

Bachelor's thesis

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CREATING INTRODUCTION MATERIAL FOR PRE- FABRICATION

– Meyer Turku Oy



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The objective of this thesis is to describe a new pretreatment process and operation of related equipment and control systems. The aim of the research was to create a clear process description for a company's new pretreatment line. The company will utilize the results of the research in the introduction of a new production line. In addition to that, the second aim was to prepare documentation of the daily maintenance activities in the form of all maintenance activities and to provide a clear listing of all maintenance required on the production line for the line operator.

The thesis consists of three parts. Firstly, a clear process description was created for the new production line according to the company's wishes. Secondly, a list of maintenance requirements was written for maintenance planning. Thirdly, work instructions were created for production line operators.

The thesis consists of a theory and practical parts. The theory section consists of the ship hull construction process, the metal pre-treatment process and the orientation process. In the practical part, there is also some theory about process description, maintenance planning and work instructions. The practical part was based on the materials sent by the supplier and on the author's observations. The information collected on the pre-treatment process due to the delimitation and purpose of the topic was general and did not go into more detailed technical information.

The result of the thesis was an updated maintenance plan, process description and orientation material for the new pretreatment line, which company can use in orientation and in the development of working methods.

KEYWORDS:

maintenance plan, new production line, orientation, pretreatment, process description, work instructions

Joonas Mäki

PEREHDYTYSMATERIAALIN LUONTI OSAVALMISTUKSEEN

– Meyer Turku Oy

Tässä opinnäytetyössä kuvataan uuden esikäsittelylinjan prosessia ja siihen liittyen laitteiden ja ohjausjärjestelmien toimintaa. Tutkimuksen tavoitteena oli luoda käyttöönoton tueksi selkeä prosessikuvaus linjan toiminnasta toimeksiantajalle, joka voisi hyödyntää tutkimuksen tulosta tuotantolinjan käyttöönotossa. Tämän lisäksi toisena tavoitteena oli laatia päivittäisistä tuotannon ylläpitävistä toimista työnohjeen muodossa dokumentaatio ja huoltojen suunnittelun tueksi oli tarkoitus luoda selkeä listaus kaikista tuotantolinjalla vaadittavista huoltotoimista linjan operaattorille.

Opinnäytetyö jäsenneltiin kolmeen osaan siten, että ensimmäisessä osiossa luotiin selkeä prosessikuvaus tuotantolinjasta toimeksiantajan toiveiden mukaan. Toisessa osassa kirjoitettiin huoltolistaus huoltojen suunnittelun tueksi ja kolmannessa vaiheessa luotiin työohjeita eri työtehtävistä.

Opinnäytetyö kostuu tietopohjasta ja käytännön osasta. Teoria osuuksissa käydään läpi laivan rungon rakennus prosessia, metallin esikäsittely prosessia sekä perehdytys prosessia. Työn käytännön osissa käydään myös hieman teoriaa prosessin kuvaamisesta, huoltojen suunnittelusta ja työohjeiden rakentamisesta. Käytännön työ rakennettiin tuotantolinjan toimittajan lähettämien materiaalien sekä omien havaintojen perusteella. Aiheen rajauksen ja käyttötarkoituksen vuoksi kerätyt tiedot esikäsittelyprosessista kuvattiin yleisellä tasolla eikä aiheessa menty syvällisempiin teknisiin tietoihin.

Opinnäytetyön lopputuloksena päästiin tavoitteeseen ja luotiin päivitetty huoltosuunnitelma, prosessikuvaus sekä perehdytyskansio uudelle esikäsittelylinjalle, jota toimeksiantaja pystyy käyttämään perehdytyksessä sekä työmenetelmien kehityksessä

ASIASANAT:

huoltosuunnitelma, uusi tuotantolinja, perehdyttäminen, esikäsittely, prosessikuvaus, työohje

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1 INTRODUCTION

The subject of this thesis is to develop new employee orientation material and work instructions at Meyer Turku Oy. The work will be carried out in cooperation with Meyer Turku Oy's production workers, development engineers and management. The thesis subject was found when the author was doing an internship in the company. The results of research will serve as a tool for all mentors and will help new and old employees in their daily work.

Foremen and production workers who are working in pre-treatment area will participate in orientation. Orientations have been conducted orally, and things to be taught have not been documented yet. The new production line did not have yet clear process description nor did it have a maintenance plan. The purpose of the thesis is to create a clear and easy-to-use database of information for orientation, so that new employees are already aware of the work to be done before starting the job.

This thesis is part of an introduction of a new production line. The pre-treatment line is part of Meyer Turku prefabrication department. More and more companies are experiencing difficulties with the introduction of new machines or processes and the benefits of these are stretching far into the future with poor deployment. The purpose of this thesis is to create a tool that can be used to introduce a production line and a new employee orientation.

Process descriptions are a tool for processing leading management and improvement. Process descriptions help entities, structure processes and responsibilities of operators, and operational efficiency needs. Process descriptions as well as work instructions enable stable and standardized work.

