Delivery at Place) This term can be used with any term of transport and the seller is responsible for the delivery, insurance and export of the equipment to the pre-defined place. The buyer is responsible for the importing of the equipment.

DDP (Delivered Duty Paid) This is the term with the most risk for the seller since this term gives the responsibility for delivery, insurance, export and import to the pre-defined place on the seller. This is a term that must be used with caution since the seller must pay for the clearing of the goods, the import taxes and all other expenses related to the importing of the goods.

(Trade Finance Global, 2018)

3.3.5 Manpower

This section is most interesting for the contractor since the cost of manpower can quite often be the biggest part of a project. There are two main ways to plan the activity on-site depending on what is more important; duration of the works or cost. Usually the best result is reached with a combination of both. (Pelin, 2011)

If we have a project that requires an estimated ten man-days to complete, this could theoretically be done by ten people during a day, but in practice this is never possible. The more practical solution would be two or three people for four to five days. This will however be more expensive than having one person working for ten days.

The additional costs to consider can be: Traveling costs, costs for acquiring visas and other onetime costs. There are also other costs associated with manpower mainly accommodation, local traveling costs and daily allowances. All these costs must be accounted for when planning a project, so according to the author it is recommended that there is a standardized way of working when it comes to reserving costs for manpower, i.e. a calculation tool.

(Kerzner, 2017)

3.4 Business proposal

The purpose of making a specifically written business proposal is to obtain a job or a project. These business proposals are most commonly made in a way so that they benefit both companies involved i.e. the company that makes the business proposal and the company to whom the proposal will be sent. These business proposals are not a project plan, but they will bring up the most important aspects of the proposed job or project. The following aspects are the most common that can be found in a proposal:

- The proposed plan to the job or project
- The price
- The delivery times
- Possibly a project schedule
- Other project specific information

A proposal is not a legal agreement but merely a proposal to make a deal, so to get the final deal there is a need for an official contract between the seller and the buyer, described in detail in section 3.5.This contract can refer to the proposals so it is in the best interest of the seller to make and accurate and correct proposal in the first place.

(Lewis, 2018)

3.4.1 Types of business proposals

There are a mainly three types of business proposals that are commonly used*;* Formally Solicited Business proposals, Informally Solicited Business proposals and Unsolicited business proposals.

Formally solicited business proposals are in most organizations a written response to the issued requirements by the customer. These come in four main forms, RTP (Request for Proposal), RTQ (Request for quotation), IFB (Invitation for Bid) and RFI (Request for Information). These four main forms will be described in more detail below:

RTP (Request for proposal) are usually issued by the customer when there is no premade solutions or products available which meets the requirement that the customer has set. These requests sometimes contain a described way of how the seller should prepare the proposal and in what ways the proposal will be evaluated.

RTQ (Request for Quotation) These requests are often issued by the customer when they are in need of a big quantity of goods, in these cases the price might not be the only deciding factor, time of delivery, quality of products or services and availability of commodities might be as important as the price itself.

IFB (Invitation for bid) as the name suggests this is an open invitation to make a bid for some predetermined services, commonly used in construction or other bigger projects. The main goal of these are to find out the prices of the people bidding, usually the price has a bigger impact than the quality of the services.

RFI (Request for information) The main purpose of this request is to check the status on the market i.e. this is a way for the seller to get closer to the final deal, sellers will usually fill this request with much care to fulfil all the requirements that has been laid out by the buyer, since a well-made RFI proposal will surely help the seller.

Informally Solicited Business proposals are a result of a verbal conversation between the seller and the buyer. In some instances, these proposals are called Sole-source proposals, since these proposals does not possess any requirement for the seller to meet. These are usually made after a short meeting to capture a deal, they range in length from twenty-five to as little as five pages, sometimes even less.

Unsolicited business proposals do not have a direct link between the seller and the buyer, since it can be any form of informal document that contains the needed information i.e. a marketing brochure. These are made to increase the chance to get a deal or a project. Unsolicited business proposals are not used that commonly when it comes to projects since project are very specific, instead they are used with premade products or solutions.

(Newman, 2016)

3.5 Contract

A project contract is an agreement between two or more parties to reach a predetermined goal in a predetermined way. There are multiple different kinds of contracts for example fixed price contract, Unit price contract and percentage contract.

Fixed price contract or lump sum contract is the preferred contract when it comes to short and simple projects. This type of contract states what the seller must provide and in what timeframe. It also states what the buyer must pay and possibly in what manner. It is also possible to define the payment terms and milestones if found necessary.

