TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY

Department of Mechanical and Industrial Engineering

STANDARDISATION AND OPTIMISATION OF PROJECT MANAGEMENT FOR PRESSURE EQUIPMENT MANUFACTURING IN ESTANC AS

PROJEKTIJUHTIMISE STANDARDISEERIMINE JA OPTIMEERIMINE SURVESEADMETE TOOTMISEL ESTANC AS NÄITEL

MASTER THESIS

Student: Erko Hermann

Student code: 163359MARM

Supervisor: Tauno Otto

Tallinn, 2019

AUTHOR'S DECLARATION

Hereby I declare, that I have written this thesis independently.
No academic degree has been applied for based on this material. All works, major viewpoints and data of the other authors used in this thesis have been referenced.

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Author: .....
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Thesis is in accordance with terms and requirements

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Supervisor: .....
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Accepted for defence

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Chairman of theses defence commission: .....

/name and signature/

Department of Mechanical and Industrial Engineering

THESIS TASK

Student: Erko Hermann, 163359MARM

Study programme, main speciality: Industrial Engineering and Management

Supervisor(s): Professor of Production Engineering, Tauno Otto, +372 530 90 118

Thesis topic:

Standardisation and optimisation of project management for pressure equipment manufacturing

Projektijuhtimise standardiseerimine ja optimeerimine surveseadmete tootmisel

Thesis main objectives:

1. Overview of Estanc and reasons why improvements are needed.
2. Researching best practices for project management with the aim of finding improvements.
3. Mapping and analysing current project management process in Estanc.
4. Suggesting and Implementing suggestions for optimisation and standardisation.

Thesis tasks and time schedule:

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1.	Defining objectives and tasks for the thesis	24.02.2019
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5.	Implementing improvement measures	24.05.2019

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Student: Erko Hermann ..... "....."....201….a
/signature/

Supervisor: Tauno Otto ..... "....."....201….a
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PREFACE

This thesis was initiated by Estanc AS where the author Erko Hermann is working as a project manager. Due to pressure equipment high demand and complexity the workload in Estanc is constantly growing. Expected revenue increase is 45% from 18 to 26 million within this year. Products ordered are more complicated than ever and with a shorter lead time than the company is used. Customers who are buying complicated and accelerated work require fast and high-quality work. Project managers need to evolve with this changing environment. These issues raise a need for more standardised and better project management. I would like to thank my colleagues who helped me with consultation.

LIST OF ABBREVIATIONS

COP – Customer order point

CPM – Critical path method

ERP – Enterprise resource planning

ETO – Engineer to order

FAT – factory acceptance test

IMO – International Maritime Organisation

IWE – International welding engineer

KPI – Key performance indicator

MTS – Make to stock

PED – Pressure equipment directive

PM – Project manager

PMBOK – Project management body of knowledge

PMI – Project management institute

PMM – Project management methodologies

PRINCE2 – Projects in controlled environments

WBS – work breakdown structure

WIP – Work in progress

INTRODUCTION

Estanc AS is specialized in production of large project-based process equipment. Industry backgrounds and know-how has been acquired with decades. In recent years the company has gone through many changes. Whole manufacturing has moved to new facilities in Jüri. On 13th of May 2019th Estanc expanded its production with additional 1500 m^2. Increasing manufacturing capacity to serve the market in state of high demand. These new facilities and the high demand on market have opened opportunities to growth that the company has also used. More and more work is done to the end customer not to dealers. End customers are more demanding, they have higher quality standards and they require frequent progress reporting. Majority of the customers insist visiting the site many times: before manufacturing, during manufacturing and for factory acceptance test (FAT).

This growth and demanding standards have put a lot of pressure on the personnel. Management of the company is aware of the problem they are constantly looking for new workers. Unfortunately, the Estonian work market is competitive, finding new qualified workers is hard. The overall direction is to optimise processes and make work more efficient than to take new workers.

Vision of the company shown on Appendices 1 is to offer manufacturing service par excellence. Project management department has the biggest impact on customer satisfaction. They are the chairman of the customer, inside the company. Representing customer and the company at the same time. There will always be tension on customer expectations and what is feasible and reasonable. New demanding customers require higher project management standards. They need to know that information coming from Estanc is trustworthy and irrespective project manager the quality provided will be same. Estanc has gotten information through customer feedback that project managers do not have enough time to interact with them. They do not feel that their projects are with upmost importance to the organisation.

The purpose of this master thesis is to propose specific plans and proposals for improving project managers efficiency. Undertake the standardisation of project management in Estanc and Identify department KPI's. In the first part of the thesis, overview of manufacturing and products produced is given. Explaining the key areas and distinguishing factors of project-based manufacturing and highlighting the sensitive equipment that is produced. In the second part, theoretical background of project management, industry best practices and methods are shown. Three main project management standards were analysed. Third part is focused on using studied best practises for developing project management in Estanc.

1. ESTANC AS OVERVIEW

Estanc is a project-based, process equipment manufacturing company, located in Estonia. It is a family company owned 100% by Raigo Tammo. The company was founded in 1992 which adds up to over two decades worth of experience on the market. By now Estanc is the biggest company in its field in the Baltics and in the Nordic countries with yearly turnover of 18 million euros. Export makes 97% of Estanc business. [1]

Major growth started on year 2010 shown in Figure 1.1. Estanc expanded to new markets that had a need for process equipment. This need occurred because of demanding environmental regulations for example the Paris agreement [2]. Companies who show that they care about the environment and try to sustain it have a market advantage. As the end customer is more aware of climate change and this is changing consumption habits.

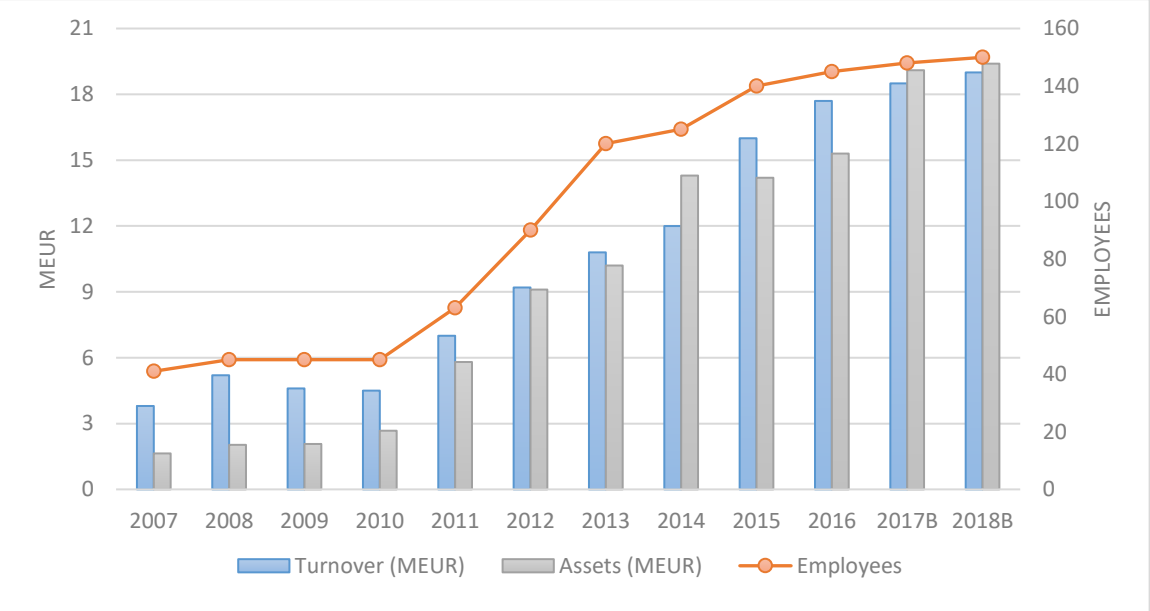

Figure 1.1 Estanc growth curve showing increase in employees and turnover in time [3]

Company possesses 4650 m2 carbon steel and 5400 m2 stainless steel workshops. Additionally, Estanc has a 1300 m2 workshop for milling and plasma services [1]. Figure 1.2 shows a drone picture taken above Estanc AS. There are three production halls, bigger hall for carbon steel products, two smaller for stainless steel products.

Figure 1.2 Estanc factory in Jüri

Estanc's vision is about manufacturing process equipment that helps to make the world a more sustainable place. Recycling, renewable energy, next generation plants are just a few of the outputs. Estanc core values lay in experience, openness, inventiveness and good service. The main objective is to provide standout products along with timely delivery to customers. [1]

1.1 Overview of manufacturing

There are many manufacturing methods that can describe businesses. Usually there are similarities depending on the customer and product group, nonetheless every manufacturing has its own capacity and way of working. Estanc is a project-based manufacturing and it is important to understand what the key areas and distinguishing factors for a project-based manufacturing are.

Project manufacturing or engineer to order (ETO) manufacturing is an operation designed to provide unique but similar products. For ETO manufacturing, every product is the ultimate result of a project. In addition, unique orders may be managed like a project. The characterised factor of ETO is the customer order point (COP) that is located before the production process. [4]

In the other end there is make to stock (MTS) manufacturing. MTS literally means to manufacture products for stock based on demand forecasts, which can be regarded as push-type production [5]. Benefits and disadvantages of ETO and MTS manufacturing are shown in Table 1.1. Between ETO

and MTS there are also assembled to order and make to order manufacturing. These are hybrid versions of ETO and MTS manufacturing.

Table 1.1 Benefits and disadvantages of ETO and MTS manufacturing

	Benefits	**Disadvantages**
Engineer to order	Minimise stock, all materials are being used to a specific product. There is not a need to stock materials. Customisable products, every product will be engineered considered customer expectations.	Long lead time, as every product is customised then the time from order to delivery is long. Sale demand is hard to predict.
Make to stock	Short lead time, products are in stock or in the shops. Stable manufacturing, even if there are low seasons manufacturing can produce to stock.	High inventory, if consumption forecast is wrong then inventory levels can fall too low or grow too high.

In an ETO manufacturing the product is customised with the customer. Project managers are the main contacts for the customers. They are the ones who need to forward changes and information from the customer to the project team. For making this process better we need to standardise project management methods. Fixed guidance and borders are important for managers to help them with their work. Standardisation will lead to faster and better information quality. This in turn leads to more focused work, less used resources and better customer satisfaction. Figure 1.3 shows work sequence for pressure equipment manufacturing.

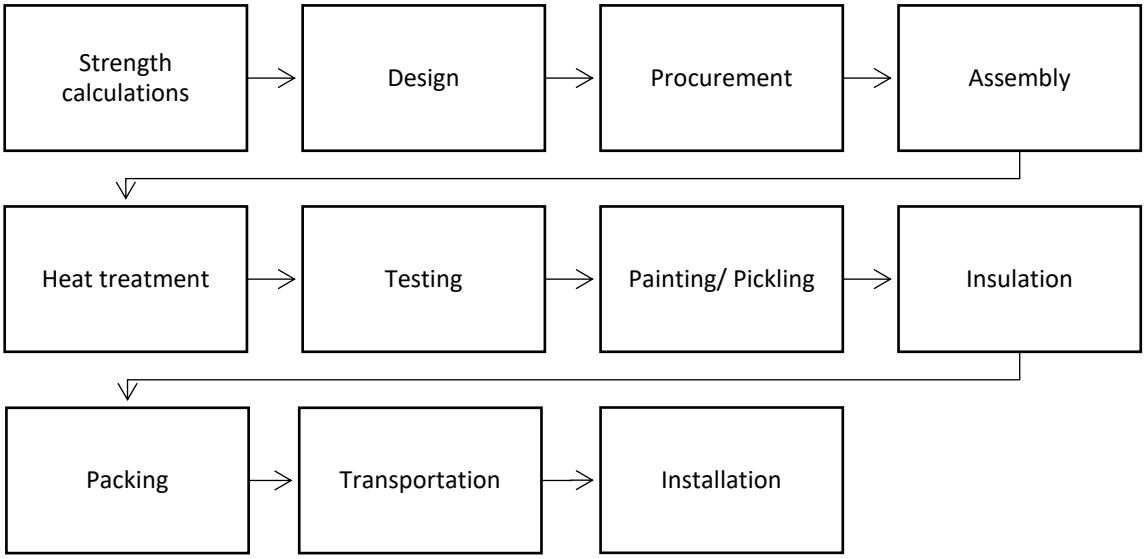

Figure 1.3 Work sequence for pressure equipment manufacturing

First step in pressure vessel manufacturing is determining the required material thicknesses. Material thicknesses are obtained from strength calculations. Strength calculations are done to every produced pressure vessel. Design phase depends on the customer and product occasionally only working drawing are done other times full design with third party approval. Procurement is complicated as materials required are non-standard and with long lead time. Usually arrival of main materials determines start of manufacturing.

1.2 Overview of products

Estanc project portfolio has changed a great deal since starting in 1992. Today the main areas in Estanc project portfolio are pressurised tanks and scrubbers. Non pressure tanks, chimneys, piping no longer plays a big role in Estanc portfolio. First pressure vessel was manufactured in year 2001 [1].

Every pressure equipment produced in Estanc is according to pressure equipment directive (PED). The Pressure Equipment Directive [6](2014/68/EU) applies to the design, manufacture and conformity assessment of stationary pressure equipment with a maximum allowable pressure greater than 0,5 bar [6].

1.2.1 Heat exchangers

Heat exchangers are devices that provide the transfer of thermal energy between two or more fluids at different temperatures. Heat exchangers are used in boiler houses for both cooling and heating processes. [7]

There are mainly tube and plate heat exchangers. Plate heat exchangers are composed of thin plates with large surface area. Inside the plats there are flow passages for heat transfer. Estanc produces mainly tube heat exchangers shown in Figure 1.4, that have circular tubes inside. One fluid flow through the tubes and the other outside the tubes. This type of heat exchanger is flexible, almost everything can be customised (tube diameter, length and pitch).

Figure 1.4 Tube heat exchanger in Estanc workshop [3]

Sales of heat exchangers has increased around 20% this year. Increase is thanks to design and sales department. Estanc has developed their own heat exchanger design. Sales department hired a new salesman who has more than 40 years of experience in selling heat exchangers.

1.2.2 Pressurised tanks

Pressurised tanks are products that are intended for containing substances above atmospheric pressure. Some pressurised tanks manufactured in Estanc are:

- Feedwater tanks, deaerators;
- Columns;
- Reactors;

Feed water tanks shown in Figure 1.5 are vessels that are used for degassing oxygen and carbon dioxide from water and if the gases are not removed, they can cause corrosion. These kinds of vessels are mainly used in the boiler houses, where they are used to degas the water that is directed into the boiler system. [1]

Figure 1.5 Feedwater tank [3]

Column shown in Figure 1.6 acts very much like a still, separating product into its different chemical components based on differences in volatility. Oil refineries use two main types of distillation columns pack and tray type. Packed Type Columns, the process stream is heated before entering the column, which causes partial vaporization. As it moves up the tower, the vapor cools. Light components will continue to rise, and heavier components will condense and fall to the bottom as liquid. In tray Type Column instead of using packed material they use trays situated at various heights within the tower. [8]

Figure 1.6 Distillation column used in crude oil refining [3]

Climate friendly biofuels are one of the key factors for reducing dependence on fossil fuels. Reactor shown in Figure 1.7 is used in production of cellulosic ethanol. Cellulosic ethanol is ethanol produced from cellulose rather than from the plant's seeds or fruit. Cellulosic ethanol does not compete with food and feed crops it will be produced from agricultural residues. [9]

Figure 1.7 Reactor with other equipment [8]

Reactor is a development project for Estanc. The scope of the whole project is around 2 million, featuring rotating parts, mechanical screw inside the product plus extra equipment. Most challenging part will be assembly of the whole product and making a run test at Estanc. Product is 15m long, diameter 2580mm and with a mass of approximately 40000kg.