Work will begin by studying and monitoring the production process daily, interviewing production workers and supervisors and reading manuals related to the production line. With that information, there will be enough information about the a production line

The theoretical part of the thesis discusses shipbuilding, maintenance planning and work instructions.

Meyer Turku Oy

Meyer Turku Oy employees 2000 people and specializes in building highly complex, innovative and environmentally friendly cruise ships, car-passenger ferries and special vessels. Together with two other Meyer owned shipyards in Germany, Meyer Werft in Papenburg and Neptun Werft in Rostock, Meyer Turku is one of the world's leading cruise ship builders. The successful shipbuilding tradition in Turku has been continuing since 1737. The company is currently building cruise ships for Costa Crociere and Carnival Cruise Lines. The order book also includes cruise ships for Royal Caribbean International and TUI Cruises. (Meyer Turku Oy 2019)

The total area of the Turku shipyard is 144 hectares, of which 14,5 hectares are built. The production capacity at the shipyard is about 45 000 tons/year. The strengths of the Turku shipyard include advanced production facilities and seamless cooperation with a very extensive network of subcontractors. (Meyer Turku Oy 2019)

Meyer Turku is constantly developing production processes that utilize the Lean production model. In Lean production, human is at the center of the action, and continuous improvement, quality checks and timelines are pillars of its operation. These measures help to achieve an established level of production, stabilize and standardize processes, and create a visually controlled production management system. (Meyer Turku Oy 2019)

2 STEEL MATERIAL PROCESSING IN THE SHIP PRODUCTION PROCESS

Ship building can be divided into two areas: hull construction and outfitting. Block building is now a way to construct a ship's hull. In the construction, the hull of the ship is built by combining standard blocks built in factory lines into a single hull. The size, shape and structure of the blocks vary according to the size and shape of the vessel. The completed blocks are assembled into one hull with other blocks in a hull building area. The steel material used to construct the hull is pre-treated prior to the start of production. The purpose of the pre-treatment is to protect the material from corrosion during the construction process. (Aalto University 2015)

The pre-treatment process stages are pre-cleaning, rust removal and anticorrosive protection. (Teräsrakenneyhdistys 2019)

2.1 Pre-cleaning

Pre-cleaning removes rust and other impurities from the surface of material with various dirt and grease removal methods. (Teräsrakenneyhdistys 2019)

The choice of the washing methods and the materials used are influenced by many factors, such as the quality and quantity of production, the quality and quantity of impurities and the next surface treatment step. Water soluble compounds such as salts and acid residues can be removed from the surface with water. Washing performance can be improved by raising the temperature or by mechanical action. The mechanical effect is achieved, for example, by brushing, blending or using a high-pressure water jet. Under high pressure washing, the water can be completely liquid or some of it may be in the form of steam, which is referred to as steam cleaning. (Teräsrakenneyhdistys 2019)

2.2 Rust Removal Methods

In rust removal, the steel and cast-iron surfaces are cleaned of rust, rolls, old paint layers and other solid impurities that remain after pre-cleaning. Mill scale is a fragile layer on the surface of the steel after hot rolling, which, due to different thermal expansion and poor

bonding, gradually releases and is therefore a poor painting base. The choice of rust removal methods is influenced by the thickness of the steel to be cleaned, the size of the material, the cleaning conditions, the quality of the rust to be removed, the degree of cleaning required for selected paint type and surface profile. Usually, the rust removal methods and levels are determined in the project specification, the specification of the protective paint combination, the painting report and/ or the painting system identifier. Rust removal methods include mechanical steel brushing and blasting, thermal methods and chemical methods. (Teräsrakenneyhdistys 2019)

Spray blasting is commonly used for removal of the rust in steel and cast iron, which is the most effective method for rolling and rust removal. Blast cleaning, denoted by "sa" refers to mechanical surface cleaning, where impurities are removed by blasting media. Spray blasting, vacuum blasting, water jet (wet blasting) or shot blasting equipment are used for blast cleaning. (Teräsrakenneyhdistys 2019)

2.3 Anticorrosive protection

The paint can be a liquid or powdery product which is applied to a material as a thin layer by different painting methods. The layer dries into a solid, adhesive paint film. Painting of the metal substrate is called corrosion protection painting. The purpose of anti-corrosion painting is to protect the metal substrate from the corrosive effect of the environment also called corrosion and to give the substrate the desired appearance. (Korroosionestomaalauksen käsikirja 2013)

Paint application has big importance for the durability of the painting. The paint can be applied using different painting methods on the surface to be painted. Painting, brushing, roller, dew painting, casting and roll painting are common painting methods. (Korroosionestomaalauksen käsikirja 2013)

The temperature may affect the drying of the paint and the formation of the film. Drying of chemically drying and air-drying paints is significantly accelerated as the temperature rises. (Korroosionestomaalauksen käsikirja 2013)

Pre-treatment methods used by Meyer Turku Oy

A new pre-treatment line was completed in 2017 for Meyer Turku, which was ordered from Rösler Oberflächentechnik GmbH. The pre-treatment line is 225 meters long and can handle 10-centimeter-thick, 3.3 meters wide and 24 meters long steel sheets. (Eurometalli 2018)