The Unit price contract divides the project to multiple units that will be defined separately. Then the bidders are asked to bid on each unit of the project and depending on the bid amount and the qualifications of the bidders the project might be given entirely to a bidder or it might be split to multiple different bidders each with their own unit.

The percentage contract is as the name suggest based on a percentage of the estimated sum of the resources and material required. Based on that sum the service provider and buyer agree upon a percentage of that that the service provider will receive.

(Kerzner, 2017)

3.6 Project Kick-off

In this chapter the reader will get understanding of what the purpose of a kick-off meeting is and what the key aspects of the different kick-off meetings are.

3.6.1 Internal kick-off meeting

As the name suggests this meeting is held internally in a company or a project team. The purpose of this meeting is to align all the different stakeholders on the customer, scope of the project, assign responsibilities and roles and plan the next step of the project.

It is important that everyone involved is on the same page when it comes to the customer and project background and information, there are a few important points that can be used as an agenda during an internal kick-off meeting:

- Customer information and background

- How was the project obtained?
- Have all internal procedures been completed and approved?
- Assign responsibilities and define stakeholders
- Present and explain the scope
- Risks and other things to consider
- Plan the next move, possibly the external kick off

Bigger organizations usually have a pre-made way of working when it comes to these meetings with templates (minutes of meeting) to fill in and share with the participants and stakeholders after the meeting.

(The Digital Project Manager, 2016)

3.6.2 External kick-off meeting

At this point there is a legal agreement between the customer and contractor, but mistakes and miscommunications do happen so the purpose of this meeting is to align the views of project with the customer.

If some contradictions between what the customer is expecting and when the contractor presents, there might be a need for a change order is the differences are too big for the contractor to manage with the current budget. Key points of these meetings can be:

- The background of the project
- A briefing of the project
- How do we determine if the project has been successful?
- Review and discuss the project plan this can include:
    - The timeline
    - What will be delivered
    - Risks and responsibilities

- What is the next step?

When these few points have been agreed upon the project has a greater chance of being successful, according to the site The Digital Project manager.

(The Digital Project Manager, 2016)

3.7 Product configurators

Usually projects can include or even be built around one or more products or solutions, but since no two projects are the same the product usually must be configured in a way to work in a specific application. These products can be very technically advanced and possibly can be configured in multiple ways. This poses a great challenge since the product can be very complex, but the configurator must still be easy to use.

According to Juha Tiihonen the basic principles of a product configurator are:

- Each product is tailor made for the specific needs of the different customers
- These products have been pre-designed to fulfil a vast range of customer needs
- The sold products are all a specific combination of pre-designed and engineered components or modules
- There are a few main components of the product that can be called the general structure.

The benefits of having a product configurator system are significant, firstly there are no need to design new components for a product in the sales to delivery phase of a project. This will lower the delivery time and it will also make it possible to stick to a tighter delivery schedule since the manufacturing time will be known. It will also be possible to reach a wider range of customers with a customisable product compared to an on-off product. A product configurator will also decrease the numbers of error when planning a proposal. Since the planning phase will be faster it will increase the amount of proposals or quotations without hiring more personnel.

There are a few different classes of product configurators Primitive, interactive and automatic. The *primitive configurator* is the simplest of the three, this one will not check if a valid configuration has been made or even that all the necessary selections has been made. If these functionalities are desired an *interactive configurator* are needed, this configurator will verify that the selections made by the user is correct and that they will work between each other. The last type of configurator, *automatic configurator* will configurate the product based on a few simple inputs from the user, these inputs can be the requirements for the product or even an amount needed of some type of components.

(Juha Tiihonen, u.d.)

The calculation tool that was made have two types of product configurators, a few primitive configurators and one automatic configurator.

4 Methods used to reach the goal

The purpose of the chapter is to give the reader an understanding of the different methods used when conducting research, the difference between qualitative and quantitative methods and the benefits of the two.

Later in the chapter the reader will get an insight in the decision making made by the author and how the different research methods where used.

This chapter will mention a few of the products and solutions used by Wärtsilä when performing retrofitting E&A projects, but the author does not explain the functionality or purpose of said products in depth.

4.1 Research methods

When deciding which research method to use the deciding factor should be the problem area, different types of problems will require different methods. Of course, one can combine multiple methods, in this case two methods where used *qualitative* and *quantitative*, this adds the benefits of both methods and improves the validity of the work.

4.1.1 Qualitative

This method is based on previously done research or studies, this has the obvious benefit of easily accessible information, this information is quite often used in the problem formulation and theory stage of the work. This method is a good way of acquiring information if the researcher is critical to the presented information and the way the research was done.