1.2.3 Flue gas Scrubbers

Flue gas scrubbers shown in Figure 1.8 are important components in both- Industry and maritime. As a result of fossil fuels burning, dangerous Sulphur Oxide compounds will break away that can cause environmental pollution in the atmosphere and even acid rains. Scrubbers are used to wash these dangerous compounds out from the exhaust gases. [1]

Figure 1.8 Flue gas scrubber in Estanc workshop [1]

Maritime pollution is regulated by the International Maritime Organization (IMO). In addition to the 0.1% sulphur limit in the North American, US Caribbean, North Sea and Baltic Emission Control Areas, the IMO has decided that the global fuel sulphur limit of 0.5% should enter into force in 2020. After the revised global Sulphur limit up to 70 000 ships must change the current configuration of power source and one option is to clean the exhaust gases using a scrubber. [1]

The market for marine scrubbers is peaking, demand is higher than can be offered. Manufacturing scrubbers is a demanding work as they have complexed inner parts and special alloy materials. Conditions where products need to work have harsh vibrations from the ship engine and seawater is everyday danger. This is the main reason why scrubber designers are afraid to use new suppliers and Estanc is already known on the market.

2. THEORETICAL BACKGROUND

One of the most important things is to understand the definition of a project. Project is a temporary endeavour undertaken to create a unique product or service [10]. From the definition, emphasis is on two words:

- Temporary, meaning it has a defined end;
- Unique, meaning that it is out of normal working flow;

All projects can be mapped with a generic life cycle shown in Figure 2.1. Project management is the practise that navigates through these steps, result is accomplished through different processes.

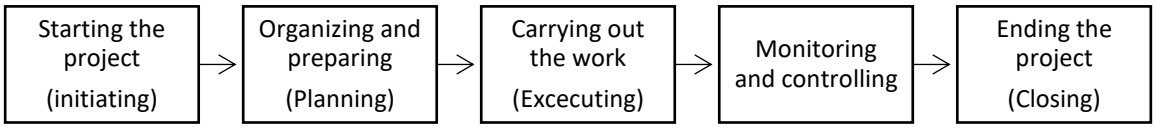

Figure 2.1 Generic project life cycle

Initiating, happens at the outset of any project and effectively covers everything from assigning a project manager, to formal project approval and concept development. Planning is fundamentally important to the success of any project. The amount of planning should reflect the overall project scope. For example, if the planned completion date is too late, project scope may need to be amended or the budget may need to be increased. Executing is usually the longest phase of the project lifecycle and is usually the most demanding. It is concerned with carrying out the project plan, performing the tasks identified, and constructing the deliverables to present to the customer, while at the same time, managing the various technical and organisational interfaces. Monitoring and controlling are the measurement of project progress to identify variances from the plan (enabling the necessary adjustments to be made), as well as to determine a project completion date. Finally, project Closing is concerned with ensuring that the project deliverables have been completed satisfactorily. [11]

In every organisation there are functional managers. Managers that are responsible for employee's everyday work (motivating, controlling and supervising). Project managers have mostly similar responsibilities: planning, scheduling, motivating and controlling. They are in direct contact with the customer, knowing customer expectations. Only difference is that the project has a start and an ending. Usually functional managers are the ones who assign specific worker to a specific project.

From that point on project manager will assign tasks and schedules to the worker. Functional manager should evaluate the tasks and if needed help with technical expertise.

2.1 Project management today

Today, emphasis is on development of an integrated project management process that focuses all project effort toward the strategic plan of the organisation and reinforces mastery of both the project management tools and the interpersonal skills necessary to orchestrate successful project completion [12].There are always scarce resources and the key is to allocate these resources to the right projects. This means selecting projects that contribute to the objectives and strategies of the organisation.

Project managers need to have the necessary skills to execute projects not only on the technical and leadership level but also according to the overall strategy of the organisation. They need to be more agile then ever as product life cycles are shorter than before. Today's projects are increasing in complexity and throughput has become a competitive advantage. Customers want more customised products and services than ever Figure 2.2, shows the skills that modern project managers need to have. [13]

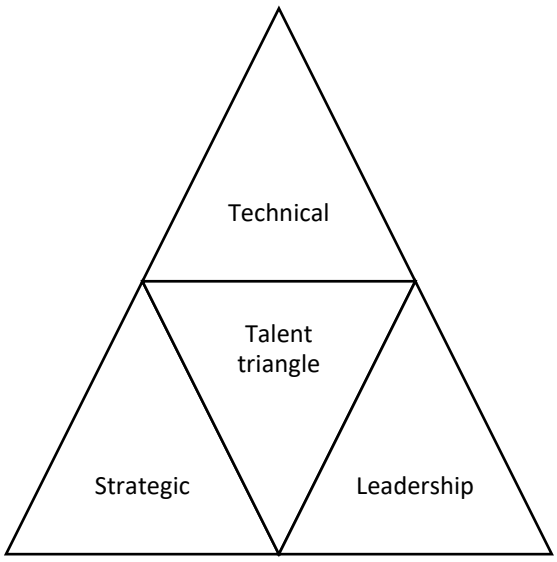

Figure 2.2 Project management institute (PMI) talent triangle [14]

This means that project managers must work more efficiently to keep up with changes and higher customer and organisational expectations. The only way how they can achieve this is through better management, leadership and technical skills.

2.2 Future of project management

The future for project managers is not going to be unrecognisable, it will still involve all the essential areas: planning, reporting, measuring key metrics, assigning tasks, resource allocation, resource visibility, and resource optimisation. What will change are the tools that project managers use. [15]

Future teams will be more intercultural. With various cultural diversities working together problems are easy to occur. Soft skills (emotional intelligence) for handling intercultural problems will be a must have for a project manager in the future.

Remote working will become more popular than ever. Teams must be managed around the world. Tasks and results will be monitored through internet. Challenges will be on resource allocation and communication. How to ensure on time results whit unexpected changes. Information needs to be divided to all team members promptly and effectively. Software and tools will become more integrated.

Industrial revolution, with disruptive technologies, new business models, increasing individualisation and the merging of virtuality and reality, goes beyond the initial possibilities of information technology of the 20th century. Digitalization leads to improved communication by giving the project manager tools to provide the information more quickly and adapted to the needs of the recipient. Project staff as well as project plans and work results are held in a common digital environment. Information can be processed and used more efficiently; the number of different spreadsheet tables is reduced. Finding and sharing information and collaborating in projects is made easier. Through improved visualization possibilities, stakeholders get a more complete picture of the project and the project environment. Surprises are avoided and risks can be better controlled. [16]

Another theory is that project management tools will become so easy that the project manager role can be divided among departments. Depending on the phase of the project like development phase or design phase, the role of the project manager will rotate throughout the development lifecycle. [17]

2.3 Project management standards

It is always time and money efficient to investigate existing good practises and approaches, versus starting to develop them from scratch. In this thesis three main project management standards were analysed. These standards were chosen based on the best fit for manufacturing companies.

- Projects in Controlled Environments (PRINCE2);
- Project management institute (PMI);
- ISO 21500;

PRINCE2 was first used by the United Kingdom government as a process-based method of best project management practices. Today, the methods are used in many countries in Europe. Teaching how to manage projects in controllable stages while keeping the big picture in focus. [18]

PMI is a non-profit organisation that has developed a set of standards that characterize project management, project management body of knowledge (PMBOK). It includes best practices, conventions, and techniques that are considered industry standard. [14]

ISO 21500 is an international standard that was released in 2012 as a result of a joint effort from 30 countries. It is the first guidance that is recognized by most of the international organisations, it resembles the PMBOK but without the tools and techniques. [19]

PRINCE2 and PMI are both organizations offering the best ways to manage projects. ISO 21500 is the international standard coming from the PMI. It does not give us any tools or techniques, but it gives everybody the same terminology. Figure 2.2 shows the basic relationship between the approaches. On the left, solid arrows show strong relationship where the dotted lines indicate weak relationship. On the other hand, PMBOK gives guidance to what a project manager should be doing also specific tools and techniques. PRINCE 2 is more generic it can be applied to many projects regardless of the project type, focuses more on the project team.

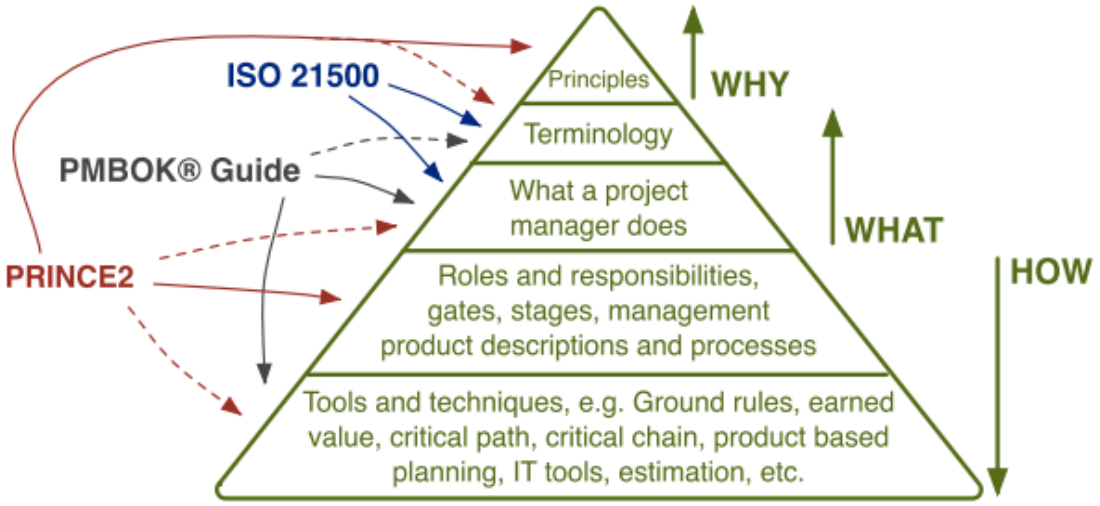

Figure 2.3 Relationship between approaches [20]

All mentioned approaches require tailoring to a specific organisation and to the right project. PMBOK guide should be followed to get the overall knowledge of project management. PRINCE2 for finding useful methods what to follow and adapt.

2.4 Project management methods

The main idea behind using known methods is that they have been proven to work. Project management methodologies (PMM) are collections of different approaches, tools, templates and techniques [21]. Project management excellence comes from four critical components:

1. Effective communication
2. Effective cooperation
3. Effective teamwork
4. Trust

Methods will help project members navigate more efficiently in mentioned components. It should not be forgotten that people manage projects not methods. Even if a team uses the best method, they will fail if they do not work together. As all projects are different there is not one method fits all approach. Subsequently, most common methods are described.

2.4.1 Waterfall method

Waterfall is perhaps the earliest example of a formal project management methodology. This method is highly structured and is referred to as waterfall as the work of one phase continues downstream into the next stage. Due to the linear nature of the work, changes to requirements can require large amounts of rework or wasted work, which can be detrimental to the project regarding schedule and cost. Typically, in a Waterfall approach, the outcome of one phase acts as the input for the next phase sequentially. [21]

Figure 2.4 shows us four project management phases. Using waterfall method, a project team will move step by step through each phase. In the first phase functional managers will choose a project and assign a project team. In the planning phase project manager with team collaboration will make the project plan, risk plan, etc. In the execution phase team members will start to solve specific assignments. Last phase will be the closure, summery of the project and lessons learned.

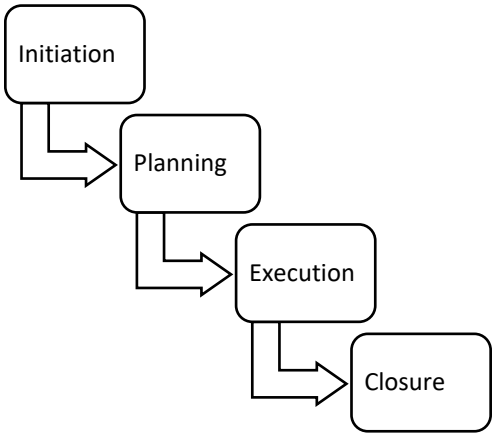

Figure 2.4 Project management life cycle in waterfall method

2.4.2 Agile with scrum

Agile is not actually a methodology, but a set of principles, it is mainly used in software development. Agile project management lets software project managers and employees alike adapt to changing circumstances, rather than try to adopt rigid formal controls, as in traditional linear development methods [22].

The core concept of agile project management is that better up-front planning cannot be guaranteed, aim is on continuous planning. It is not a linear process; aim is to offer the product to the customer as soon as possible and then constantly improve it with the customer. Agile de-emphasizes up-front planning and extensive documentation. The advantages of the agile approach are cost savings and speed of delivery. Further, it is a flexible method that embraces change.

Scrum is an agile approach on product development. Scrum significantly increases productivity and reduces time relative to waterfall. Team members in scrum:

- Product owner a key stakeholder with a vison;
- Team members are professionals who share mutual responsibility;
- Scrum master is the same as a project manager;

Idea behind scrum shown in Figure 1.1 is that you do not plan and build the product linearly. You make short sprints and with the feedback from these sprints you plan a new sprint. At the end of each sprint you need to have a functional feature that you can present to the customer. At the beginning of the project all features are evaluated and but into product backlog in product backlog the features are evaluated and prioritised. [23]

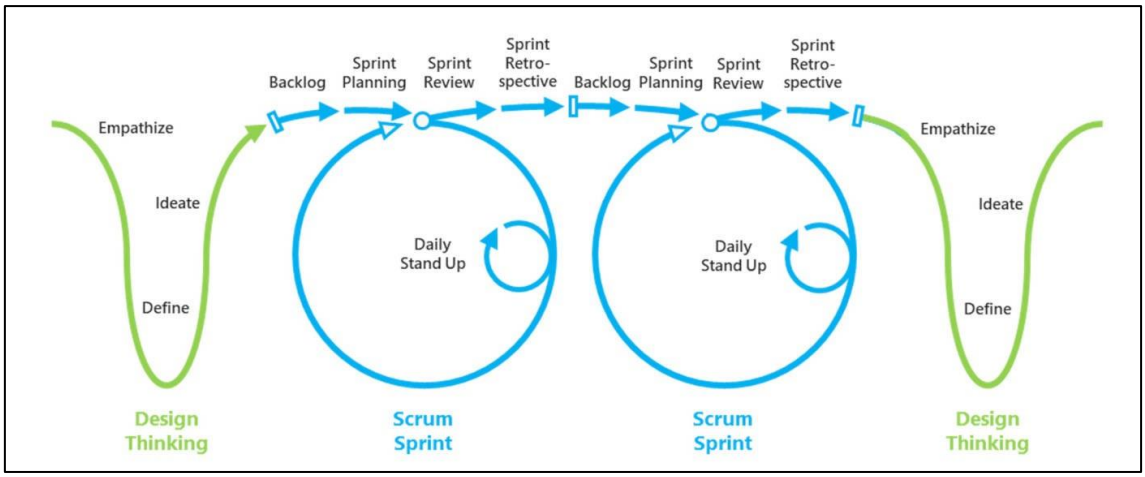

Figure 2.5 Scrum methodology [23]

Scrum theory teaches that it is not feasible for the management to plan the project fully at the end of the project. It is better to plan small steps and then let the project team plan further steps during the project.

When thinking on agile method for manufacturing large process equipment the first thoughts are that it cannot be used. Although it cannot be used in that sense that the product must be comprehensive when shipping. It sure can be used in the design phase, for example sending customer main drawings for confirmation as soon as they are ready. It is not reasonable to plan that the design phase is 2 weeks and at that moment drawings will be sent to customer. Most definitely there will be some comments imminent. It should be planned that for 2 days the designer models' general drawings and the sends them to the customer. When feedback arrives then a new plan can be made.

2.4.3 Critical path method (CPM)

The duration of a project most often depends on the most important task. Critical path method shown in Figure 2.6 allows the mapping of these tasks and their durations. Helping with the evaluation of project time and budget. For mapping, list of all activities is required. Then evaluation of the duration for each activity and dependence between activities. With this information the longest path can be detected, and a logical path created. [24]

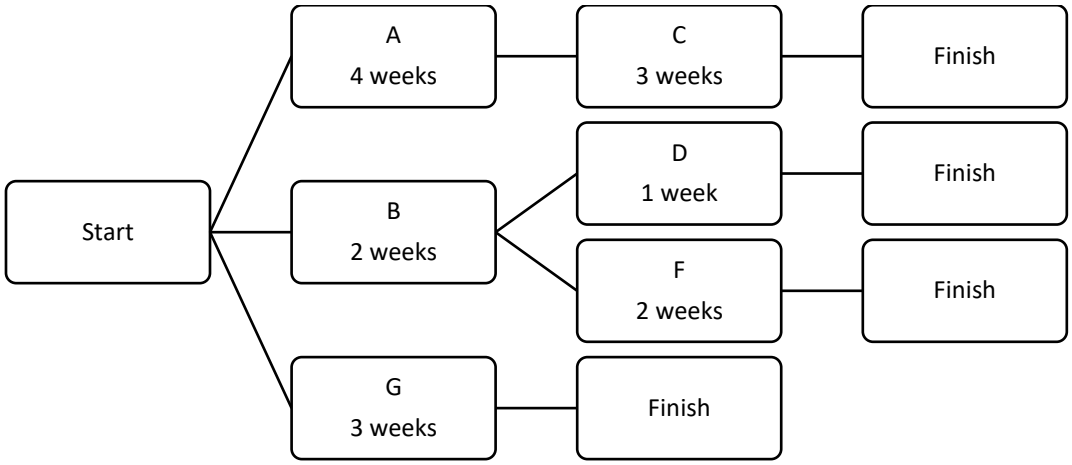

Figure 2.6 Critical path visualising

If a task in the critical path is delayed, then the whole project will be delayed. This shows that these tasks need to be monitored more carefully. Mapping should be done before starting the project. It is important that actual progress is considered, and the map is updated successively.