Before the steel sheets are part of a ship, they pass through the pre-treatment line, where machines remove debris from rolling and corrosion during storage. In the first stage of the line, snow and ice are removed with pressure washers and preheating equipment. In the second stage, blasting machines remove rust and other impurities from the surface of the plate. In third stage of the line, plates are painted with a 2-component paint that prevents the plate from rusting. After painting, the plate goes through the dryer. (Eurometalli 2018)

Rösler Group is a global company specializing in surface treatment who provides its customers various surface treatment equipment and production units. The company offers the entire process from designing machinery or production lines to yearly maintenance and technical support throughout its lifetime. (Rösler Group 2019)

3 NEW EMPLOYEE ORIENTATION

Orientations are a variety of practices aimed at ensuring that a new and old employees learn to control their work and adapt to a work community. Employees need to adopt many new skills and common ways of working to perform well-assigned tasks. They also need to learn to work effectively with others in the organization. (Eklund 2018, 25–26.)

Orientation is about learning new things and applying that information. In addition to the person being educated, the organization receives the new information, modify existing practices and adapt to the change brought by the new employee in the organization. Functional orientations support interaction between the organization and the new employee and gives the opportunity to ask questions and receive answers. New methods of working are never instantaneous, but require a lot of time, repetition and follow-up. This will require that enough resources are devoted to orientation. Different parties in the orientation must get to know each other enough to understand each other and work together effectively. (Eklund 2018, 25–26.)

3.1 Productivity and efficiency

Recruiting a new employee is always a major investment for the company. The purpose of the orientation is to ensure the success of this investment and its long-term profitability. However, organizing a good orientation requires a lot of resources from the company. In order for them to be ready to offer resources, the organization is required to understand what they want and can achieve with this investment. (Eklund 2018, 31–32.)

Hiring a new employee always causes an organization to change, and may have an effect much wider than what is anticipated. Any change, in this case arrival of a new person into the organization, requires adaption and reorganization. The change causes a momentary disruption to an organization's operation efficiency (Figure 1.). Usually this disruption is seen as a momentary dip in efficiency of the organization compared to the present. However, efficiency gradually starts to rise. Professionally and carefully designed and implemented orientation makes it possible to minimize the slump caused by change in efficiency and time. (Eklund 2018, 32.)

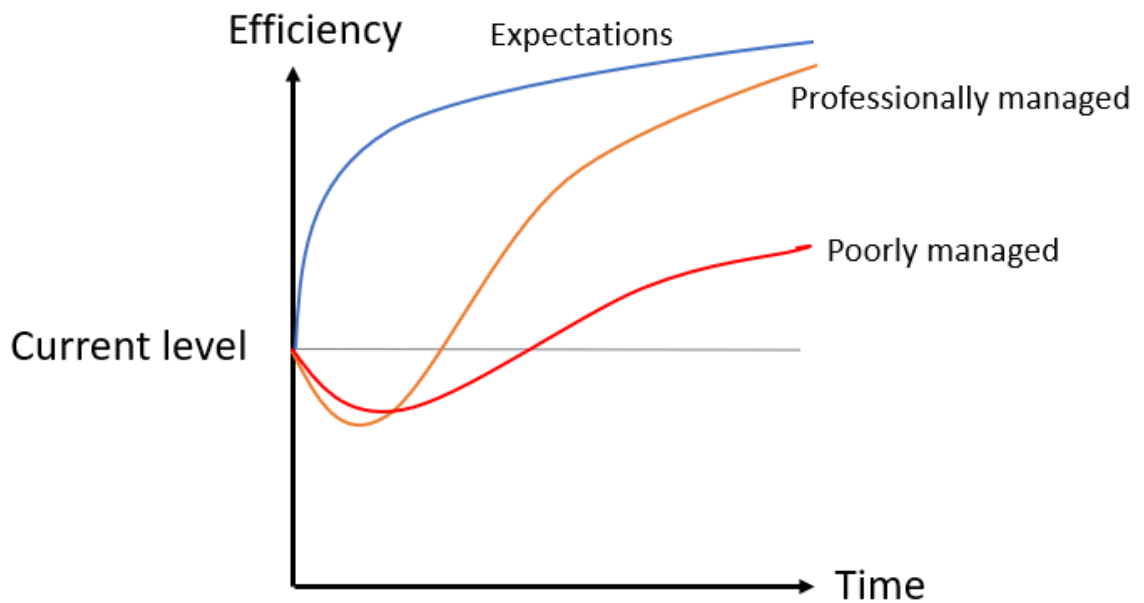


Figure 1 Effect of change on organizational efficiency (Eklund 2018, 32.)

Expectations for a new employee are often high. It is expected that the new person will add value to the organization immediately, as shown in the above figure in the Expectations-curve. In the early stages of orientation, there are big expectations, but rarely are they met. A new employee may not be able to work independently and generate value for a company. This can cause a large negative reaction in an organization if the organization is not prepared for it. When an organization understands the challenges of change and plans orientation professionally, expectations will be closer to reality. (Eklund 2018, 33.)