4.1.2 Quantitative

The quantitative research method is a way of analysing data collected in a structured way from varying sources. One of the most important aspects of the qualitative research method is the researcher collecting data from the target audience or key persons. The data collection can be done via multiple methodologies for example face-to-face, phone or online.

4.2 Choice of methods

For this work both the qualitative and quantitative methods where chosen since both are suitable for this work. For the theoretical part the *qualitative* method where used since there are a lot of research and knowledge available about project planning and cost calculations.

For the empirical part the *quantitative* method where used since the costs the different segments of a project will wary and change, there was also a need to update the existing prices. This was done by gathering information from different internal and external stakeholders and suppliers. The information was gathered via meetings, previously delivered project, internal experts and official annual agreements. There are also many previously done projects with a vast amount of data available, this data was analysed to find the correct costs for the calculation tool.

4.3 Solutions approach

In this chapter the author presents the reader with all the methods used to reach the goal. Since some of the information in this chapter is considered confidential this information has been changed to “Item” or “1”.

4.3.1 Choosing the platform

The choice of platform to develop this tool was an easy one, there were already some development done to an older tool so naturally this was the way forward. The older tool was built in Microsoft Excel. Microsoft O365 is extensively used within Wärtsilä so this was also a deciding factor when choosing the platform.

Another option could have been APEX a web browser-based tool, but since the majority of employees use excel on a regular basis this was the preferable option.

4.3.2 Physical items and their costs

The scope of the projects that the E&A project sales team plan and sell varies a lot, but there are a few key products, there products are UNIC, sWOIS, PLC, AVR, Protection relays and LV & MV switchgear. How these products functions and how these costs where gathered is described in this chapter.

UNIC is a Wärtsilä engine control system built up of a few different modules, the amount and what modules that needs to be used will vary depending on the engine type and the fuel type.

- The cost for these modules where acquired from the product manager for UNIC, and with the guidance of the product manager a quick selection algorithm was made that will give the cost for the UNIC hardware depending on the engine and fuel type, see Figure 1 (Wärtsilä, 2018b)

UNIC C3 Hardware	Included:	No				0.00
			Included	**eng #**	**á price**	**Total**
Unic C3 basic package for engine	W12V26			5	1	5
Item				5	1	5
Item			0	5	1	0
Item			0	5	1	0
Item			0	5	1	0
Item				5	1	5
Item			1	5	1	5
Item				5	1	5
Item						
Item			1	5	1	5

Figure 1 UNIC configurator.

sWOIS is a Wärtsilä human machine interface solution for controlling and monitoring the status and data in a power plant or marine application. These are three main types of sWOIS solutions: Redundant server, Single server and Desktop version. In addition to this there are around ten optional equipment that can be necessary to include to fulfill the customers' requirements. (Anttila, 2018)

- The costs for the sWOIS main modules and optional equipment where well known, but these were also confirmed with the resp. product manager before being inserted into the calculation tool, see Figure 2

sWOIS HMI system			12.00
	Qty	á price	Total
sWOIS main products (not selected):	1	0	0
Item	1	1	1
Item	1	2	2
Item	1	1	1
Item	1	1	1
Item	1	1	1
Item	1	1	1
Item	1	1	1
Item	1	1	1
Item	1	1	1
Item	1	0	0
Item	1	1	1
Item	1	1	1
	0		0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0

Figure 2 sWOIS configurator.

PLC or Programable Logic Controller this is the main controller of the whole powerplant, the PLC system controls and transfers many of the main functions and signals throughout the powerplant. Throughout the years Wärtsilä has used a few different makes and models of PLCs, to add to the complexity depending on the requirements the customer that originally bought the powerplant had the complexity and layout of the PLC-system will wary.

- Due to the variation of the PLC system there will always be a need to prepare a tailor-made PLC solution, so no costs can be present in the calculation tool, there are however a template present on what should be checked when planning PLC upgrades, see Figure 3.

According to the offer from sub-supplier.			0.00
	Qty	á price	Total
Add basic items here	0	0	0
Add basic items here	0	0	0
Add basic items here	0	0	0
Add basic items here	0	0	0
Add basic items here	0	0	0
Add basic items here	0	0	0
Add basic items here	0	0	0
Add basic items here	0	0	0
Add basic items here	0	0	0
Add basic items here	0	0	0

Figure 3 PLC configurator.

AVRs or Automatic Voltage Regulators are used to stabilize the voltage when the load changes. The AVR compares the output voltage of the generator and a set point based on the feedback it generates an error signal that then adjusts the excitation of the generator this in turn increases the voltage output from the generator. (Short, 2014)

- The costs of AVRs from the main suppliers that Wärtsilä uses is based on annual agreements so they could simply be entered to the calculation tool, see Figure 4.