2.4.4 Kanban board

Kanban is based on a very simple idea. Work in progress (WIP) should be limited and something new should be started only when an existing piece of work is delivered or pulled by downstream function. The principle of Kanban is that work is done step by step and on one thing at a time. Value stream is understood and then WIP limits agreed for each stage in the process. WIP is limited and it can clog the system. It is important that team members get one assignment at a time but do not forget the big picture. [25]

Kanban board shown in Figure 2.7 is a tool that is used to boost team productivity. In the first column backlog is identified. This means that work items are created prioritised with the team and assigned to team members. Workflow goes from left to right helping the project manager visually monitor every task. Kanban board will help project manager identify potential troubled areas, for example when cards are building up then more resource allocation is needed.

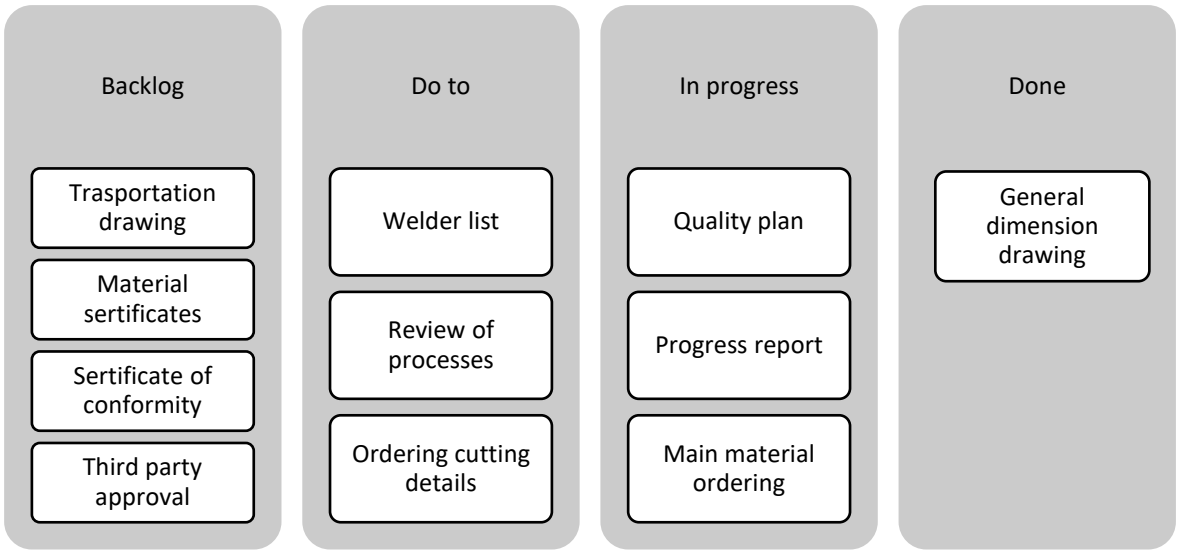

Figure 2.7 Kanban board

There are a lot of online Kanban boards, but it is recommended to start the implementation process with a visual board on the office meeting room. The main problem when using the Kanban board is that teams forget to respect the WIP limits. Team members will get slow and overloaded when WIP limits are not followed. This method is best used in the beginning of a time critical project. For example, in the kick-off meeting explaining to the team that this project is going to be manage using a Kanban board. Assigning tasks and visualising them on the wall and on the next meeting updating the tasks on the wall.

2.5 Project management in organisation structure

The right organisational structure has a big impact on achieving organisational goals. Organisational structure defines communication chain and subordination relationships. Structures need to be defined otherwise it can lead to uncertainties, that lead to productivity loss. Good structure needs to balance both project's needs and everyday work irrespective the structure.

Three structured approaches of running a project in an organisation shall be analysed:

- Functional;
- Dedicated project team;
- Matrix;

In a functional organisation shown in Figure 2.8 a project is something that is out of company's normal workflow. When there is a need to manage a project, the functional managers must step in. This will put more pressure on them as they are the ones who need to coordinate the project.

Functional structure for managing a project is feasible when one department has the biggest role in the project. Another good thing is that specialist in one department can work together, more experience is involved. On the other side, they may have lack of focus and ownership as everyday work needs to be done also. This solution for running a project is thought to be slow. [26]

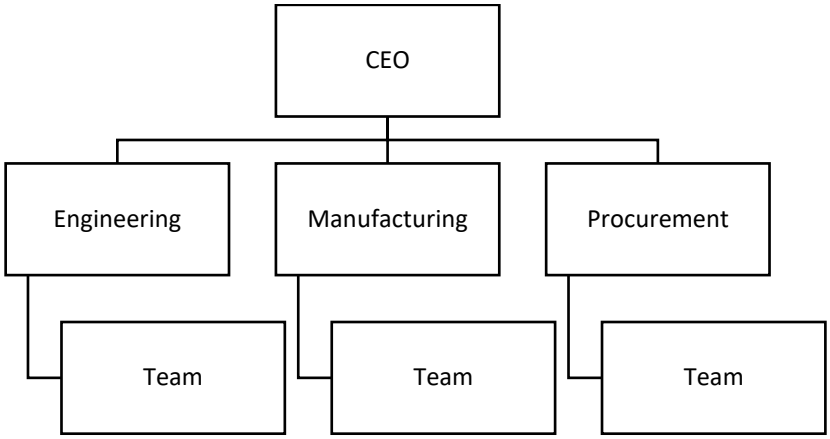

Figure 2.8 Functional organisation

Dedicated project team shown in Figure 2.9 means that there are independent project teams that work separately from the organisation. Project manager can recruit workers but more common is that functional managers denote workers to project team. Financially project team can be independent, meaning that they have their own budget. Positive aspects are that work is done quickly, team members are motivated and have a high ownership feeling. Cross-functional integration is also high as different departments must work tightly together. This solution is expensive, workers need to transition from one work to another. High chance that they forget organisation overall objectives and concentrate sourly on the project. [27]

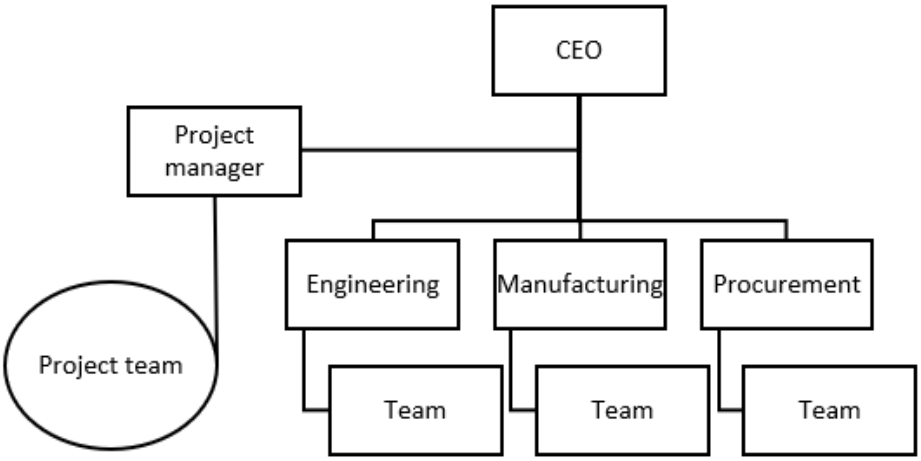

Figure 2.9 Organisational chart for dedicated project team

Matrix organisation shown in Figure 2.10 features a head of project management who supervises all projects. A matrix organisation is defined as one in which there is dual or multiple managerial accountability and responsibility. Workers from different departments are expected to work on projects and on core work. Project manager will give assignments, budget and deadline to team members. Functional mangers will help team members in accomplishing the work. Functional managers need to keep an eye on overall organisational strategy and evaluate how the project effects it. Functional and project managers have constant negotiation about:

- Who is suitable for the project;
- Is the task well explained;
- When will the delivery be;
- When will materials arrive;

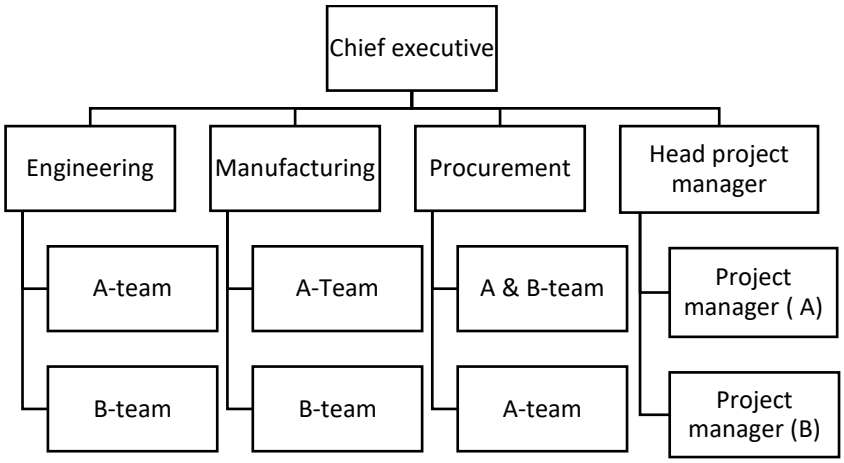

Figure 2.10 Matrix organisation

This type of structure is efficient as resources are shared across multiple projects. People working in the project have a strong emphasis on project work and the willingness to succeed. However, as the workers have two supervisors, project manager and functional manager things can get confusing. Sharing of resources can be a hustle and stressful work. [28]

In practice there are different type of matrix organisations

- Weak matrix;
- Balanced matrix;
- Strong matrix;

In weak matrix project managers act as an assistant. They will monitor progress and help when needed. Functional managers are the ones who are responsible for their department work.

Balanced matrix is the most common type. Project managers give input on what and when is needed to be done. Functional managers help team members in accomplishing their objectives in the project. In strong matrix the project managers have the final say also on how something is done. Functional managers are consulted on a need to know basis. Advantages and disadvantages of different matrix organisations are shown in Table 2.1. [14]

Table 2.1 Comparative Advantages and Disadvantages of a matrix organisation [26]

Advantages	Functional Matrix	Balanced Matrix	Project Matrix
Resource efficiency	High	High	High
Project integration	Weak	Moderate	Strong
Discipline retention	High	Moderate	Low
Flexibility	Moderate	High	Moderate
Improved information flow	Moderate	High	Moderate
Disadvantages			
Power struggles	Moderate	High	Moderate
Heightened conflict	Low	Moderate	Moderate
Reaction time	Moderate	Slow	Fast
Difficulty in monitoring and controlling	Moderate	High	Low
Excessive overhead	Moderate	High	High
Experienced stress	Moderate	High	Moderate

There are advantages and disadvantages on all matrix organisations. The core key is that It should be possible to divide the authority and responsibility equally between project and functional manager. Seldomly this is possible that's why all organisations should choose one structure and educate employees about the power borders. Time will show was it correct or does the organisation need to change these borders.

2.6 Key performance indicators

Measurements are important they are not only helping to indicate and eliminate the weaknesses but also providing managers with the information that describes the present situation at an enterprise. It is important for companies to define the relevant indicators, their influence on the formulated goals and how they rely on the activities performed. The key performance indicators can be defined as measurements that reflect the health of an organisation, and the health of its business development system. They connect the firm's goals and strategies to its activities and outcomes, keeping management informed of overall health: past, current and future. It is not enough just to measure and collect different data, it is obligatory to understand what exactly should be measured and how to deal with the acquired information. Key Performance Indicators (KPIs) indicate precisely where to act to improve performance. [29]

The companies who had adopted sustainable practices and had started to follow the KPIs were able to achieve better product quality by improving the first pass yield and quality ratio, higher market share and increased profits [30]. There are many different types of KPIs, they can be categorised: cost reduction, revenue improvement, process improvement and increased customer satisfaction. There is not a one size fits all approach for choosing which KPI to focus on. SMARTER model is presented for choosing the most effective. SMARTER model consists of seven steps [31] [32]:

- Specific – The goals should be detailed, clear and as specific as possible. Loose, not clear or uncertain goals are not desirable;
- Measurable – Each target, process or KPI should be measurable. The measurement itself could be quantitative or qualitative;
- Achievable – The objectives should be set at the right level. They need to be ambitious and realistic however, making them too simple will not be motivating;
- Relevant – Objectives need to be relevant to specific role and the main course of the team. Furthermore, KPIs should provide insight in the performance of the company in obtaining its strategy;
- Time-specific – the work or tasks should have time frames;
- Explainable – Everyone, who is involved in the process, is aware of goals and tasks;
- Relative – the KPIs should be relative and they still could be implemented even if the company and volumes are growing;

3. DEVELOPING PROJECT MANAGEMENT IN ESTANC

Project management starts when sales department finalises a purchase order. This means that the purchaser and seller have agreed on the work to be done. Every transaction is different but the main factors that seller and buyer need to agree on are:

- Scope of work;
- Price of work;
- Terms of delivery;
- Terms of payment;

Estanc has 5 project managers, depending on the project type and project managers work load the lead project manager needs to decide who to appoint as the manager. This is explained more detailed in paragraph 3.1. Every project manager has different background and different focus. However, all of them need to perform on the same level and provide satisfaction to the customer and company. Main project management steps in Estanc are shown in Figure 3.1

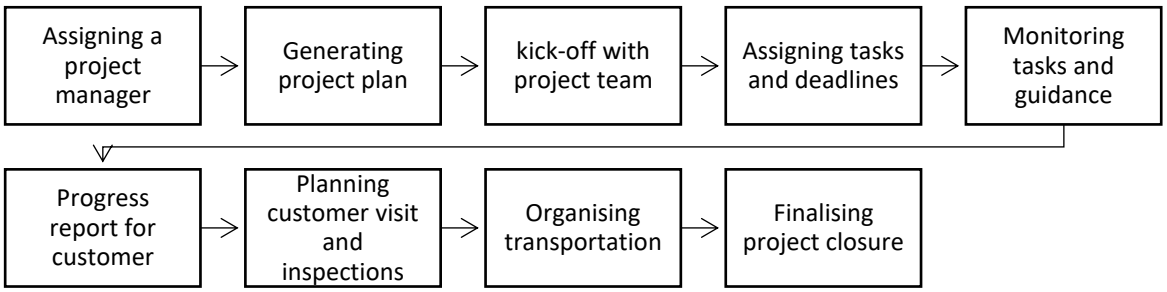

Figure 3.1 Main project management tasks in Estanc

Project manager will go through the contract signed by seller and purchaser. With that preliminary information a project plan is generated. Preliminary plan and information will be discussed with project team, assigned by other department leaders. Project team consist of project manager, designer, quality specialist for documentation, quality specialist for visual inspection and international welding engineer (IWE). On the first kick-off meeting project managers will assign deadline for design freeze, production start, documentation and production. Throughout project life project manager will guide and help team members. He will be the spokesman between team and customer. Project manager will notify the customer constantly about the ongoing progress and problems. All pressure vessels require pressure testing, project manager must notify customer as

soon as possible about the possible date and organise customer visit. Further several steps and improvements are described in more detailed.

3.1 Improving project management structure

Structure of project management in Estanc is shown on Appendices 2 tends to move between balanced matrix and soft matrix. In majority of projects the project managers are coordinating activities. In some cases, they even act as assistants who draw schedules, checklists and collect information on status. Project manager has indirect authority to expedite and monitor the project. Functional managers like production manager and design manager call most of the shots. On the other end there are projects where the project manager defines what and when is needed to be accomplished. Functional managers are concerned with how it will be done.