In the extreme case, the new employee will not get caught up in his/her work and will not become part of the work community. In the worst case, the employee himself resigns because employee does not feel capable to do his job and the employee do not enjoy working. The cost of a failed investment is very high. (Eklund 2018, 33.)

3.2 Monitoring and responding to the orientation process

The organization should always monitor how the orientation proceeds and ensure that it proceeds in the right direction. The purpose of the monitoring is to ensure the continuous development of the new employee and progress towards the agreed goals. Without continuous and active monitoring, it is not possible to keep up with the progression of

the process. The aim of the monitoring is to get information for the mentor on what kind of support the new employee needs at the moment. Some things may seem to be the most difficult for others and it is almost impossible to know in advance. By following the progress of the process, the mentor will find out about the situation and will be able to react quickly. (Eklund 2018, 119.)

3.3 Work instructions in orientation

Orientation and work instructions are required regardless of the size of the workplace or industry. Systematic orientation and work guidance should include all staff groups, without forgetting supervisors and temporary workers. (Ahokas & Mäkeläinen 2013)

Orientations and work guidance facilitate and accelerate work and are an important part of staff development. It is an ongoing process that is being developed to meet the needs of staff and workplace. (Ahokas & Mäkeläinen 2013)

Work guidance is always required when

- The work is new for an employee
- Works tasks change
- Work methods change
- Procuring and introducing new machines, equipment or materials
- Work rarely occurs
- Failure to follow safety instructions
- Occupational accident at work or occupational disease
- Deficiencies in job guidance given
- The situation differs from normal
- Errors in performance and shortcomings in the quality of product and services(Ahokas & Mäkeläinen 2013).

Work guidance's are an important part of proactive occupational safety and therefore the guidance plan should be based on the information obtained from the work hazards. Hazards and incidents detected in the work or work environment must be eliminated or hazards reduced even before work begins. (Ahokas & Mäkeläinen 2013)

Written instructions must be prepared for various disturbances and for cleaning and maintenance work, which may be used for guidance. It is a good idea to use illustrative photos when guiding rare situations. (Ahokas & Mäkeläinen 2013)

The company often has ready-made support material guidance. These are: (Ahokas & Mäkeläinen 2013)

- Manuals
- Diagrams and floor plan
- Safety instructions
- Tutorial instructions
- Operating instructions
- Reports
- Process description
- Brochures and product descriptions
- Risk assessments
- Photos and videos (Ahokas & Mäkeläinen 2013).

A written plan to monitor the progress of guidance should always be provided to support orientation and guidance. The plan saves time for the guidance itself and at the same time serves as a memory support. (Ahokas & Mäkeläinen 2013)

4 IMPLEMENTATION OF THE RESEARCH

At the beginning of the thesis, Meyer Turku Oy's Head of the pre-fabrication department and Technical Officer in the pre-treatment area expressed their wishes for a new production line. The given guidelines for the thesis were to describe process description, work guidance and list maintenance activities. The purpose of the thesis was to combine existing documentation, manuals and observations of employees working in the area into a single easy-to-use database. Orientation in Meyer Turku has been carried out by production workers and foremen, but the topics to be familiarized with were done only orally. Mentors should follow the progress of employee orientation and make quick tests to see how successful the orientation has been received.

One of the target areas of development for the target company was to improve new production line documentation, which led to the creation of clear operating instructions and a maintenance plan for this area. The maintenance plan will categorize machines and time frames. Daily activities will be documented and guided as work instructions. The thesis will be part of a project, which the company is increasing the transparency of the process. Process transparency means that the process is clearly documented and there are clear documents on how the process progresses in that area. This thesis is part of the project whose intention is to increase the transparency on the new pretreatment line. It was suggested from the company that in the work instructions, there should be more pictures and less text. Work instructions will be in that way easier read and understand.

4.1 Describing the process

The first part of the thesis was to create a clear process description for the company's new pre-treatment line, what was introduced in 2018. The process description will serve as orientation material for new employees. The process description for the new line had not yet been made, so the completion of the thesis was an important step for the future. The process description is intended to combine the wishes of the company and theory of literature.

In this section, there will be some theoretical process description and then a report about how the author combined that with company's wishes.

The process descriptions will help people understand how the organization works. The process description is a tool for management, developers, service managers and information and document management. They can also be used in changing management when organizations are combined or when a company wants to change old ways to new ones. Managers make use of process description to clarify the division of responsibilities, to identify resource needs, problematic situations and overlaps and familiarize new employees with orientation and job guidance. Process descriptions help in the development of work phases, measuring results, mapping security risks and evaluating quality. In process descriptions, it is important to describe the process in one way, as collaboration often goes beyond organizational and industry boundaries. The process description method is important to be consistent in all processes within and outside the organization. All process descriptions should be similar in company so it's easier to understand different process description through the company which makes it time efficient. (Prosessien kuvaaminen 2012, 3.)