	Qty	Eng Qty	á price	Total
Item	0	5	1	0
Item	0	5	2	0
Item	0	5	3	0
Item	0	5	4	0
Item	0	5	5	0
Item	0	5	6	0
Item	0	5	7	0
Item	0	1	8	0
Item	0	5	9	0
Item	1		0	0
	0	5	0	0
	0	5	0	0
	0	5	0	0

Figure 4 AVR configurator.

Protection Relays are used to protect the generator and the MV switchgear, busbars and transformers. The protection relay is designed to defect a fault in the system and automatically and quickly trip the circuit breakers. (Short, 2014)

- Wärtsilä also has annual agreements with the makers of the protection relays so they could be inserted into the calculation tool, see Figure 5.

	Qty	á price	Total
Item	0	1	0
Item	0	2	0
Item	0	3	0
Item	0	4	0
Item	0	5	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0

Figure 5 Protection Relay configurator.

4.3.3 Documentation

The costs for updating the drawings and other documentation was done with the help of the experts in this area, and we came to the conclusion that this should be a cost that is based on the number of generator-sets affected by the project, another factor that will contribute to the cost of the documentation is if there is a need for dual-language drawings and documentation.

When reserving the cost for the documentation the user only needs to enter the correct number of engines that are affected by the project they are planning, this cannot be done automatically even though the generation-set is entered in the tool, it is not correct to assume that all drawing needs to be updated. see Figure 6.

B HMI system				0
	Qty	hrs / pcs	á price	Total
Item	0	1	1	0
Item	0	1	1	0
	0	0	0	0
	0	0	0	0

Figure 6 Example of a documentation cost section.

4.3.4 Engineering

Engineering costs are planned on an hourly basis, the amount of these hours will vary greatly on a project to project basis, even within a project the various products and solutions will require different amount of engineering hours.

In the calculation tools there are some hours preset but these are only there to give an indication of how hours can be needed. The finial number of hours are confirmed by the user that is planning the project, see Figure 7.

B HMI system				0
	Qty	hrs / pcs	á price	Total
Item	0	1	1	0
Item	0	0	0	0
Item	0	0	0	0

Figure 7 Example of an Engineering cost section.

4.3.5 Project Management

Like engineering the project management base cost is hourly based. These costs will also vary from project to project but they are more stable. Together with project management we came up with a default numbers of hours per product or solution used in a project.

However, these hours do not stack, this means that if more than one product or solution is needed in a project. The cost for project management for the other items can be reduced, this was also discussed with the project management team. Additional costs for project management can be traveling to and from site for kick-off meetings and also traveling during the execution stage of the project, see Figure 8.

B HMI system				0
	included	pcs	á price	Total
Item	0	1	1	0
Item	0	1	1	0
Item	0	0	0	0
Item	0		0	0
Item	0		0	0
Item	0		0	0
Item	0		0	0
Item	0		0	0
Item	0		0	0
	0		0	0
	0		0	0
	0		0	0

Figure 8 Example of an Project management cost section.

4.3.6 Material transportation

Material transportation is a cost that is based on what needs to be transported to where and on what terms, see Chapter 3.3.4 for INCOTERMS. The transportation cost is estimated with a tool that is used in Wärtsilä, Logwiss, when the correct delivery place and the dimensions and weight is entered the user gets and estimated shipping cost.

This cost is then entered in the tool, depending on the delivery terms there might be a need for additional costs for inland transportation. There is a section for packing and marking if this is required and a few other sections for exceptional cases, see Figure 9.

B HMI system				0
	included		á price	Total
Item	0		1	0
Item	0		1	0
Item	0		0	0
Item	0		0	0
Item	0		0	0
Item	0		0	0
Item	0		0	0
Item	0		0	0
Item	0		0	0
Item	0		0	0

Figure 9 Example of a material transport cost section.

4.3.7 On-site works

This is the part of the cost estimation stage that can be the most challenging and time consuming, and for good reason. On-site works and commissioning varies a lot, this is due to the variation of site condition and the condition and availability of the equipment present on site.