According to the study "Relative Effectiveness of Different Project Management Structures". That is based on a sample of more than 1600 project professionals and managers actively involved in project management within their organisation. Both the functional approach and weak matrix were rated ineffective, and the balanced matrix was considered only marginally effective, results are shown in Figure 3.2. A key finding was that matrix management can be as effective as a project team if the project manager is given significant control over project activities. [26]

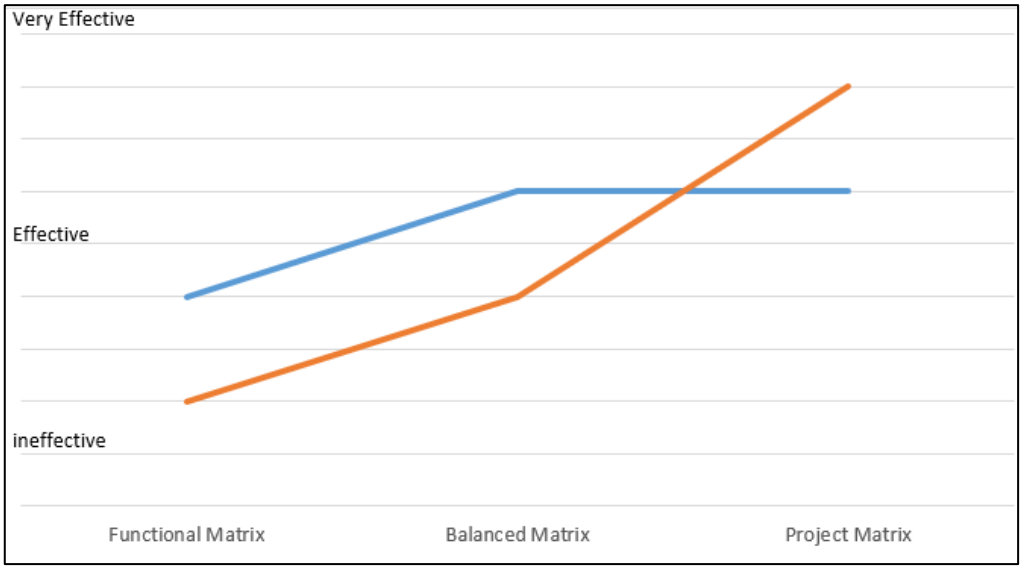

Figure 3.2 Rated effectiveness of different project structures: Orange- construction projects, blue- new products [26]

Another researcher by Hobbs and Minard identifies seven factors that should influence the choice of project management structure:

- Size of project;
- Strategic importance;
- Novelty and need for innovation;
- Need for integration (number of departments involved);
- Environmental complexity;
- Budget and time constraints;
- Stability of resource requirements;

The higher the level of these seven factors, the more autonomy and authority the project manager and team need for being successful. Strong matrix structures should be used for large projects that are strategically critical and are new to the company, thus require much innovation. Correspondingly for complex, multidisciplinary projects that require input from many departments and constant contact with customers. [12]

Based on these two researches it can be said that Estanc should consider implementing the strong matrix organisation structure. Alternative possibility is to start labelling projects: standard and strategically critical. Strategically critical project will be managed by strong matrix or a separate project team for achieving best results. This will allow project manager to choose the best possible team. Project integration will be enhanced, and internal power struggles diminished. It requires that project managers become better specialists with management and technical skills. Top managers must give real and immediate support to the matrix. Stating out purpose of the project and specify responsibilities and authority of the project manager.

3.2 Assigning the correct project manager

It is important to choose the right project manager. Right project manager is one of the key persons for ensuring the outcome of the project. There are two main factors that need to be considered when choosing the right project manager. Project managers skills in relation to the project type and workload evaluation. If a project manager is overwhelmed with work, then it will harm project success. This can express in delays, cost of poor quality and bad customer satisfaction. Table 3.1 shows developed evaluation method for working load. Each area of importance has been assigned with a numerical evaluation factor.

Table 3.1 Evaluating load index

Project	Project manager	Quality class	Customer sector	Project type	Term of delivery	Phase	Sum	Multiply	**Load index**
W1802901	Erko	2	1	1	1	1	6	2	4
W1803301	Erko	1	1	1	1	1	5	1	2
W1803302	Erko	1	1	1	1	1	5	1	2

First column shows project number W1802901, explained in Figure 3.3 this number comes for enterprise resource planning (ERP) program.

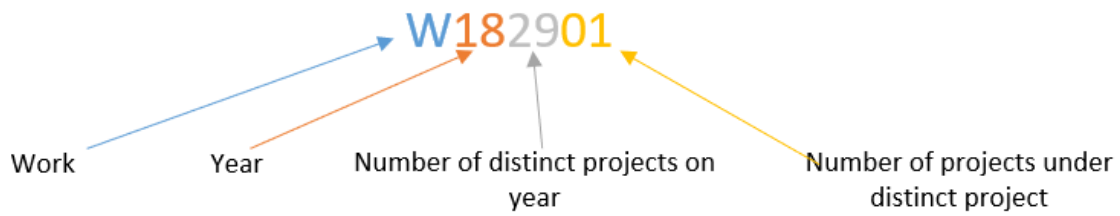

Figure 3.3 Working number explained

All the following parts in the table are developed through experience for giving the best estimation on the workload. It must not be forgotten that each project manager is an individual and the numbers can vary depending on the project and manager. For one a specific customer sector can be new and challenging but for the other it is familiar. Explanation of sectors in Table 3.1 are shown below:

- Quality class, number 1 if simple pressure vessels, 2 if complex pressure vessels;
- Customer sector, number 1,5 for energy and chemical, 1 for marine and Pulp Paper industries;
- Project type, number 1 for repeating projects 2 for development projects;
- Terms of delivery, number 1 for customer delivery, 1,5 for Estanc delivery;

Phase, column needs to be updated when a project moves from one step to another shown in Table 3.2.

Table 3.2 Phase column meaning

On hold	0
Little activities	1
Design	3
Pre-production	2
Production	3
After treatment	4
Finished	0

When a new project comes inhouse the lead project manager will evaluate with a team or already assigned manager all mentioned factors and will calculate the load index for each project.

$$LI = (CS + PH) * QC * PT * TOD \quad (3.1)$$

where LI - load index,

CS – Customer sector,

PH – Phase,

QC – Quality class,

PT – Project type,

TOD – Term of delivery.

Load indexes for each project are summed up under sum of load index shown in Table 3.3. The table shows that Erko has 16 distinct projects (customers) that make up 31 projects. Evaluation of working load is 225 points.

Table 3.3 Evaluating project managers working load

Project manager	Distinct Count of projects	Count of projects	**Sum of load index**
Aavo	17	38	221
Erko	16	31	225
Leho	11	24	242
Roger	4	8	30

This method allows the lead project manager to evaluate project managers workload. Showing how many active customers a project manager has and a structured evaluation of working load. Downside of this method is that it only shows current working load. It is almost impossible to predict what will be the working load of a specific worker within four months. For accomplishing this it is needed to connect the load index with project lifecycle. Necessity of this has evolved from monitoring and evaluating the index. Next development area will be connecting the load index with project lifecycle.

3.3 Generating standardised project plan

One of the primary jobs of a project manager is to manage the trade-offs among time, cost and performance [12]. Project plan is a strong tool in helping project managers with that trade-off. Generating preliminary project plan is a huge milestone for the project manager. This is done after project manager has familiarised with project information, scope and deliverables. Standardised work breakdown structure (WBS) for subdividing work into smaller components was created with Microsoft Projects, shown in Table 3.4. The WBS begins with the project as the final deliverable. Major deliverables go from top to down in a waterfall structure. These major deliverables are fixed for all projects. Project managers will add their own necessary sub deliverables under the main deliverables. This process should be repeated until the sub deliverable detail is small enough to be manageable by one person.

Table 3.4 Standardised work breakdown structure

WBS	Task Name
0	**Project name Time Schedule**
1	Contract date
2	Design information from customer
3	Design freeze
4	Design
5	Purchase of material
6	Pre-production
7	Production work
8	After treatment work

WBS	Task Name
9	Inspections
10	Production finished
11	Delivery finished
12	Installation
13	Documentation delivered

For example, design deliverable can be divided into different detailed drawings. Pre-production into cutting, rolling and chamfering. WBS helps to assure project manager that all products and work elements are identified. Elements are in a hierarchical framework and relationships between them are established. It allows the right persons to deal with appropriate level. Production manager with the production deliverable, hall master with the assembly and welder with welding.

For example, if a project manager has a fixed design freeze point highlighted, starting from the beginning then it will be much easier to negotiate with the customer when some changes have happened late in the manufacturing. Although all projects are different and may have some different area (fireproof painting that is done with a supplier) this standard structure should be used. It will display Estanc customers that the management is well thought. When customers make an order then they know that stable and standardised report shall be provided. For the project managers who are following these fixed guidelines, progress reporting will be easier than in customer own systems. They need to learn how to use this system and implement it into their everyday work.

WBS should be a result of group efforts. The whole project team may be involved in braking down the project. Another approach is that project manager will delegate braking down process to team members. Example of a conducted project plan is shown in Appendices 3. A standardised WBS offers a project manager two major benefits. First, it helps to guide all tasks that need attention down to a specify worker. Secondly, it offers the customer a good overview of the progress.

3.4 Kick-off with project team

Kick-off meeting is the second big milestone. It is the first team meeting, setting the tone on how the team will work together. The primary goal is to run a productive meeting and give realistic objectives. First meetings are done in two parts, first part will be the meeting between salesman

and project manager. Salesman will give as much as possible and relevant information about customer expectations. Proper introduction between the project manager and customer will be made. Salesman will send an e-mail to the customer introducing the project manager. Budget calculations for material, services, working hours etc will be examined.

Second part will be meeting with project team. Prerequisite for a successful meeting is that project manager has made the preliminary production plan. Forwarded this to the assigned project team. Project team is assigned by functional managers. Team members need to study the plan and requirements highlighted by the project manager. At the end of the meeting members need to know what their specific part in the project is and deadline for completion.

To run these meetings productively the manager needs to understand that a meeting is a process that requires preparation, delivery and follow-up. Figure 3.4 shows insights into the key activates involved in planning and running a productive meeting. [33]

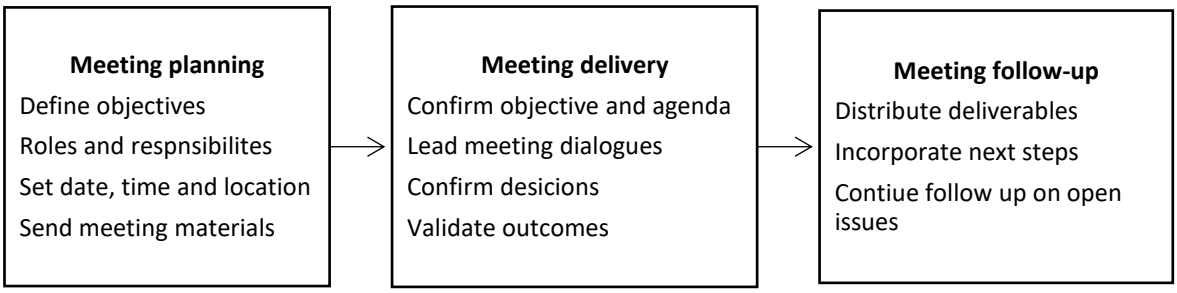

Figure 3.4 Project meeting process

Good meeting starts with defining the objective and inviting the right people. Most effective meetings are the ones where the objectives are clear and attendance ready to accomplish the objectives. This can be in the form of a simple statement, what is expected to achieve. Timing the meeting is important as the attention span that can be comfortably held by an interested human engaged is somewhere in the 18-minute span [34]. When to meet and when not to meet, decision that the project manager must make. A 2005 survey commissioned by interactive Meeting Solutions found that:

- 55% of meetings are dominated by one or two people;
- 32% of people feel they could ger fired for speaking the truth on a meeting;
- 39% of decisions are made once the meeting is over;
- 80% of the discussion is about things people already agree on;

Therefore, the meeting should be held only if the meeting is essential to the project. The goal requires collaborative interaction, right people can be present and there is someone to manage the meeting. [33]

All meetings are not the same; not only do they have different objective, expectations, and deliverable, but they also vary in tone and complexity. Project managers should understand that they cannot be an effective facilitator for every sort of meeting. During the meeting project manages should ask question that guide the group rather than give answers or dictate solutions. There are four basic types of project meetings: information exchange, creative development, decision making and coaching. [33]

Fixed but flexible structure for the kick-off meeting (information exchange) memo was made show in Figure 3.5. If needed project manager will introduce the team in the beginning of the meeting. Next step will be stating the objective, overview of project now (maybe some main materials have been purchased) and what is intended to accomplish. This may include background of customer or product where and for what will it be used. Discussion on what decisions have already been made.

OBJECTIVE: **Date:**	
Project number:	
Project manager:	Scope:
Participants:	
Discussions	
Time-schedule	Design start: Main materials in-hous: Drawings to manufacturing: Pre-production: Production: Aftertreatment:
Design	
Purchas of materials	
Pre-production	
Production	
Aftertreatmen	
Quality inspections	
Next meeting	

Figure 3.5 Kick-off meeting memo

Project manager will present the preliminary time schedule with proposed dates for design start, drawings to manufacturing, pre-production, production and aftertreatment. From that point the team will go through the project flow step by step revising specify requirements for design,

production, quality etc. At the end of the meeting team members need to know what is expected from them and when, they will have an overview of project deliverables and business needs. Before ending the meeting next follow up (status meeting) points should be agreed on and project manager will forward meeting memo with agreed tasks and deadlines to all participants.

3.5 Monitoring with Power BI

Purpose of monitoring is to establish how is time used and forecast what is likely to happen soon. Project in Estanc increase in size and complexity, monitoring needs to move to a more structured approach. It is always economically cost effective to change the course of a project in an early stage. That's why progress reporting needs to be as accurate as possible. For example, if a welding project is underperformed in the 1/5 part of the project then changing the course can be as easy as assigning a second shift. On the other side if this is realised one week before delivery, then the project manager is powerless to bring the project in on time, because increasing the workforce with one shift will not help. Also assigning more than one welder at a time may not be possible. In some cases, assigning more workers can even slow down production. This is because those already working need to start explaining the work.

Power BI is a business analytics solution that lets you visualise your data and share insights across your organisation or embed them in your app or website. Connect to hundreds of data sources and bring your data to life with live dashboards and reports. [35]

All the data that is used for creating charts comes from ERP system. Charts are outputs for the data that is collected into the system. Power BI gives the possibility to use this data in user friendly way and make charts that can help with everyday work. Once links are made between ERP program and Power BI then it is convenient to make charts, calculation, filters etc. System is set to automate data once in a day. This means that if new information is entered to ERP system it will automatically update in Power BI for the next day. Overview of project managers desktop when entering Power BI program is shown in Figure 3.6. There are four main applications in the view that will be explained more detailed below. For all views different filters and focus modes are possible. To the right (vertically) there is a master filter. From that filter time period, project manager, finished or in progress project can be chosen. Here and now the filter is set to show all Erko Hermann's projects that are not finished. On top (horizontally) selected project manager (Erko Hermann) with 18 finished projects and 37 in progress projects. On the top (horizontally) there is also the economically summed up view that has only meaning with one project or with all finished projects.