When describing the process, the starting point is to state why the process is being described. Process descriptions must be appropriate and must bring benefits. Process mapping starts with identifying processes and selecting the process to be described. After that, it is good to decide purpose of the process and the level of description and base information for process. At this stage, the layout and base of description are also prepared. The progress of process mapping is illustrated in a straight forward manner and simplified in Chart 1

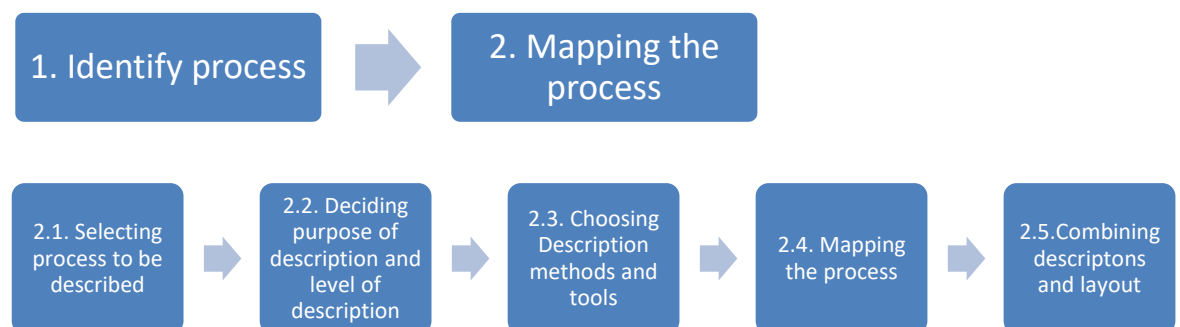


Chart 1 Process of process description (Julkisen hallinnon tietohallinnon neuvottelukunta, Prosessien kuvaaminen 2012, 4.)

Implementation of the pre-treatment process for Meyer Turku

In the process description phase, the emphasis was on the visual appearance and it should have more pictures and less text. Company wanted process description in the company's own Microsoft PowerPoint templates, which limited the work frames. The company did not give other requirements to the process description, so this part is based on the author's vision.

The process description will be part of introduction of new production line, as well as the experience of creating a clear new kind of process description inside the company.

Research started by interviewing production workers and continued by reading machine manuals. The author worked daily around production to get enough information about the process.

After a few days, the proposal will be that all the machines on the production line would be named in the process description and that each machine would have small description and that the manufacturer would have been mentioned. The company also wanted to have a clear layout in process description, so a new version of it was created, where every machine has a picture of it.

These interviews and being on the production premises gave a clear picture of the process. Daily discussions with production workers around the production line provided valuable information about the line and its operations.

Process description I presented in section 5.1.

4.2 Maintenance plan

The second part of the thesis consists of compiling a maintenance plan as a tool for the process operators. In this section, the author will write shortly about the theory of planning maintenance activities and then discuss how the theory has been implemented into the maintenance plan.

However, when talking about maintenance in industry, we usually talk about preventative maintenance. Maintenance is one of the scheduled maintenance procedures that includes inspecting, adjusting, cleaning, changing the oil, changing the filter, greasing

and other similar activities. Maintenance is carried out with scheduled cycles, for example, according to calendar time, hours of operation or production volume. (Laine 2010, 123.)

Very often, machine maintenance programs are based on the machine manufacturer's recommendations, which are modified based on the factory's own user experience. The maintenance programs found in the equipment manufacturer's manuals are often engineers' best guesses and the equipment manufacturers do not have the necessary practical experience. (Laine 2010, 124.)

Over time, maintenance programs are built into one large entity, based on experience and equipment manufacturers' recommendation. (Laine 2010, 125.)

It is a good idea to proceed in the following order when designing the maintenance program and allocating the maintenance activities: (Laine 2010, 130-131.)

- 1) Selecting machines for maintenance plan
- 2) Evaluation of the device faults
- 3) Choosing maintenance measures
 - a) Inspections
 - b) Scheduled maintenance
 - c) Cleansing
- 4) Assessing reliability
- 5) Scheduling maintenance operations
 - a) Frequency of measures
- 6) Creating instructions for maintenance activities
- 7) Documentation
- 8) Final evaluation

This list aims to be a reliable maintenance program. (Laine 2010, 131.)

The purpose of maintenance is to maintain the performance of the desired item or restore the impaired performance of the object before failure occurs. Scheduled maintenance is performed at regular intervals and the intervals are determined by usage and burden on the machine. Scheduled maintenance operations may include lubrication, cleaning and restoring functionality. The boundary between maintenance and preventative maintenance is blurred, so the measures that appear in them overlap. (Järviö 2004, 39–40.)

Maintenance planning of pre-treatment line operations

The maintenance plan was started with identification of serviceable machines and equipment. With development engineers and supervisors, we went through the machines and equipment that need maintenance. There were two thesis writers, so the maintenance plan had to be divided into two parts. In this thesis, the second task was to create a maintenance plan for production lines operators. The plan was to create a clear list about maintenance activities and guidance for daily and weekly activities. Guidance will be in section 4.3.