When reserving cost for this part one must consider multiple things:

- What network should be used for the on-site works?
    - Wärtsilä is operates in 80 countries, (Wärtsilä, 2017a) some of these countries has the capability to provide man-power for projects, this is many times a great option since it will cut down on traveling costs, but quite often there is a need for man-power to travel from Finland, this depends on what is planned to be done on-site and also availability of man-power locally.
- Daily-rate for the chosen network
    - When the appropriate network is chosen there is a need to adjust the daily rate according what the said network has, this has now been automated, from a dropdown list the user selects the desired network and the daily rates are automatically updated.
- Traveling costs, flight & local transportation
    - Traveling costs includes plane tickets and transportation, this will wary depending on from where to where in the world the traveling is required, there is a preset cost that will cover plane tickets, if a more accurate cost is needed it is easy to get an accurate cost online. The local transportations are traveling

from the airport to the hotel and then to the site, taxi, rented car or local transport depending on the availability of these. This is also preset in a way that it will cover this cost.

- Traveling days
    - When traveling to and from site the daily rate is applied so these days must be estimated based on where in the world the project is being executed.
- Accommodation costs
    - Accommodation costs are mainly the hotel or other lodging costs, this is preset to a fixed cost that will cover this part, but if needed can be adjusted to more accuracy.
- Daily allowance
    - Daily allowance cost is based on the 13th paragraph under the Finnish Income Tax Act, that provides a list on the maximum per diem per country or region. When the user enters the country of region in which the project is being executed in this cost is automatically updated.

    (Verohallinto, 2018)

All these above-mentioned costs were previously entered manually as individual items, now the process has been automated, the user enters the amount of gen-sets to be modified and then enters how many days is needed per gen-set and by how many men and the algorithms calculates a price for all the above-mentioned points. This saves time and improves the consistency of the price estimation and because the different costs where carefully discussed and planned the accuracy is increased as well, see Figure 10, Figure 11 and Figure 12

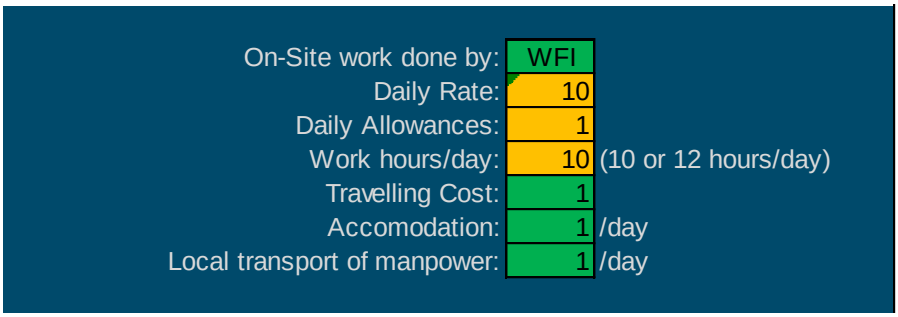

Figure 10 General cost selection for on-site works.

C PLC Engineer	**5**	:Engines to be modifed					-	€
Installation	**1**	:Installation days/Eng	**0**	man	**10**	:Daily Rat	-	€
Commissioning	**1**	:Commissioning days/	**0**	man	**10**	:Daily Rat	-	€

Figure 11 Product specific on-site works configuration.

C PLC Engineer	**5**	:Engines to be modifed					-	€
Installation	**1**	:Installation days/Eng	**0**	man	**10**	:Daily Rat	-	€
Item	1	days		0 man	10		-	€
Item	0	days		0 man	0		-	€
Item				0 man	1		-	€
Item	1	days		0 man	11		-	€
Item	3	days	5	0 man	1		-	€
Item	3	days	5	0 man	1		-	€
Item	1	days	5	0 man	10		-	€
Item	3	days	5	0 man	1		-	€
Item	1	days		0 man	11		-	€
Item	1			0 man	10		-	€
Item	1	days/pcs		0 man	0		-	€

Figure 12 dropdown section with the pre-configured installation costs.

4.4 Critical view of the methods

The hardware cost for products and solutions that are based on annual agreements will be valid throughout the year, after that they must be updated. Until that they are correct since the annual agreement is an agreement to commit to the specified price and scope of supply between the sub-suppliers and Wärtsilä.

The non-physical costs have been estimated by a few key people, but since these are estimations only one should be critical to these costs, especially so if the project at hand is special in any way shape or form. The costs for the engineering, project management and on-site activities will wary in every project, so the costs present may be too high or too low in some projects and must be corrected accordingly.

The transportation costs present in the tool are estimations only and will depend on from and to where the goods will be transported. Since this tool is used by sales managers and sales support managers who plan and sell projects all over the globe it would have been too time consuming to get shipping cost estimations that would cover all the projects that are being offered.

This calculation tool is only as the name suggests, a tool to help with the pricing of a project and will only provide an estimation of the sales price. The final sales price and its accuracy is in the responsibility of the person offering the project.