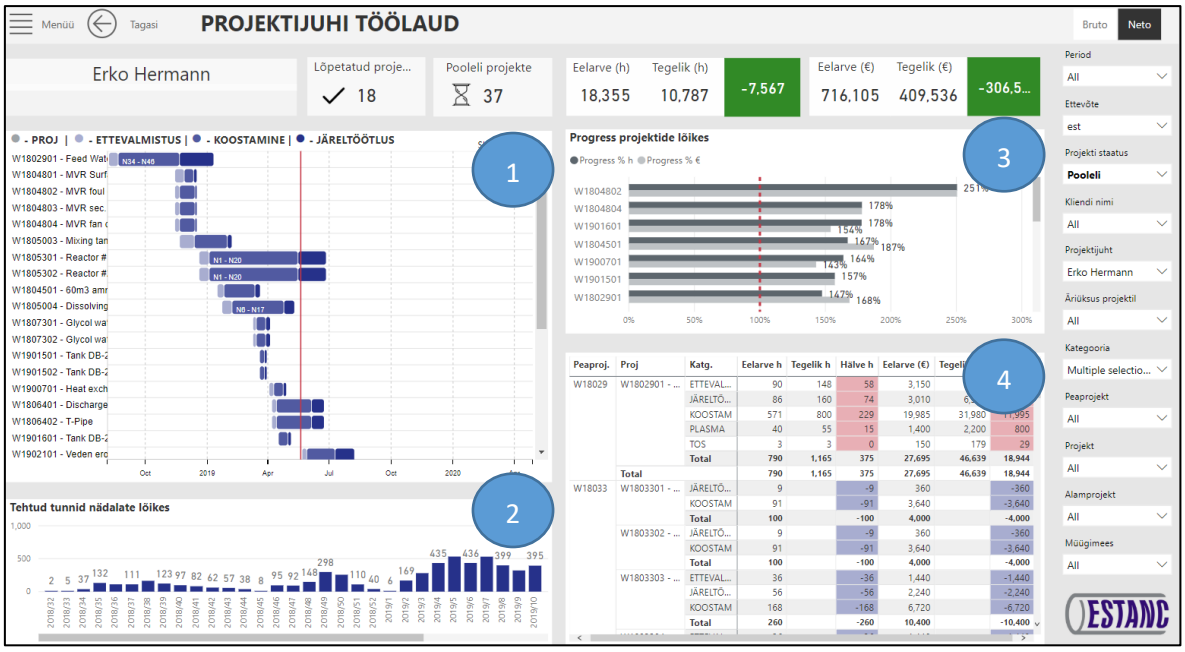

Figure 3.6 Overview of project managers desktop: 1- full portfolio overview, 2- working hours in weeks, 3- progress by projects, 4- economic overview in first level detail

In the schema in Figure 3.7 full portfolio overview can be seen. On the left (vertically) is a list of all projects ordered with contract date. Horizontally project deliverables on a time scale. This was created with the aim of helping project managers visually see the whole portfolio and evaluated further steps. Whit just one view the project manager can see which projects are in production, pre-production, aftertreatment or design phase. This information gives managers reins for controlling. For example, questions like is the design ready are we planning to start with aftertreatment, can be asked. Design is inactive because the organisation did not collect data on the start and finish of the design. Design end date will be renamed as drawings released to manufacturing, calculated as $preproduction - 1day$, starting date will be divided linearly from the end date with expected working hours. Starting date for design is something that the project manager needs to discuss in the kick-off. if it is seen that the date needs to be rescheduled then project manager needs to change it manually in the ERP system.

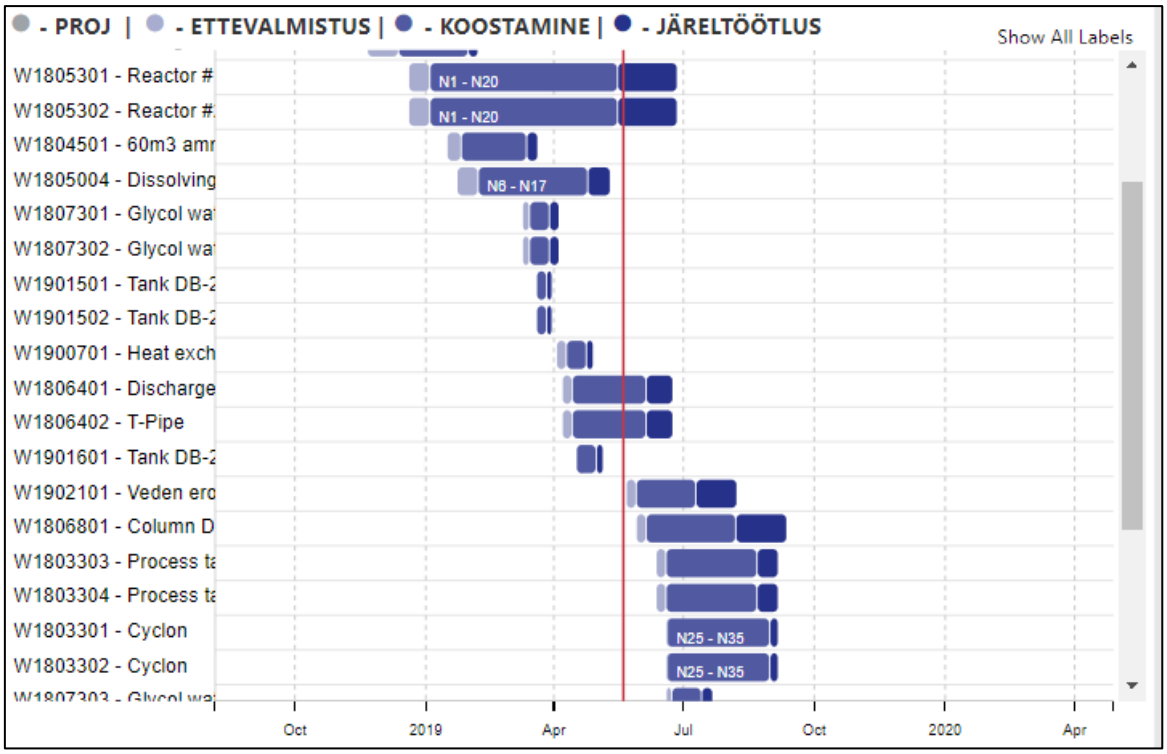

Figure 3.7 Full portfolio overview: light blue- pre-production, blue- production and dark blue- aftertreatment

Second bar chart shown in Figure 3.8 displays to the user working hours in weeks. There is also a possibility to drill down and see working hours in days. This view comes handy in seeing how working hours are broken down during a project. In many cases the problem is that at the beginning of the project everybody has the attitude that there is still time and less work is done. Regretfully at the end of the project everybody is in a hurry and extra effort is needed. Starts and stops are emphasised, project that run with starts and stops are costly because employees need to readapt into specify working flow. This schema is not finished it will be redesign cumulatively, allowing the user to see visually how many planned hours are left in a project.

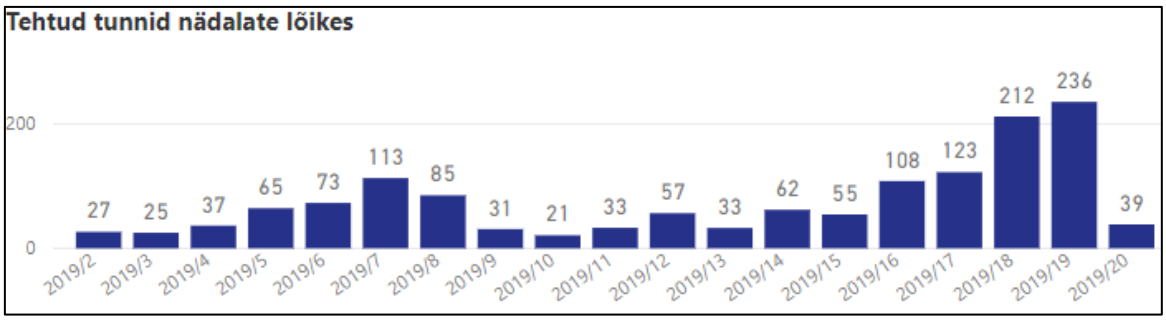

Figure 3.8 Working hours in weeks

Third bar chart shown in Figure 3.9 gives the user an overview in time and money struggles. If both columns cross the red line, then the project has been economically a failure. Only inhouse process are shown, cost of materials and subcontracting services has been taken out.

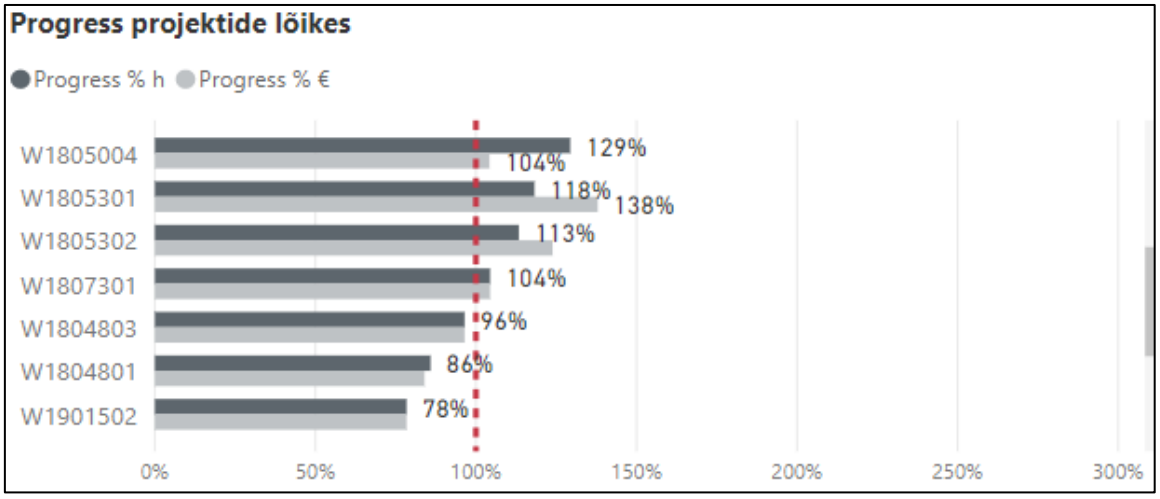

Figure 3.9 Progress by projects: dark gray- progress in %h, light gray- progress % €

Fourth diagram shown in Figure 3.10 displays the economical overview in first level detail. From Figure 3.9 it was only seen that the project had used all resources. From first level overview it can be seen more detailed that what fragment and how much money and hours were used. At the end of the working day all workers log their working hours. For example, 4 hours for project W1807201 for welding longitudinal shell and 4 hours for project W1807302 pipe welding. This method helps to control the workers, plan repetitive project and processes. With the assumption that working hours are planned realistically it is easy for project manager to follow project progress and delivery dates.

Peaproj.	Proj	Katg.	Eelarve h	Tegelik h	Hälve h	Eelarve (€)	Tegelik (€)	Hälve €
W18072	W1807201 - ...	ETTEVALM	21		-21	840		-840
		JÄRELTÖÖT	49		-49	1,960		-1,960
		KOOSTAM	56		-56	2,240		-2,240
		PLASMA	6		-6	240		-240
		Total	**132**		**-132**	**5,280**		**-5,280**
	Total		**132**		**-132**	**5,280**		**-5,280**
W18073	W1807301 - ...	ETTEVALM	10	4	-6	400	160	-240
		JÄRELTÖÖT	13	7	-6	520	280	-240
		KOOSTAM	35	54	19	1,400	2,140	740
		PLASMA	10	7	-4	400	260	-140
		Total	**68**	**71**	**3**	**2,720**	**2,840**	**120**
	W1807302 - ...	ETTEVALM	10	5	-5	400	200	-200
		JÄRELTÖÖT	13	7	-6	520	280	-240
		KOOSTAM	35	29	-7	1,400	1,140	-260
		PLASMA	10		-10	400		-400
		Total	**68**	**41**	**-28**	**2,720**	**1,620**	**-1,100**

Figure 3.10 Economic overview in first level detail

Figure 3.11 shows an example for monitoring a project with Power Bi. Managers can see that the project is currently in manufacturing stage, that needs to be finished for the end of week 22. After manufacturing stage comes aftertreatment that is predicted to last from week 23-25. On week 15 only 2 hours of manufacturing was completed, this was the result of absence of critical component. At the beginning of week 16 component arrived at the warehouse and manufacturing started at full power. With this information the project manager can start investigating possibilities on how to accelerate production or negotiate new delivery date. There is still 161 planned working hours left question, is this enough, should be asked. As pre-production, plasma cutting, and design together took 98h more than planned.

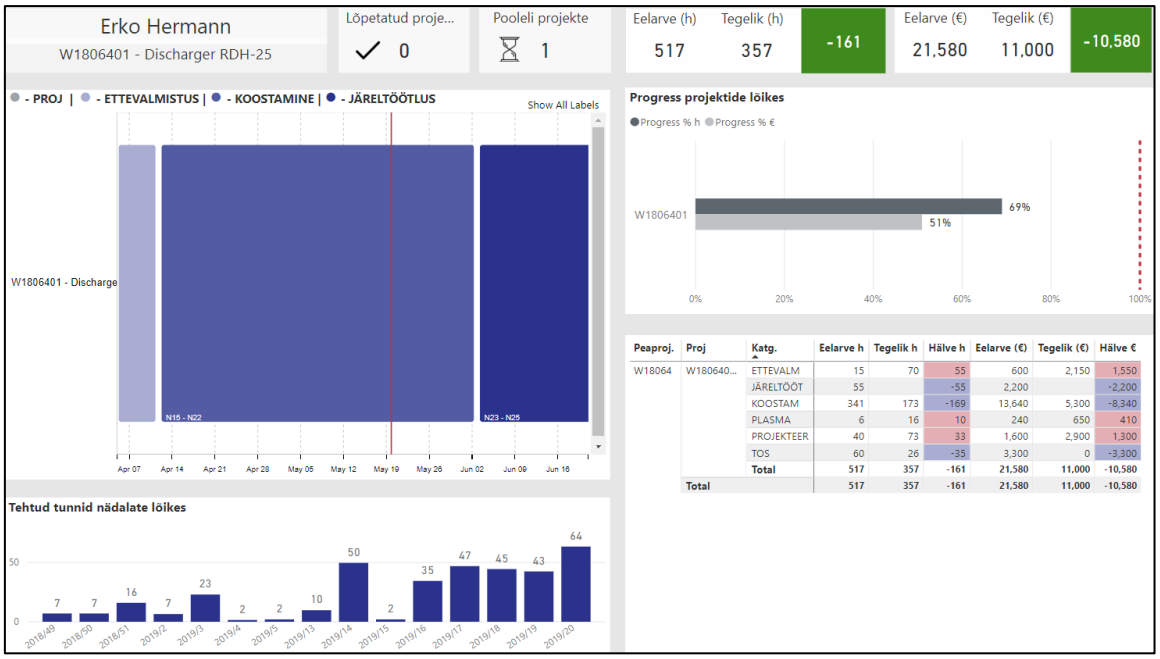

Figure 3.11 Example of monitoring with Power BI

Project manager needs to act early to any variation in the progress, before a small problem becomes a disaster. Toolbox from Power Bi is one way of helping managers detect problems early in the pipeline. Likewise, visualisation gives new input to the ERP system, directions for further development. Information that should be collected into the ERP system and then visualised in Power BI.

3.6 Progress reporting

Progress reporting is an essential activity for project managers. Normally reports on progress against budget, schedule and scope are mandatory. In Estanc the project manager reports once a month all finished projects economic status to the lead manager with an email. Only showing the project outcome. Another story is with progress reports submitted to the customer this is part of project managers everyday work. Progress is reported to the customer on schedule and quality.

In 95% of contracts it is written that the supplier needs to report constant progress. In long scale projects reporting is required once a month, starting from the order. With shorter projects progress needs to be sent once in every two months. Some big customers (Neste) have their own progress reporting systems. Navigating between customer systems is time consuming and nerve-racking. For better customer satisfaction and for easier filling (leading to time saving) standardised progress report was made shown in Appendices 4. Progress report for customer.

Standardised progress report consists of three parts. First part shows overall project information with equipment final inspection dates highlighted. Inspection date is important for the customer as customer quality specialist may come to inspect product before shipping is allowed. Majority of contracts specify that the supplier must notify at least two weeks in advance about visual test inspections and pressure testing. Having these dates always shown on the report will reduce inconveniences that may emerge when these dates are not reported to the customer.

Manufacturer:	**Customer:**
Estanc AS Põrguvälja tee 5a Pildiküla 75308 Rae vald Harjumaa, Estonia	
Project reference:	**Project reference:**
W18	
From:	**To:**
Erko Hermann Erko.Hermann@estanc.ee +372 53465731	
Progress report version: 0 Date: 08.05.2018	

Equipment name	Design Freeze	Production start	Final Inspection	Delivery date
Equipment 1				
Equipment 2				

Figure 3.12 First part of progress report, overall project information

Second part shown in Figure 3.13 illustrates general project updates about design, procurement, quality and production. If there are risks concerning deadline or quality this is the place where to specify these problems if everything is upright, then information that project is on track should be written. Updated production schedule is attached as an appendix to the progress report, example shown in Appendices 3.