During the research, it was discovered that almost every machine had maintenance every month. The list of machines in the maintenance plan was immediately mapped after few days of working around the production line. Then, the author created an excel file from the sketches that were made in the production line.

After compiling the list of machines, maintenance cards were made into excel in daily, weekly, monthly and 3-month periods. The maintenance activities were first collected from the manuals what came with the machines. The findings from the manuals were compared with activities currently performed. The manuals clearly showed how often the machines should have maintenance breaks and measures necessity to do maintenance. Some of the machines did not have maintenance activities listed in their manuals. In those cases, only those activities what had occurred with that particular machine were listed. List of machines and situation were discussed with development engineers and supervisors. The conclusion was that the author will continue with that list.

After the listing, the writer started to think and outline what else there should be in maintenance plan. The company's wish was to find out who performed operation itself and who was the inspector.

The following columns were made in the maintenance plan:

- For whom
- Who performed the maintenance operation?
- inspector
- Date
- Machine
- Maintenance object

- Use time

In addition to the above, scheduling was also added into the maintenance plan so operators know when they need to perform each operation. Use time sections were also added to the maintenance plan, so it will be easier to schedule maintenance breaks. This will allow planned maintenance to fit into the production plan. At the time of the thesis, the durations of maintenance tasks were not gathered.

4.3 Creating work instructions

The third stage of the thesis was to provide guidance for daily and weekly maintenance activities and guidance for control panels.

In this chapter, discusses shortly theory about work instructions and how that information is implemented to the work.

The employer must adequately familiarize his/her employees with the use of machinery and safety regulations at work. (Hietala & Kaivanto & Valvisto, 2013, 168)

When starting to do work instructions, the goal is usually one these: (Guitar 2005)

- For training
- As a source of information
- Problem solving
- For development

All of these tasks are important to the company. Work instructions are used as a tool for training new employees. Work instructions also help to speed up the solutions for potential fault situations, thus minimizing production breaks. Work instructions can help in development, speeding up work and improving work. (Guitar 2005)

The content of a good work guide should be clear, logically progressive and similar in form to the other instructions are in the company. A working instruction is part of quality management and monitoring. Work instructions should be developed as the activity develops, in which case the work instructions serve as a toll for the developer as well. (Guitar 2005, Hidget 2008.)

Effects of good working instructions on the employee can be easily detected; motivated employees, good product quality and therefore satisfied customers. When employees understand and know their work, they are more motivated and try to reach their goals in terms of the quality and production levels. (Hidget 2008.)

People also deal with information differently. Some of people can better understand the text where as others need pictures to illustrate the text. However, the common advantage of the working guidelines is that they are relevant. Not so important and other irrelevant content can make the instructions confusing, so it is challenging for the reader to perceive the real picture of the matter. The superiority of the written instructions compared to the oral instructions is its immutability and the attainment of the workers. The weakness of the oral instructions is that they reach out only those who are present and listening. Oral instructions also change a lot, because fewer people speak the same way every time, and there is no trace of the word that could be repeated. There is no perfect basis for the work instructions, but they change and evolve through experience and time. Handwritten and sticky notes are a good help when writing work instructions. (Hidget 2006; Hidget 2008.)

The research began by reading the manuals for machines, which helped to get clear idea about how the machine works and how it should be maintained on the daily and weekly basis. By reading manuals, other important things were also taken for problem solving situations. Some maintenance measures were clearly presented and guided step by step in manuals, which could be used to make the first work instructions.

Work instructions were started on daily and weekly maintenance operations, as some of them were instructed in manuals. In this section, the writer used maintenance plan to see what maintenance activities are done daily and weekly. The first step was taken to guide these activities.

The work instructions wanted to emphasize the visual look. As a basis for instructions, the company had PowerPoint based instructions.

The next step was to study and analyze how various production control systems are currently used and same time writer took pictures for instructions. Production workers were interviewed when they were doing their own work. Questions gave useful information about how and why the workers performed these activities.

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After interviews, the writer started to combine the collected data. At the same time, it was considered whether there are expectations regarding the working methods instructions of the manuals. After comparison, writer started to create a clear step-by-step guide for various maintenance activities and control panels.

The instructions for the maintenance activities and control panels were discussed with the supervisor of the thesis and the language of instructions was reviewed. Finally, the works instructions were approved with some changes suggested by the supervisor and then a clear package of the all instructions, which can be used in the future as orientation and knowledge bank, was created.

5 RESULTS OF THE RESEARCH

5.1 Describing the process

In the first part of the thesis, a clear process description of the company's new pretreatment line was started to be researched and developed. The first step was to create a clear layout of the production line. Figure 2 shows results of the work, where the machine is defined. In process description, there are several colors and numbers in order to make it easier to understand. Material flows were also created for the process description.

The layout image can now be used in production development and as orientation material for new employees.

Due to confidentiality, the process description cannot be published.