4.5 Implementation

This thesis work was done by the author with the help of my co-workers and my supervisor at Novia UAS.

The planning of the calculation tool started during the late summer of 2017, but later in September the development was put on hold until the beginning of summer 2018. The development and planning of the tool was done during my traineeship in the E&A sales team.

Once there was a clear plan with a defined goal the gathering or information and data begun, this was done via mails and meetings, the meetings where held face to face where possible, otherwise Microsoft Skype for Business where used. The work was done at the Runsor office in Vasa since it was my primary working location and all the contact persons and other information could be reached from the office.

The development and writing on the work was done on the side of my primary work responsibilities so the timespan for this work is stretched over a long time, around one year, but as mentioned before I was not working full time with the development.

When it came to the visual design and layout the color scheme was well defined beforehand, following the Wärtsilä brand colors. The layout was also decided quite early on, it is designed to suit all the peoples that will be in contact with the tool.

5 Results

In this chapter the results of this thesis work will be presented, the cost calculation tool will be presented, and a few selected features.

5.1 Calculation Sheet

This is the page that all the required information, products and solutions needed for a project is entered, some of them are pre-set, others are not. The costs that are pre-set have been discussed and confirmed by the correct stake-holder, product managers or project managers and in some cases both.

The way of working with this tool is, the sections that are highlighted in green can and should be changed if the corresponding product of solution will be used in the project. Yellow is safe to change in a special case if required but should normally not be changed.

Let us say that we have a project X that will be executed in South Africa, then starting of the user would fill in all the project specific information in the top green section of the calculation sheet. Every project gets a project name and number, these are used to identify the project. The amount and type of engine to be modified is also specified in this section, and lastly the country on which the project is being executed in is selected from a drop-down list, see Figure 13.

Made by:	Benjamin Gripenberg	Doc.rev. 2.80
Date:	9.11.2018	
Project name:	Project X	
New Engine / Engines to be modified:	5 x W12V26	
Proposal ID:	PS20180XXX	
Rev:	-	
Country:	South Africa	

Figure 13 Project specific information entry.

After this the margins can be changed if required, but it is recommended that these stay the same unless otherwise is required. There are usually pre-set values for all the margins, but for this thesis work these has been changed to 1%. In addition to this, if one solution is riskier than the others, risk insurance can be changed independently on all the different solutions.

If the user would like to make a solution optional and get that price split from the rest of the scope then this can be done by selection “No” on the green button in the middle of the calculation tool, see Figure 14. If a solution is selected to be optional, the text for that solution will change and the cost will be displayed in an orange box, so it can easily be distinguished from the main scope, see Figure 15.