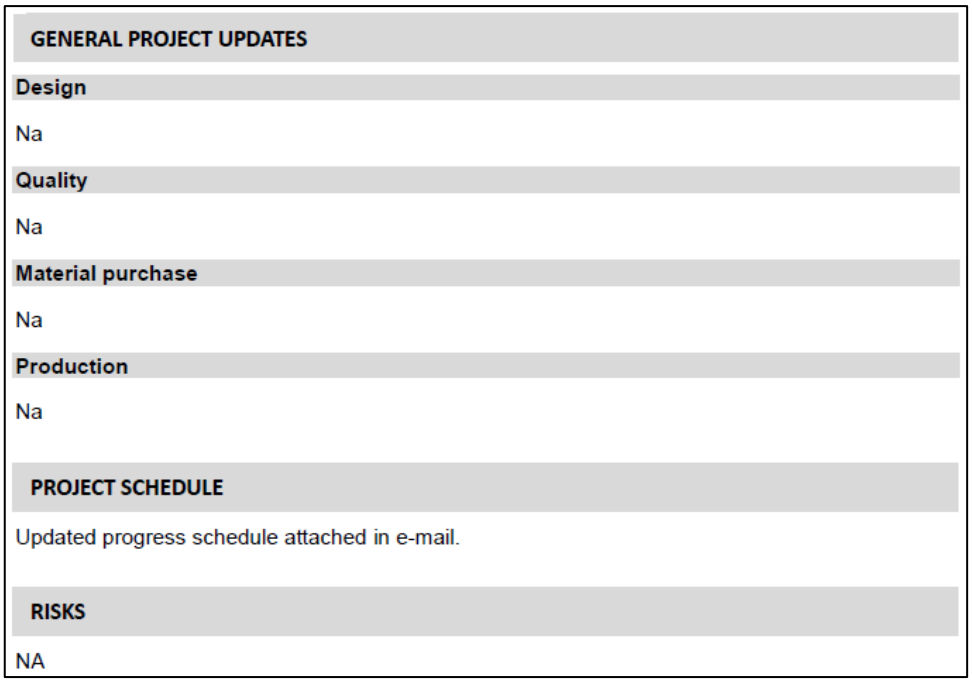

Figure 3.13 Second part of progress report, general progress

Third part is for the commercial topics, list of additional work and milestone payments. This is one of the most important parts for cost management. Additional works need to be highlighted to the customer as early as possible, this will increase the chance that they will get accepted. Additional work area on the progress report will help project managers with getting the acceptance from customer. Important column on milestone payments is the received payments. Customers tend to pay bills as late as possible and even in some cases payments are delayed. It is project managers responsibility to influence customer to pay their bills on the correct time. For Estanc this issue is critical as we need to buy expensive materials for projects. Liquidity of the company may go to the wrong side when there are many projects with expensive materials and project payment terms are 60 days after delivery.

STATUS OF ADDITIONAL WORK

Pos.	Date	Change	Initiator	Total cost	Date Accepted
1					

MILESTONE PAYMENTS

%	Description	Invoice date	Due date	Received
40%	Main materials inhouse			
50%	After delivery			
10%	After final documents			

PHOTOS OF PROGRESS

	Photo 1 –

Figure 3.14 Third part of progress report, commercial topic plus pictures

In some cases, it is recommended to send the report also to internal project team. This will prevent confusion about what has been said to the customer. Disagreements in the future are easily solved as it can be always referred to the report. Regular progress reporting creates a valuable written record of a project's life and main points from the report can be taken to the project closure phase. Later it can be looked back and decided how to improve running of future projects.

3.7 Project closure

Every project comes to an end. In Estanc this happens when ownership of the product is transferred to the customer. This is done partly with the delivery although, the final sign to close the project happens when final documents are sent to the customer and final invoice payed, project closure steps are shown in Figure 3.15.

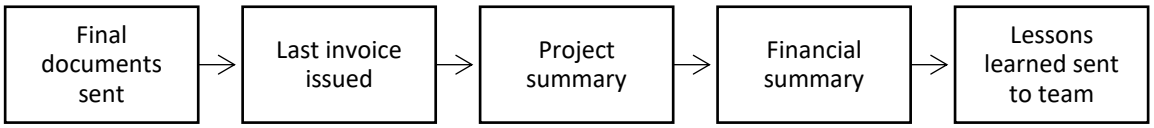

Figure 3.15 Steps for project closure

Many project managers overlook the project closure process. They consider project closing as overburden work that is done to satisfy organisational requirements. Also, project participants are looking forward to future projects or other opportunities. Project managers challenge is to keep the project team focused on the project activities and delivery to the customer until the project is

closed. The final steps are the ones that leave the last and most important impression to the customer. [27]

In Estanc project manager needs to fill in project summary, all the departments that were evolved are evaluated. In Table 3.5 there are questions that project manager needs to answer for evaluating project departments.

Table 3.5 Evaluating project departments in project summary report

Department	**Evaluation**
Sales	Was the budget accurate?
Project management	How was the project managed and was the plan feasible?
Design	Were drawings well-made and released on agreed date? Was design on budget?
Purchasing	Did materials arrive on time? Were the materials on budget?
Quality	Were there deviations concerning standards or customer expectation?
Production	Evaluation of working hours. How much was used vs. what should be normal.
Evaluation of client	Was communication smooth?

Project summary needs to be concern for the whole organisation. For this the mindset of workers needs to change. As projects in Estanc are growing larger in scope every year then the management skills and methods need to grow as well. Project summaries cannot be the solo work of the project manager anymore. After every milestone inscription to the summary needs to be maid evaluating every step when it is relevant not at the end of the project. At the end of the project, manager should make a project summary meeting where already filled summary is discussed. Improvement areas are to take project summary into the ERP system. In there the information would be easily accessible and it would be a living document that everyone can fill.

Project summery will come handy next time when a similar project is planned. Team can examine documents, including progress report, of previous projects to find out what was done right, what went wrong and what can be improved. This can shed light on systemic issues, loopholes that cause delays or failures. If standardised project summaries would be in the ERP system, then with Power Bi these can be visualised. From the visualisation systematic issues can be identified. For example,

design department is 80% late in preparing the drawings. For 90% of projects materials are cheaper than expected etc.

3.7.1 Lessons learned

Most valuable part in project closure is capturing of lessons learned: What was done well, and should be documented so it can be repeated in the future? What could have been done better? And if so, how can it have been done better? Capturing lessons learned should be an on-going effort. All team members need to have the right mindset that weaknesses and strengths need to be written down and analysed for further progress. Failure compared to success is even a stronger learning possibility. By not learning from project failure the organisation is doomed to repeat similar mistakes. By not maximizing on project successes the organisation will miss out on the opportunities to implement good processes and practices. [36]

Lessons learned should be identified when they occur and implemented as soon as possible. If lessons learned are not documented when they happen then there is a high possibility that they will be forgotten for the end of the project. Estanc lessons learned are currently responsibility of project manager. When closing the project, project manager needs to fill project summary and lessons learned in that summary. Proposed lessons learned process is shown in Figure 3.16.

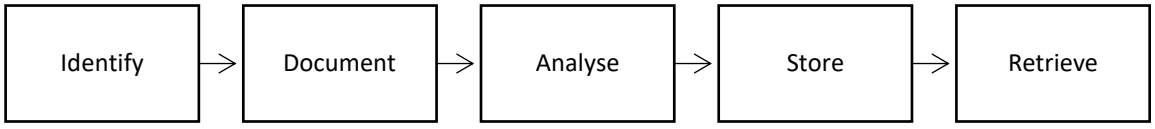

Figure 3.16 Lessons learned process

First step is to identify comments and recommendations that could be valuable for future projects. These notes can come from the whole organisation as everybody is responsible for giving feedback. Comments should be saved under project folder and discussed. If the project manager and team detect that this comment is suitable then it moves to the second (documentation) step. In the second step the finding will be shared with stakeholders. Facilitator should distribute the detailed lessons learned report to all participants and participants should start a discussion. Third step is analysing, and organising lessons learned, specific proposal are offered. For example, changing a process or proposing training for employees. Fourth step is storing the lesson that was learned with proposed discussion and improvements onto project folder with other project documents. Last step is retrieving the lesson from the folder if lessons are only relevant for similar projects and were not

implemented to overall processes. This is hard as they will be restored onto a shared drive where there is lot of information and finding correct learning material can be hard.

3.8 Developing project management department KPIs

Successful businesses are driven by well-defined goals. Below are shown some of Estanc's strategical goals for year 2019th.

- Revenue increase from 18 to 26 million with a profit margin of 1,15 million
- Spreading Estanc's story as being a sustainable company
- Increasing customer satisfaction
- Improving manufacturing efficiency

Strategies are put into place by the top management. For ensuring that these strategies are followed, and company is going in the right direction a tool for measuring is needed. For this purpose, the organisation and every department in it need to have KPIs. As it was specified in the literature review KPIs are implemented for showing how well a business is performing against strategic goals. First, let's define a successful project. Since projects are temporary in nature, the success of the project should be measured in terms of completing the project within the constraints of; scope, time, cost, quality, resources, and risk [10]. However, this does not factor in whether the project will benefit the organisation managing the project.

Following is a count of KPIs that best fit for project management department. They were chosen by a 6-member expert group where all have higher education and more than a year managing different projects.

1. On time delivery (OTD)

On time delivery is a measure of process showing how many products where delivered to the customer on time and in full. It helps to determine how effectively customer expectations are fulfilled. If the figure is low, then somewhere in the supply chain there is a bottleneck. It is a simple measure and can be calculated as follows:

$$OTD = UDT/TUD \quad (3.2)$$

where OTD – on time delivery,

UDT – units delivered timely,

TUD – total units delivered.

Idea behind OTD is that the delivery time can fluctuate. At the beginning of the project it is agreed that delivery time is X but when time goes by the customer shows that product is needed x-2days or x+ 5days. Another example wold be that there is a problem in meeting the agreed date and project manager will ask if a delay is permissive. If this is suitable a new OTD will be agreed.

2. Delivery accuracy (DA)

Delivery accuracy differs from OTD, it will show companies efficiency in meeting the contact date that was agreed in beginning of the project. Showing how reliable is the company in planning and delivering.

$$DA = TUD/CSD \quad (3.3)$$

where DA – delivery accuracy,

TUD – total units delivered,

CSD – contract specified date.

3. Number of nonconformities (NON)

Nonconformities are defects or changes that the organisation needs to clarify with the customer and the customer requires that a nonconformity report is made. From project management perspective these should be shown per project also.

$$NC = TUD/TNC \quad (3.4)$$

where NC – nonconformity,

TUD – total units delivered,

TNC – total nonconformities issued.

4. Customer satisfaction (CS)

Idea behind this KPI is to evaluate project managers and organisations soft skills. How fast was the communication, how kind and outgoing was the project manager etc. After a project is finished a satisfactory questionnaire will be sent to the customer. There is an area for rating the project manager. These can be summed up and divided by total number of answers, giving average mark of Estanc project managers.

5. Cost performance index (CPI)

Cost performance index is a measure of the project efficiency of budgeted resources, expressed as a ratio of earned value to actual cost. It shows how much is earned for each euro spent on the project.

$$CPI = \frac{EV}{AC} \quad (3.5)$$

where CPI – cost performance index,

EV – earned value,

AC – actual cost.

6. Number of adjustments to the schedule (NATS)

Measurement for evaluating project managers planning competent. This measure can be evaluated by how many revisions project manager has made to the project plan. Changes can accrue by poor planning or poor fulfilment of the plan.

7. Working hours versus planned (WHP)

Shows the relationship between working hours and planned. Evaluating salespersons competence in planning and workers competent in working. When the relationship is under 1 then somebody needs to give an explanation to where did the extra hours go? Or did the salesperson calculate something wrongly?

For evaluating these KPIs the SMART method is used shown in Table 3.6. SMART coefficients are numbers from 1 to 9, 1 indicating least suitability. Statements that are evaluated are; increasing on time delivery, delivery accuracy, customer satisfaction and cost performance index and decreasing nonconformities, number of adjustments to the schedule and improve working hours versus planned relationship. Measures that where hard to evaluate (achievable and timely) were taken out. Measures are assigned with purpose of determining KPIs for project management department.

Table 3.6 SMART coefficients to KPIs: S- smart, M- measurable, R- relevant, E- explainable, R- relative

KPI	S	M	R	E	R	Sum	Coefficient
On time delivery	9	8	8	9	9	43	6,14
Delivery accuracy	9	9	8	9	9	44	6,29
Number of nonconformities	9	8	6	9	9	41	5,58
Customer satisfaction	8	7	8	5	8	36	5,14

KPI	S	M	R	E	R	Sum	Coefficient
Cost performance index	9	8	6	6	7	36	5,14
Number of adjustments to schedule	6	4	4	8	8	30	4,29
Working hours vs. planned	8	9	7	7	7	38	5,43

Coefficient is calculated as $\frac{Sum}{Number\ of\ KPIs}$, larger the coefficient better the fit. From the table delivery accuracy and on time delivery got the highest score. Some KPIs like cost performance index and working hours vs. planned house best suits top management. Number of adjustments to schedule is a measurement that is hard to understand. Changes can come from many departments and there will always be the question is the change big enough to change the schedule.

Secondary evaluation was done with a narrower approach to project management departments KPIs, selection is shown in Table 3.7. Relative benefit and relative penalty were introduced.

Relative benefit: shows the benefit that the KPI will provides to the customer or the business when realised on a scale from 1 to 9, with 1 indicating very little benefit and 9 being the maximum possible benefit. Relative penalty: shows the penalty the customer or business would suffer if there is a problem. Again, a scale from 1 to 9, where 1 means essentially no penalty and 9 indicates a very serious downside.

Table 3.7 Prioritisation matrix for evaluating KPIs

KPIs	Relative benefit	Relative penalty	Penalty and benefit coef.	SMART coefficient	Sum	Rank
On time delivery	9	9	2,57	6,14	8,71	I
Delivery accuracy	8	6	2	6,29	8,29	II
Number of nonconformities	7	8	2,43	5,58	8,01	III
Customer satisfaction	9	9	2,57	5,14	7,71	IV
Cost performance index	7	8	2,14	5,14	7,28	V
Number of adjustments to schedule	5	4	1,29	4,29	5,58	VII
Working hours vs. planned	6	7	1,71	5,43	7,14	VI

Penalty and benefit coefficients are calculated $\frac{Sum}{Number\ of\ KPIs}$. It is understood that on time delivery is the best KPI for project management department and increasing on time delivery best objective. Although, delivery accuracy was first then after the second evaluation it dropped to second. This happened because it shows customer requirement only in the beginning of the project, but this may change. Penalty and benefit for delivery accuracy can be the same (usually they are not) for OTD and DA if the customer is unwilling to change the preliminary contact date. If nonconformities are serious enough then the customer will not accept the product. Benefit for not having any nonconformities means that quality of the product is satisfactory. Customer satisfaction is hard to evaluate as this comes directly from the quality and service. If customer is satisfied, then there is a likely change that a new order will be made. Cost performance index will directly show if the company is earning money or not and no company can sustain long term losses. If number of adjustments to the schedule is high, then employees are doing non-productive and costly work. This will affect cost and delivery time. Planning working hours poorly can lead to delayed delivery and unmotivated employees as everybody is overloaded with work.

On Table 3.8 delivery accuracy and on time delivery for projects managed by one project manager and finished on year 2019th are shown. In delivery accuracy and on time delivery columns number 1 displays that Estanc did not fulfil customer requirements. When Estanc was ready earlier or at the required time then the result is zero. For the first project the product was ready from Estanc side on 11.04.2019 initial date from contract was 04.02.2019. Delivery accuracy was off with 66 days but on time delivery was correct as this postponement came from customer. Delivery accuracy is 8,3% meaning that 91,7% of the times when a customer makes an order then the delivery date from contract is not followed. From the other side on time delivery is 75% meaning that 25% of the times customer will not receive the product when they required it.