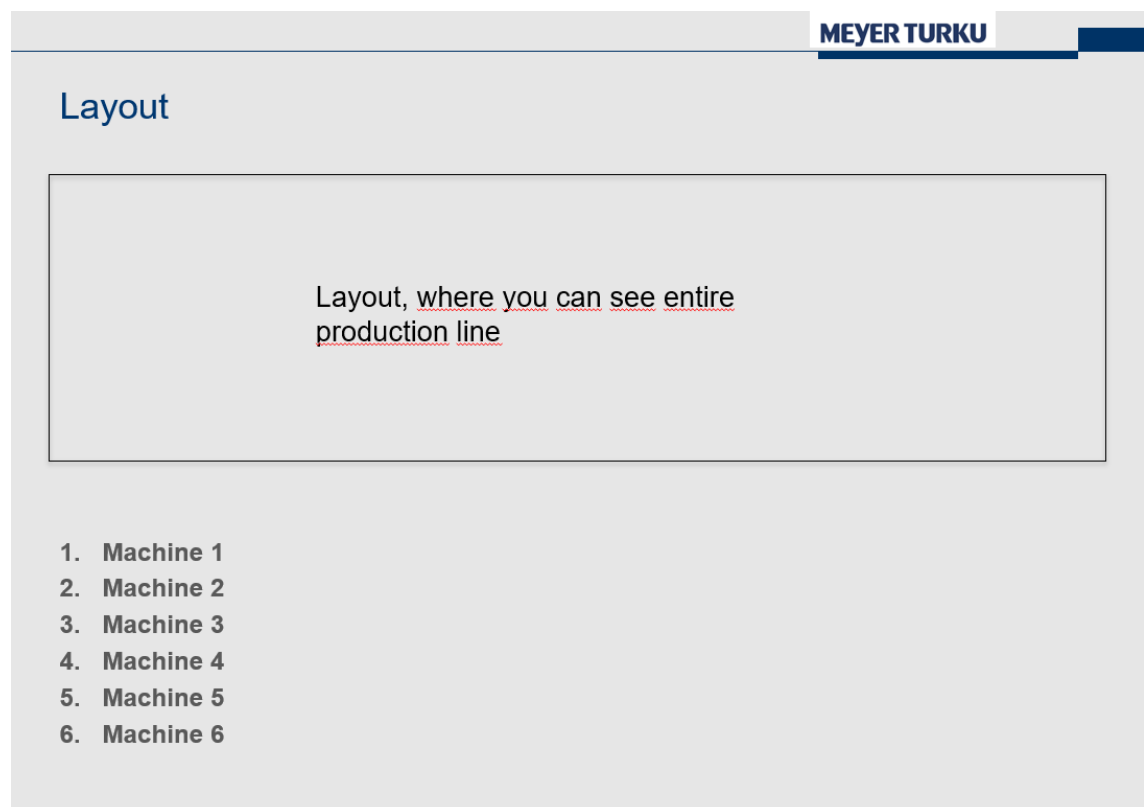


Figure 2 Process description for pre-treatment line

Idea of the process description is that each machine has its own description, showing it in the production facilities and as well as showing what it does. At the bottom of PowerPoint slide, the layout is clearly displayed, and machine, whose description is viewed, is circled. The machine is circled in the layout for better understanding.