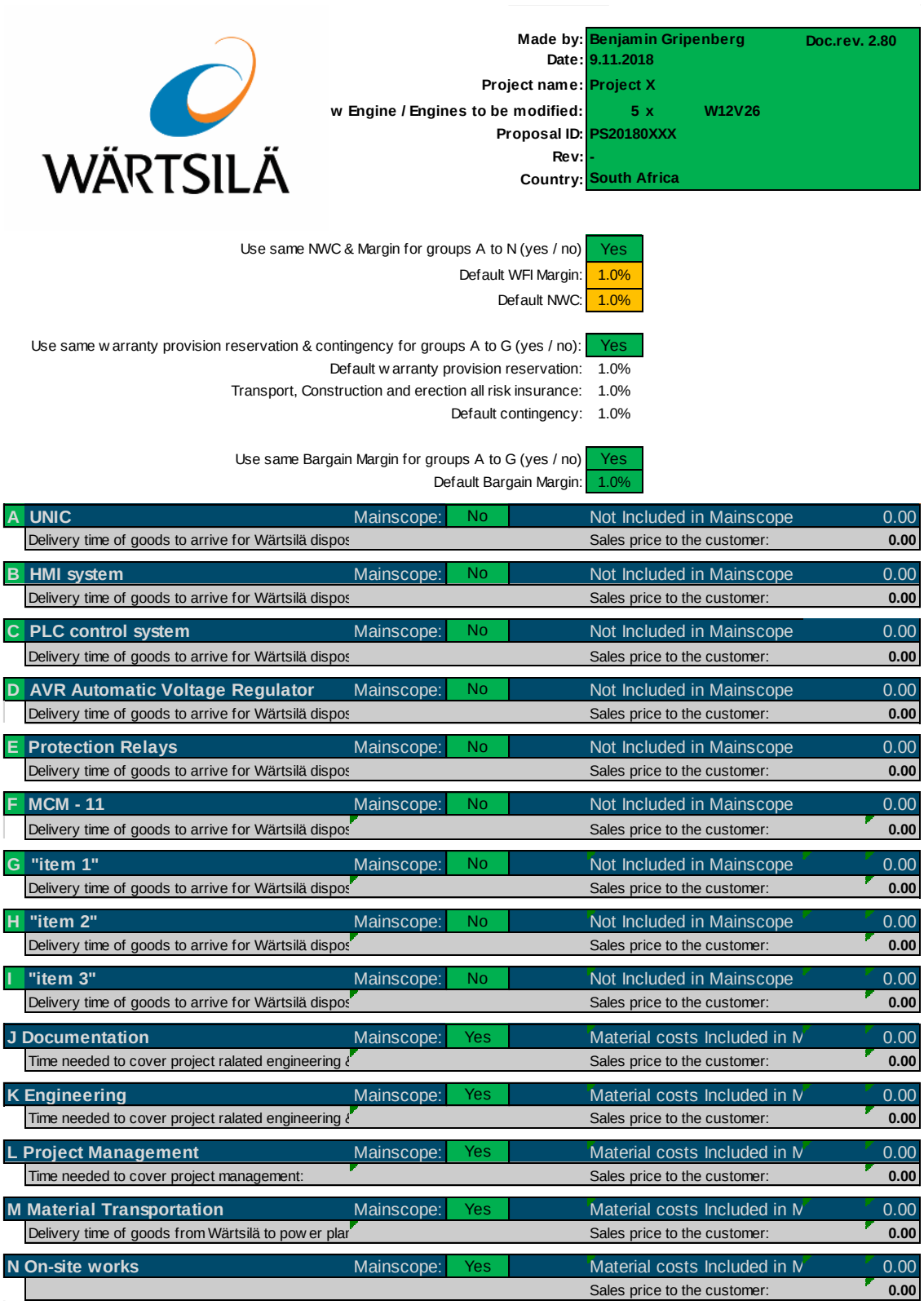

Figure 14 calculation page.

Mainscope:	No	Not Included in Mainscope	0.00	30.00	:Material Costs if selected as Option
		Sales price to the customer:	0.00		

Figure 15 optional item selected.

5.2 Summary page

When all the project specific information and costs have been entered or selected, the user can move to the summary page. This page shows all the vital information about this case, the margins, material costs, on-site costs, documentation, engineering and transportation costs and delivery time for each solution, with a total delivery time at the bottom. Finally, it shows the sales price per item and the lowest possible price that the specific project can be sold for.

If any of the solutions where selected as optional, they can be selected from a drop-down list under the main summary, this section shows, the costs as one sum and then the margins separately. The delivery time is also shown along with the sales price and the lowest possible sales price.

WÄRTSILÄ

Doc.rev. 2.80

Proposal Calculation Main page

Made by: Benjamin Gripenberg
Date: 9.11.2018
Proposal ID: PS20180XXX
Project: Project X
Proposal revision: -
Engine type: W12V26
Amount of engines to be modiefied: 5

WFI Margin (fixed, not to be changed): 1.0%
NWC (fixed, not to be changed): 1.0%
Warranty provision reservation: 1.0%
Transport, Construction and erection all risk insurance: 1.0%
Contingency: 1.0%
Bargain margin: 1.0%

FCA Xcity, Ylandia
Using: WFI

Mainscope

Item:	Direct Cost €:	Margin €:	Margin %:	Bargain €:	Bargain %:	Delivery time:	Customer €:	%t:
A UNIC	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
B HMI system	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
C PLC control system	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
D AVR Automatic Voltage Regı	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
E Protection Relays	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
F MCM - 11	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
G "item 1"	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
H "item 2"	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
I "item 3"	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
J Documentation	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
K Engineering	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
L Project Management	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
M Material Transportation	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
N On-site works	- €	- €	2 %	- €	1 %	0 Weeks	- €	0 %
								0 %
Total:	0 €	0 €		0 €		0 Weeks *	0 €	
			The lowest possible price for the customer:				0 €	

* = Does not include on-site working time

Figure 16 Main scope summary.

Option 1	Direct Cost €:	Margin €:	Margin %:	Bargain €:	Bargain %:	Delivery time:*	Customer €:
A UNIC	31 €	1 €	2 %	0 €	1 %	0 Weeks	32 €
			The lowest possible price for the customer:				32 €
Option 2	**Direct Cost €:**	**Margin €:**	**Margin %:**	**Bargain €:**	**Bargain %:**	**Delivery time:***	**Customer €:**
No Options Selected	0 €	0 €	0 %	0 €	0 %	0 Weeks	0 €
			The lowest possible price for the customer:				0 €
Option 3	**Direct Cost €:**	**Margin €:**	**Margin %:**	**Bargain €:**	**Bargain %:**	**Delivery time:***	**Customer €:**
No Options Selected	0 €	0 €	0 %	0 €	0 %	0 Weeks	0 €
			The lowest possible price for the customer:				0 €

* = Does not include on-site working time

Figure 17 Optional items summary.