Table 3.8 Delivery accuracy and on time delivery for projects finished so far on year 2019th

Project	PM	Delivery date from contract	Accepted delivery date	Ready for delivery or arrived	DA	OTD
W1805003	Erko	04.02.2019	11.04.2019	11.04.2019	1	0
W1803501	Erko	08.02.2019	28.02.2019	28.02.2019	1	0
W1803601	Erko	08.02.2019	22.02.2019	28.02.2019	1	1
W1901101	Erko	19.03.2019	19.03.2019	19.03.2019	1	0
W1804501	Erko	20.03.2019	27.03.2019	27.03.2019	1	0
W1901501	Erko	28.03.2019	01.04.2019	01.04.2019	1	0

Project	PM	Delivery date from contract	Accepted delivery date	Ready for delivery or arrived	DA	OTD
W1901102	Erko	28.03.2019	20.03.2019	20.03.2019	0	0
W1807301	Erko	04.04.2019	08.04.2019	08.04.2019	1	0
W1807302	Erko	04.04.2019	08.04.2019	08.04.2019	1	0
W1900701	Erko	30.04.2019	03.05.2019	09.05.2019	1	1
W1901601	Erko	03.05.2019	10.05.2019	17.05.2019	1	1
W1805004	Erko	08.05.2019	27.05.2019	25.05.2019	1	0
					8,3%	**75%**

It must be pointed out that these numbers do not represent 100% true resolute as the data that is obtained is only for the first quarter of 2019th and from one project manager. From this only a certain trend can be seen. For example, that delivery accuracy is vague in evaluating customer satisfaction in process equipment manufacturing. As the schedules for customers are also constantly changing. Tracking pack is almost impossible as project managers do not remember agreements that were made on emails. Therefore, it is reasonable to implement this tracking for all further projects. Idea is to bind the ready for delivery date with realization date and with the possibility to change it. Then from ERP system import this to Power BI and start monitoring on time delivery and delivery accuracy for all projects.

SUMMARY

The purpose of this thesis was to optimise and standardise project management in Estanc. The master thesis was successful in developing improvements and revealing new improvement possibilities. Thesis starts with Estanc overview highlighting that Estanc is an ETO company and that efficient work is necessary because company is experiencing rapid growth, long lead times and more complex products. Second part displays theoretical background about project management theory, key performance indicators, standards and methods. Best practises from three main standards were examined. Mixture of different methodologies described were used in the third part, developing project management is Estanc.

First proposal that was made is changing project management status in the organisation structure. According to two studies a strong matrix structure would be more efficient than the current soft or balanced matrix. Alternative possibility is to start labelling projects: standard or strategically critical and manage them accordingly. Second proposal arises from the beginning of the project when it is not known yet who will be the project manager. Project managers skills and workload need to be evaluated. Methodology for evaluating project managers workload was created. Helping to prevent overloaded project managers and by that improving customer satisfaction.

Project management consist of five general phases; initiation, planning, execution, monitoring and closure. Specific proposals for last four phases were made. Primary job of a project manager is to generate the project plan. Standardised work breakdown structure for subdividing work into smaller components was created with Microsoft Project. This structure will help to assure project managers that all products and work elements are identified, decreasing error rate and increasing project managers efficiency. Also, with time customers will get familiar with Estanc report structure and know what to expect therefore, satisfaction will be increased. Another part of the planning phase is the kick-off meeting. Meeting is a process that requires preparation, delivery and follow-up. Overview how a meeting should be held and a fixed but flexible structure for the kick-off meeting memo was made. Being a checklist for the manager not to forget anything and afterwards a do to list for the workers. Preventing miscommunication at the beginning of the project that can affect the cost, quality or the deadline afterwards.

During execution phase the main task for the project manager is monitoring the progress and when possible give guidance to the team. Business analytics solution Power Bi was introduced for visualising project data. Programme helps to identify problems in early stage, and it is always economically cost effective to change the course of a project in an early stage. Another part in the

execution phase is reporting monitored progress to the customer. For this a standardised progress report was made. When learned how to use, it will save valuable managers time, increase customer satisfaction. As it has received payments column then controlling if the customer has payed the bill or not is mandatory for the project manager, helping to prevent enterprise liquidity losses.

In the project closure phase, it was proposed that project summary and lessons learned need to be concern for the whole organisation. After every milestone, inscription into the summary report needs to be maid, evaluation every step when it is relevant not at the end of the project. For the last proposal on time delivery, delivery accuracy and customer satisfaction were chosen as the key performance indicators for project management department.

All in all, there is still a lot to improve as manufacturing is a complex system that should be developed concurrently, and some proposals have not been implemented yet. Future development possibilities:

- Connecting project lifecycle view with project manager workload index;
- Connecting project plan and progress report into one system;
- Implementing kick-off meeting and project summary into enterprise resource planning program;
- Implement key performant indicator tracking and move it Power Bi;

KOKKUVÕTE

Käesoleva lõputöö eesmärk oli optimeerida ja standardiseerida projektijuhtimist Estancis. Magistritöö võib lugeda edukaks, selle käigus arendati parandusmeetmeid ja identifitseeriti uusi arendus suundi. Magistritöö algab projektipõhise tootmise tutvustamisega ja seletab miks just nüüd on tõhusam töö Estancis vajalikum kui kunagi varem. Teine osa tutvustab projektijuhtimise, tulemusnäitajate, standardite ja meetodite tausta ja teoreetilist osa. Uuriti arimaid praktikaid kolmest põhilisest standardist. Sünergia erinevatest meetoditest on kasutusele võetud kolmandas peatükis, milles käsitleti projektijuhtimise arendamist Estancis.

Esimene ettepanek oli projektijuhtimise staatuse muutmine organisatisooni struktuuris. Kahe uuringu kohaselt on tugev maatriksstruktuur tõhusam kui praegune pehme või tasakaalustatud maatriks. Alternatiivne võimalus on alustada projektide sildistamist: standardne või strateegiliselt kriitiline ja hallata neid vastavalt. Teine ettepanek tuleb projekti algusstaadiumis, millal pole veel teada kes on projektijuht. Projektijuhi määramiseks tuleb projektijuhi oskusi ja töökoormust hinnata. Loodud sai projektijuhtide töökoormuse hindamise metoodika, eesmärgiga aidata vältida ülekoormatud projektijuhte ja seeläbi parandada klientide ja töötajate rahulolu.

Projekitjuhtimise võib jagada viite üldisesse etappi: algatamine, planeerimine, teostamine, järelvalve ja sulgemine. Käesolevas töös on tehtud parandusettepanekuid viimase nelja etapi kohta. Projektijuhi üks esimestest ülesannetest on projektiplaani koostamine. Microsoft Projectiga loodi standardiseeritud tööjaotuse süsteem, mida saab iga projektijuht ise alamsüsteemideks jagada. Selline süsteem aitab tagada, et kõik tööelemendid oleksid tuvastatud ja kirjeldatud, vähendades veamäärasid ja suurendades projekitjuhtide tõhusust. Aja möödudes õpivad kliendid seda süsteemi lugema ja hindama, teades mida Estanci projektijuhtidelt oodata. Teine osa planeerimisfaasist on esmane koosolek meeskonnaga. Koosolek on protsess, mis nõuab ettevalmistamist, teostamist ja hilisemaid järelmeetmeid. Peatükis antakse ülevaade produktiivsest koosolekust ja abistamiseks loodi fikseeritud kuid paindliku struktuuriga koosoleku protokoll. Protokolli on võimalik kasutada kontrollnimekirjana, et ei unustataks olulisi teemasid ja samuti hiljem töökäsuna projektimeeskonnale. Protokollimine aitab vältida ebakõlasid projekti alguses, mis omakorda võivad mõjutada kulusid, kvaliteeti ja tarnet projekti kulgedes.

Projekti teostamise faasis on projektijuhi põhiline eesmärk jälgida edusamme ja võimalusel anda meeskonnale juhiseid. Andmete visualiseerimis programmis Power Bi arendati projektijuhtimis moodul. Tänu sellele on võimalik tuvastada probleeme projekti varajases staadiumis. Varajases staadiumis identifitseeritud muudatusi on alati majanduslikult tasuvam ja lihtsam

implementeerida. Teises osas, teostamis-faasis, on tuvastatud edusammude edastamine kliendile. Ülevaatliku ja olulise progressi edastamiseks loodi standardiseeritud eduaruanne. Aruandel on kuvatud ka makstud arvete lahter, tagamaks kontrolli arve tasumise üle. Projektijuhi ülesanne on motiveerida klienti õigeaegselt tasuma, aidates vältida ettevõtte likviidsus kadusid.

Projekti sulgemis-faasis tehti ettepanek, et projekti kokkuvõte ja saadud õppetunnid peavad olema kogu organisatsiooni kohustuseks. Pärast igat verstaposti tuleks kokkuvõttesse teha sissekanne, hinnates igat projekti osa vahetult peale selle lõppu. Viimase ettepanekuna valiti projektijuhitimise tulemusnäitajateks tarnekindlus, tarnetäpsus ja kliendi rahulolu. Tuleviku arendamisvõimalused:

- Projekitjuhi koormusindeksi ja projekti elutsükli vaate ühendamine, hindamaks projektijuhi koormust ettevaatavalt;
- Projekti plaani ja eduaruande ühendamine üheks süsteemiks;
- Koosoleku protokolli ja projekti kokkuvõtte ERP süsteemi viimine;
- Projektijuhtimis tulemusnäitajate laialdane jälgimine ja Power Bi vaatesse arendamine;

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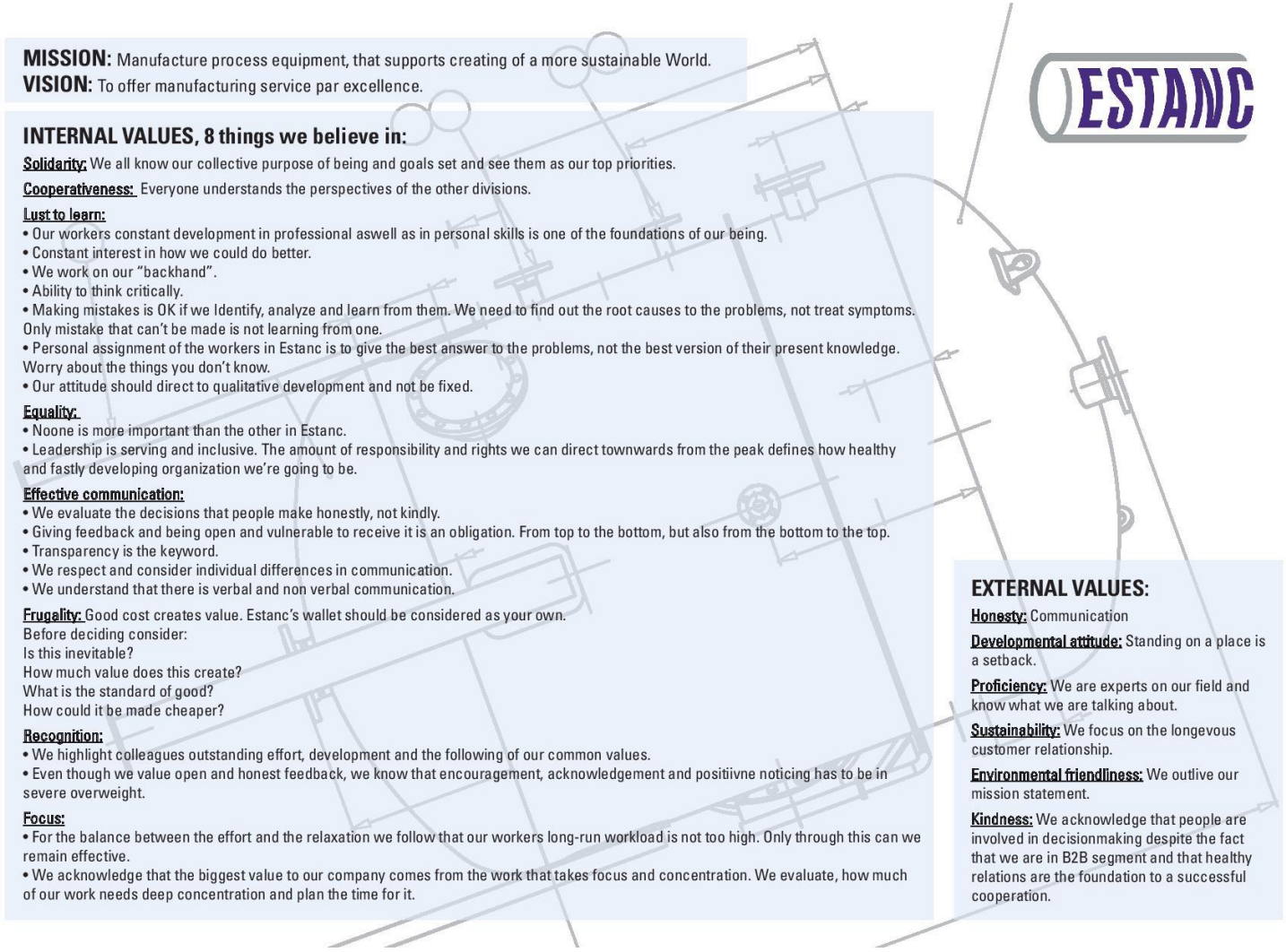
APPENDICES

Appendices 1 Estanc vison and mission



MISSION: Manufacture process equipment, that supports creating of a more sustainable World.
VISION: To offer manufacturing service par excellence.

ESTANC

INTERNAL VALUES, 8 things we believe in:

Solidarity: We all know our collective purpose of being and goals set and see them as our top priorities.

Cooperativeness: Everyone understands the perspectives of the other divisions.

Lust to learn:
- Our workers constant development in professional aswell as in personal skills is one of the foundations of our being.
- Constant interest in how we could do better.
- We work on our "backhand".
- Ability to think critically.
- Making mistakes is OK if we Identify, analyze and learn from them. We need to find out the root causes to the problems, not treat symptoms. Only mistake that can't be made is not learning from one.
- Personal assignment of the workers in Estanc is to give the best answer to the problems, not the best version of their present knowledge. Worry about the things you don't know.
- Our attitude should direct to qualitative development and not be fixed.

Equality:
- Noone is more important than the other in Estanc.
- Leadership is serving and inclusive. The amount of responsibility and rights we can direct townwards from the peak defines how healthy and fastly developing organization we're going to be.

Effective communication:
- We evaluate the decisions that people make honestly, not kindly.
- Giving feedback and being open and vulnerable to receive it is an obligation. From top to the bottom, but also from the bottom to the top.
- Transparency is the keyword.
- We respect and consider individual differences in communication.
- We understand that there is verbal and non verbal communication.

Frugality: Good cost creates value. Estanc's wallet should be considered as your own.
Before deciding consider:
Is this inevitable?
How much value does this create?
What is the standard of good?
How could it be made cheaper?

Recognition:
- We highlight colleagues outstanding effort, development and the following of our common values.
- Even though we value open and honest feedback, we know that encouragement, acknowledgement and positiivne noticing has to be in severe overweight.

Focus:
- For the balance between the effort and the relaxation we follow that our workers long-run workload is not too high. Only through this can we remain effective.
- We acknowledge that the biggest value to our company comes from the work that takes focus and concentration. We evaluate, how much of our work needs deep concentration and plan the time for it.