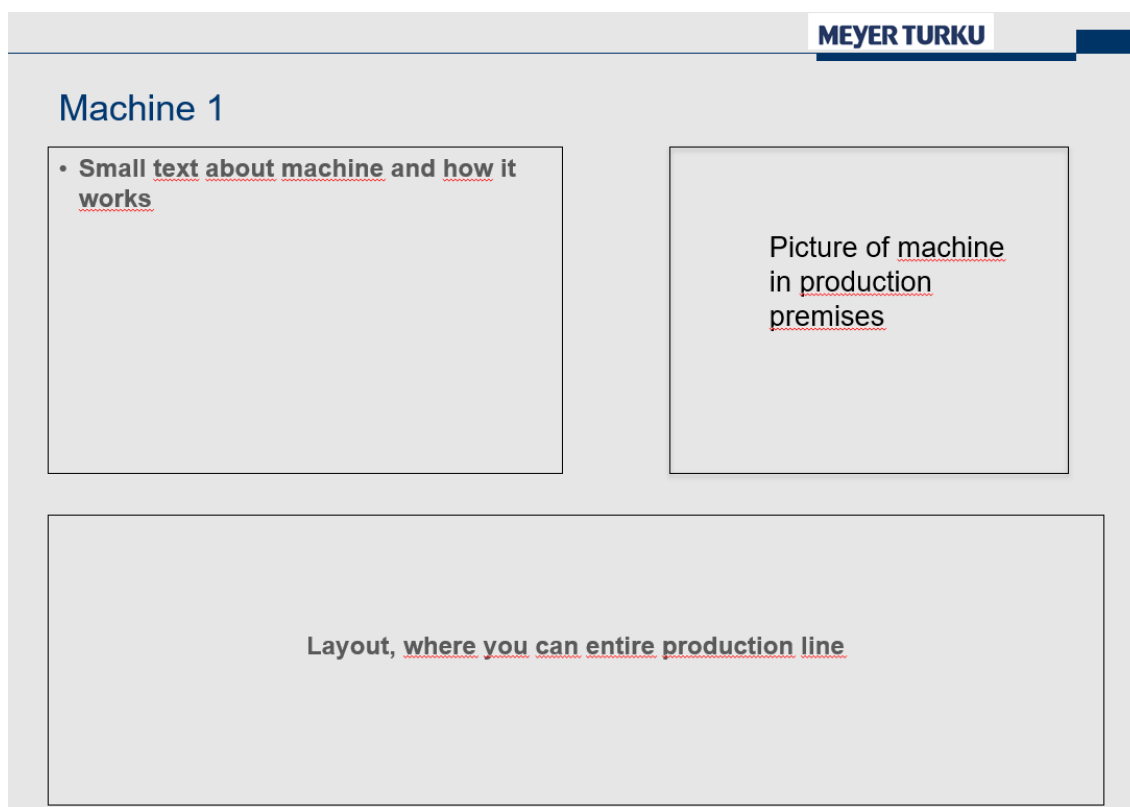


Figure 3 Machines specific description

5.2 Maintenance plan for pretreatment line

The second part of thesis resulted maintenance plan for Meyer Turku's pretreatment line. Maintenance plan can be found in the Excel file except work instructions and scheduling. The Excel file contains five tabs. The tabs were used to periodize maintenance to sufficient time slots.

Because of the research, new maintenance objects were found, and they were reviewed with a production line foreman.

The second part of the thesis was mostly done according to the wishes of company by listing all the actions on a single list, where a maintenance and production planner can see when a pre-treatment line has the biggest maintenance breaks.

The primary objective was to collect maintenance activities from the manufacturer's manuals and compare them with what is currently been done. With a new maintenance plan, the company can see if they have done maintenance correctly. Because of the large number of machine manuals, it is good that all the needed maintenance activities are listed and defined.

The Maintenance activities were clarified and simplified for the new person in the company to understand it. In the Annex 1 shows results of the second part of the thesis.

Due to the confidentiality obligations all data cannot published.

5.3 Work instructions for the pretreatment line

In the third part of the thesis, work instructions were made for operator who work on the production line. The aim of the work instructions was to create a clear database of daily activities that are done on the line. The work instructions will be used in case of possible illnesses as instructions for replacement worker. Eight PowerPoint presentations were made and approximately 120 pages were created.

Instructions were made on job descriptions of the line operator and the material sender. Work instructions focused on control room and control panels and daily and weekly maintenance activities. The instructions were created on the company's own Microsoft PowerPoint template.

The work instructions were visualized using pictures to make instructions easy to read and understand. The most important points were circled in pictures.

The production line was new and not all maintenance activities were known during the time of writing the thesis. The known maintenance activities were instructed and in the future, the company will be able to update the instructions based on new information.

The functionality of the instructions could not be tested at the time of writing the thesis, but the management conducted the instructions and confirmed their reliability.

Due to the confidentiality obligations, the work instructions cannot be published.

6 CONCLUSIONS

The aim of the study was to enhance the introduction of Meyer Turku's new pre-treatment line by creating a clear and easy-to-use process description, a clear list of tasks to be performed by line operators for line maintenance, and documentation of work tasks as orientation material for new employees.

The work was carried out in co-operation with production workers, management and development engineers of the pretreatment line. Work started in the autumn of 2018 and the work was completed in the spring of 2019. The work was carried out by daily monitoring of the production process, reading machinery manuals related to the pre-treatment line and interviewing production workers on the pre-treatment line.

When the study was conducted, there was lack of knowledge and documentation on some point and that slowed down working efficiency. Production line was new, so often there were new things what people did not know.

The results of the thesis were a clear process description, a maintenance plan for pre-treatment line, and work instructions for line operators.

The author thinks that the work went well because main goals were achieved on time. The author gained valuable experience about introducing a new production line and about the manufacturing of a cruise ship.

The results can be used as part of the orientation of new employees. The company can use the same process description idea in other production lines as well, to make the process description consistent. The maintenance plan can be used for scheduling maintenance and planning. The results can be used to implement the Lean ideology in the ship industry.

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Maintenance plan

Because of the research, a tool was developed that can be used for planning and monitoring maintenance.

Maintenance activities for operators							
		Daily					
Maintenance actions by		Inspector				Date	
Pre-treatment line					Completed	Revised	Used time
Machine 1							
	Maintenance operation 1						
Machine 2							
	Maintenance operation 2						
	Maintenance operation 3						
	Maintenance operation 4						
	Maintenance operation 5						
	Maintenance operation 6						
	Maintenance operation 7						
Machine 3							
	Maintenance operation 8						
Machine 4							
	Maintenance operation 9						
	Maintenance operation 10						
	Maintenance operation 11						
	Maintenance operation 12						
	Maintenance operation 13						
	Maintenance operation 14						
Machine 5							
	Maintenance operation 15						
Machine 6							

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Daily
Weekly
In 3 weeks
in 3 months
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