5.2.1 Timeline page

Some projects might require a preliminary timeline in the sale stage, so this calculation tool automatically makes a time line based on a few inputs from the user and how many days where reserved for the different solutions in the cost reservation stage. The user selects the order on which they would like to perform the on-site installation, this is done from a drop-down list. The tool then automatically fills in the timeline with the correct amount of days.

For demonstration purposes two days was entered for installation and one day for commissioning, this does not represent any real project.

On-Site installation Order	Manufacturing Time	Installation	Commissioning	Weeks													
Manufacturing Time				1													
Project management					1												
Delivery to customer						1											
B HMI system	2	2	1				1	2									
C PLC control system	2	2	1						1	2							

Figure 18 Preliminary timeline example.

5.3 Updating costs

Making sure that the costs could easily be updateable was a key point of interest when this thesis work begun. This was done via a standard layup on a separate cost page in the calculation tool. If a new set of costs should be used these costs should be sent in the predefined layout, and then these costs can simply be copied to the cost page.

The calculations page automatically takes the costs from the cost page and inserts them into the correct place.

For an example of a standard list see the table below where “item” is the name of the product, “2018” states the valid year of the costs that are in yellow next to the product name:

AVR	2018
Item	
Item	1
Item	2
Item	3
Item	4
Item	5
Item	6
Item	7
Item	8
Item	9

Figure 19 Example of a standard cost list

6 Conclusion

This chapter will give the reader the authors opinions of the thesis work. It will tell the reader how the author believes views the results and compares them to the goal, the problems during this thesis work and what improvements that still could be done.

In my opinion the goal set up for this thesis has been reached, an easy to use quick and accurate calculation tool for E&A upgrade projects for the energy side of the business. The tool decreases the time it takes for the sales and sales-support managers to prepare a proposal for a customer. It also increases the consistency and accuracy of the pricing thanks to pre-applied costs for specific items. In addition to that it manages to do all this while remaining clear and simple to use.

The scope of the thesis could have included the marine E&A business but after some evaluation the decision was reached that the current marine calculation tool is sufficient for the time being. Theoretically it would have been possible to automate a lot more features but in practice the accuracy of the tool would have suffered since every project is different and it is not possible to estimate every detail in every upcoming project.

6.1 Problems

Developing a tool like this in excel is time consuming, so a lot of time went in to developing and planning this tool, but that was not without problems. One problem I faced was making the tool flexible enough, in this case not having enough empty slots on the calculation sheet for possible extra items not included in the standard sections.

Getting costs per item for some items got delayed so these pre-sets are not present in the version of the calculation tool as of writing this thesis work.

Another problem was the issue of optional items, when offering a project some items will be mandatory, but some items might be optional upgrades, making a way to split the price for these items easily proved to be a challenge, but after a while a solution was reached, see Figure 17.

6.2 Suggestion for further improvements

As mentioned in the previous chapter adding the missing data for a section is one thing that is recommended to be done in the future. Another improvement could be a page that is

specifically made for the project opening team so the essential data and costs they use to open a project in SAP is standardized and easily accessible.

The costs for transportation of goods could be pre-set per area and item, this can be based on known costs from previous projects and estimations from the program mentioned in Chapter 4.3.6 The cost would be automatically retrieved when the correct area is selected. This could be setup as follows for every item:

- sWOIS Single server
    - Europe X€
    - Africa X€
    - Asia X€
    - North America X€
    - South America X€

It could be setup as a worst-case scenario with the furthest possible shipping in that area, then if a more accurate cost is needed it can be estimated with the previously mentioned program.

Another improvement could be to integrate the marine E&A upgrades to this calculation tool, this would minimize the amount of calculation tools used in the E&A project throughout Wärtsilä. It would also standardize the way of working when opening projects in SAP after they have been handed over from sales.

6.3 Final conclusions

This has been a great experience for me, I have learned a lot when it comes to project sales. I got a lot of insight of the complete process from project planning to project execution, I also improved my excel skills significantly.

Learning the way, a powerplant works and how all the various products and solutions work together to provide a better operational experience for the power plant operator was an excellent experience for me.

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