EXTERNAL VALUES:

Honesty: Communication

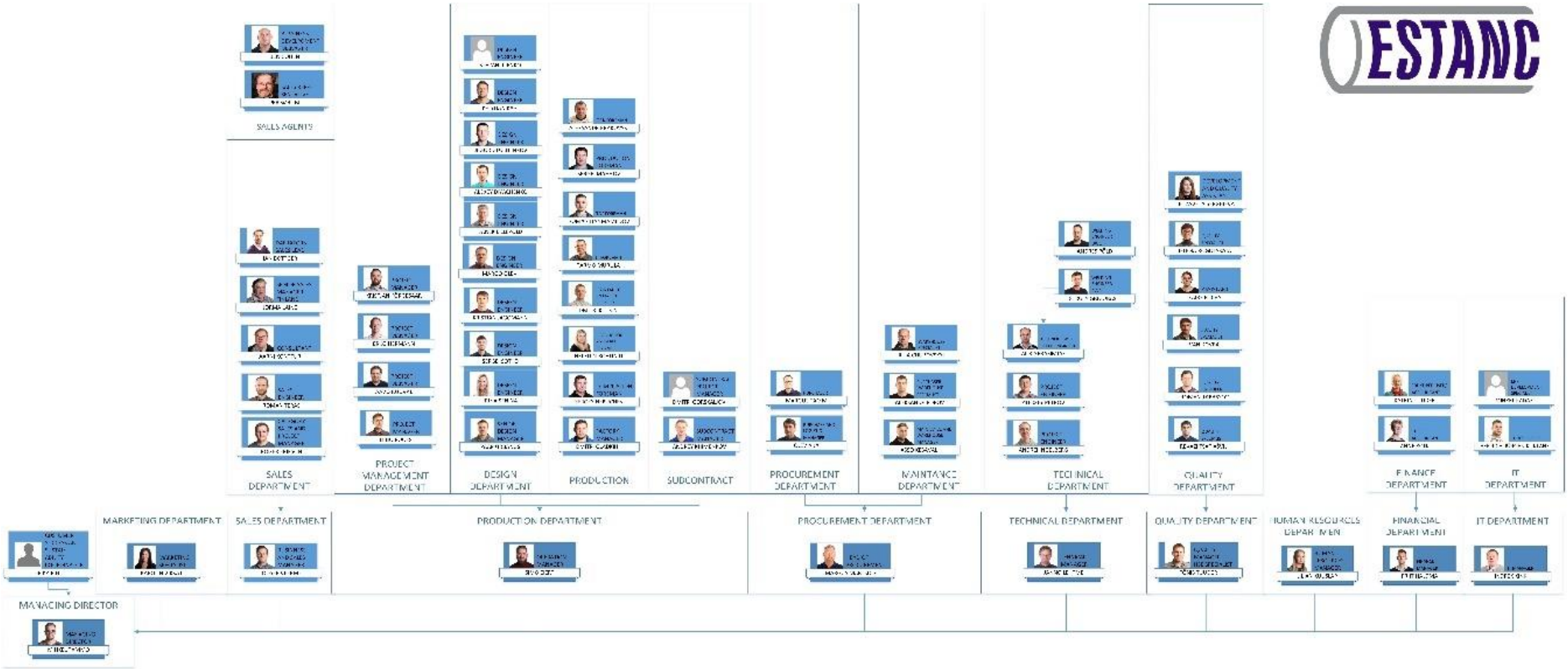
Developmental attitude: Standing on a place is a setback.

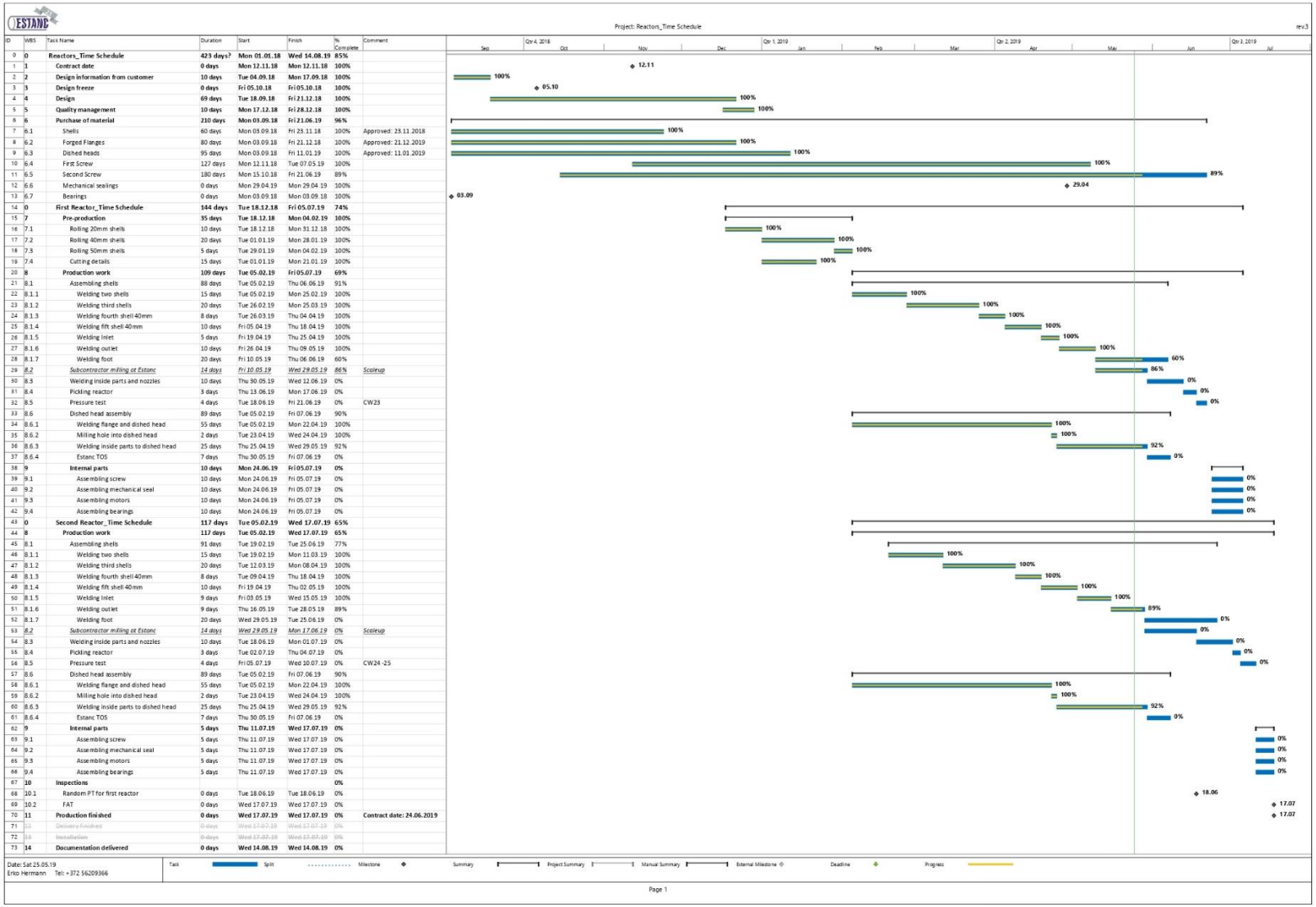
Proficiency: We are experts on our field and know what we are talking about.

Sustainability: We focus on the longevous customer relationship.

Environmental friendliness: We outlive our mission statement.

Kindness: We acknowledge that people are involved in decisionmaking despite the fact that we are in B2B segment and that healthy relations are the foundation to a successful cooperation.


SALES AGENTS
SALES DEPARTMENT
PROJECT MANAGEMENT DEPARTMENT
DESIGN DEPARTMENT
PRODUCTION
SUBCONTRACT
PROCUREMENT DEPARTMENT
MAINTANCE DEPARTMENT
TECHNICAL DEPARTMENT
QUALITY DEPARTMENT
FINANCE DEPARTMENT
IT DEPARTMENT
MARKETING DEPARTMENT
SALES DEPARTMENT
PRODUCTION DEPARTMENT
PROCUREMENT DEPARTMENT
TECHNICAL DEPARTMENT
QUALITY DEPARTMENT
HUMAN RESOURCES DEPARTMENT
FINANCIAL DEPARTMENT
IT DEPARTMENT
MANAGING DIRECTOR



Project: Reactors_Time Schedule

rev.3

ID	WBS	Task Name	Duration	Start	Finish	% Complete	Comment
0	0	**Reactors_Time Schedule**	**423 days?**	**Mon 01.01.18**	**Wed 14.08.19**	**85%**	
1	1	**Contract date**	**0 days**	**Mon 12.11.18**	**Mon 12.11.18**	**100%**	
2	2	**Design information from customer**	**10 days**	**Tue 04.09.18**	**Mon 17.09.18**	**100%**	
3	3	**Design freeze**	**0 days**	**Fri 05.10.18**	**Fri 05.10.18**	**100%**	
4	4	**Design**	**69 days**	**Tue 18.09.18**	**Fri 21.12.18**	**100%**	
5	5	**Quality management**	**10 days**	**Mon 17.12.18**	**Fri 28.12.18**	**100%**	
6	6	**Purchase of material**	**210 days**	**Mon 03.09.18**	**Fri 21.06.19**	**96%**	
7	6.1	Shells	60 days	Mon 03.09.18	Fri 23.11.18	100%	Approved: 23.11.2018
8	6.2	Forged Flanges	80 days	Mon 03.09.18	Fri 21.12.18	100%	Approved: 21.12.2019
9	6.3	Dished heads	95 days	Mon 03.09.18	Fri 11.01.19	100%	Approved: 11.01.2019
10	6.4	First Screw	127 days	Mon 12.11.18	Tue 07.05.19	100%	
11	6.5	Second Screw	180 days	Mon 15.10.18	Fri 21.06.19	89%	
12	6.6	Mechanical sealings	0 days	Mon 29.04.19	Mon 29.04.19	100%	
13	6.7	Bearings	0 days	Mon 03.09.18	Mon 03.09.18	100%	
14	0	**First Reactor_Time Schedule**	**144 days**	**Tue 18.12.18**	**Fri 05.07.19**	**74%**	
15	7	**Pre-production**	**35 days**	**Tue 18.12.18**	**Mon 04.02.19**	**100%**	
16	7.1	Rolling 20mm shells	10 days	Tue 18.12.18	Mon 31.12.18	100%	
17	7.2	Rolling 40mm shells	20 days	Tue 01.01.19	Mon 28.01.19	100%	
18	7.3	Rolling 50mm shells	5 days	Tue 29.01.19	Mon 04.02.19	100%	
19	7.4	Cutting details	15 days	Tue 01.01.19	Mon 21.01.19	100%	
20	8	**Production work**	**109 days**	**Tue 05.02.19**	**Fri 05.07.19**	**69%**	
21	8.1	Assembling shells	88 days	Tue 05.02.19	Thu 06.06.19	91%	
22	8.1.1	Welding two shells	15 days	Tue 05.02.19	Mon 25.02.19	100%	
23	8.1.2	Welding third shells	20 days	Tue 26.02.19	Mon 25.03.19	100%	
24	8.1.3	Welding fourth shell 40mm	8 days	Tue 26.03.19	Thu 04.04.19	100%	
25	8.1.4	Welding fift shell 40mm	10 days	Fri 05.04.19	Thu 18.04.19	100%	
26	8.1.5	Welding Inlet	5 days	Fri 19.04.19	Thu 25.04.19	100%	
27	8.1.6	Welding outlet	10 days	Fri 26.04.19	Thu 09.05.19	100%	
28	8.1.7	Welding foot	20 days	Fri 10.05.19	Thu 06.06.19	60%	
29	*8.2*	*Subcontractor milling at Estonc*	*14 days*	*Fri 10.05.19*	*Wed 29.05.19*	*86%*	*Scaleup*
30	8.3	Welding inside parts and nozzles	10 days	Thu 30.05.19	Wed 12.06.19	0%	
31	8.4	Pickling reactor	3 days	Thu 13.06.19	Mon 17.06.19	0%	
32	8.5	Pressure test	4 days	Tue 18.06.19	Fri 21.06.19	0%	CW23
33	8.6	Dished head assembly	89 days	Tue 05.02.19	Fri 07.06.19	90%	
34	8.6.1	Welding flange and dished head	55 days	Tue 05.02.19	Mon 22.04.19	100%	
35	8.6.2	Milling hole into dished head	2 days	Tue 23.04.19	Wed 24.04.19	100%	
36	8.6.3	Welding inside parts to dished head	25 days	Thu 25.04.19	Wed 29.05.19	92%	
37	8.6.4	Estanc TOS	7 days	Thu 30.05.19	Fri 07.06.19	0%	
38	9	**Internal parts**	**10 days**	**Mon 24.06.19**	**Fri 05.07.19**	**0%**	
39	9.1	Assembling screw	10 days	Mon 24.06.19	Fri 05.07.19	0%	
40	9.2	Assembling mechanical seal	10 days	Mon 24.06.19	Fri 05.07.19	0%	
41	9.3	Assembling motors	10 days	Mon 24.06.19	Fri 05.07.19	0%	
42	9.4	Assembling bearings	10 days	Mon 24.06.19	Fri 05.07.19	0%	
43	0	**Second Reactor_Time Schedule**	**117 days**	**Tue 05.02.19**	**Wed 17.07.19**	**65%**	
44	8	**Production work**	**117 days**	**Tue 05.02.19**	**Wed 17.07.19**	**65%**	
45	8.1	Assembling shells	91 days	Tue 19.02.19	Tue 25.06.19	77%	
46	8.1.1	Welding two shells	15 days	Tue 19.02.19	Mon 11.03.19	100%	
47	8.1.2	Welding third shells	20 days	Tue 12.03.19	Mon 08.04.19	100%	
48	8.1.3	Welding fourth shell 40mm	8 days	Tue 09.04.19	Thu 18.04.19	100%	
49	8.1.4	Welding fift shell 40mm	10 days	Fri 19.04.19	Thu 02.05.19	100%	
50	8.1.5	Welding Inlet	9 days	Fri 03.05.19	Wed 15.05.19	100%	
51	8.1.6	Welding outlet	9 days	Thu 16.05.19	Tue 28.05.19	89%	
52	8.1.7	Welding foot	20 days	Wed 29.05.19	Tue 25.06.19	0%	
53	*8.2*	*Subcontractor milling at Estonc*	*14 days*	*Wed 29.05.19*	*Mon 17.06.19*	*0%*	*Scaleup*
54	8.3	Welding inside parts and nozzles	10 days	Tue 18.06.19	Mon 01.07.19	0%	
55	8.4	Pickling reactor	3 days	Tue 02.07.19	Thu 04.07.19	0%	
56	8.5	Pressure test	4 days	Fri 05.07.19	Wed 10.07.19	0%	CW24 -25
57	8.6	Dished head assembly	89 days	Tue 05.02.19	Fri 07.06.19	90%	
58	8.6.1	Welding flange and dished head	55 days	Tue 05.02.19	Mon 22.04.19	100%	
59	8.6.2	Milling hole into dished head	2 days	Tue 23.04.19	Wed 24.04.19	100%	
60	8.6.3	Welding inside parts to dished head	25 days	Thu 25.04.19	Wed 29.05.19	92%	
61	8.6.4	Estanc TOS	7 days	Thu 30.05.19	Fri 07.06.19	0%	
62	9	**Internal parts**	**5 days**	**Thu 11.07.19**	**Wed 17.07.19**	**0%**	
63	9.1	Assembling screw	5 days	Thu 11.07.19	Wed 17.07.19	0%	
64	9.2	Assembling mechanical seal	5 days	Thu 11.07.19	Wed 17.07.19	0%	
65	9.3	Assembling motors	5 days	Thu 11.07.19	Wed 17.07.19	0%	
66	9.4	Assembling bearings	5 days	Thu 11.07.19	Wed 17.07.19	0%	
67	10	**Inspections**				**0%**	
68	10.1	Random PT for first reactor	0 days	Tue 18.06.19	Tue 18.06.19	0%	
69	10.2	FAT	0 days	Wed 17.07.19	Wed 17.07.19	0%	
70	11	**Production finished**	**0 days**	**Wed 17.07.19**	**Wed 17.07.19**	**0%**	**Contract date: 24.06.2019**
71	12	Delivery finished	0 days	Wed 17.07.19	Wed 17.07.19	0%	
72	13	Installation	0 days	Wed 17.07.19	Wed 17.07.19	0%	
73	14	**Documentation delivered**	**0 days**	**Wed 14.08.19**	**Wed 14.08.19**	**0%**	

Date: Sat 25.05.19
Erko Hermann Tel: +372 56209366

Task Split Milestone Summary Project Summary Manual Summary External Milestone Deadline Progress

Page 1

PROGRESS REPORT

PROJECT NAME
PO:

Manufacturer:	Customer:
Estanc AS Põrguvälja tee 5a Pildiküla 75308 Rae vald Harjumaa, Estonia	

Project reference:	Project reference:
W18	

From:	To:
Erko Hermann Erko.Hermann@estanc.ee +372 53465731	

Progress report version: 0

Date: 08.05.2018

Equipment name	Design Freeze	Production start	Final Inspection	Delivery date
Equipment 1				
Equipment 2				

1

GENERAL PROJECT UPDATES

Design

Na

Quality

Na

Material purchase

Na

Production

Na

PROJECT SCHEDULE

Updated progress schedule attached in e-mail.

RISKS

NA

STATUS OF ADDITIONAL WORK

Pos.	Date	Change	Initiator	Total cost	Date Accepted
1					

MILESTONE PAYMENTS

%	Description	Invoice date	Due date	Received
40%	Main materials inhouse			
50%	After delivery			
10%	After final documents			

PHOTOS OF PROGRESS

	Photo 1 –