University of Stavanger

Faculty of Science and Technology

MASTER'S THESIS

Study program/ Specialization: Offshore Technology – Industrial Asset Management	Spring semester, 2014 Restricted access
Writer: Kristin Vedøy	Kristin Vedøy (Writer's signature)
Faculty supervisor: Jayantha Prasanna Liyanage External supervisor(s): Gunnar M. Ulland	
Thesis title: Review and Recommendations of technical and organizational project execution: The case of the MEG project	
Credits (ECTS): 30	
Key words: Project management Project execution Projects Improvements Roles and Responsibilities Decision Making Performance Quality improvement	Pages: 104 + enclosure: 42 Stavanger, 16.06.2014 Date/year

ACKNOWLEDGEMENT

This master thesis is written in cooperation with the University of Stavanger (UiS) and a chosen service company in the oil and gas industry. The thesis is written in the field Offshore Technology- Industrial Asset Management during the spring of 2014.

The thesis is written for the chosen service company in order to put a light on the implementation of big projects in the organization after a re-organization process.

I want to thank my supervisor at the University, Jayantha Prasanna Liyanage, for support, constructive criticism and help throughout the thesis.

I would also like to thank my supervisor at the chosen service company, Gunnar M. Ulland for his time and support throughout the thesis.

A special thank to Steffan Kruse Lindsø for his kindness, his time, and his constructive feedback on my thesis. Hopefully the hours spent on flights have been a lot more fun while reading my thesis!

I am so thankful for the time Silje, Beata and Rune has spent on reading and commenting on my thesis. Thank you for letting me use you to check different sections, and thank you for being there and supporting me throughout the thesis!

I also want to thank my colleagues (especially the project organization in this project) for supporting me, making time for me to ask them questions, and for giving me constructive criticism on my work. Without my colleagues this thesis would never be possible to write, and hopefully, the information they have provided me is clear in the thesis, and that the information can be used to make project work even better in the future!

Hopefully this thesis will be useful for the company in future large and complex projects.

Stavanger, 16.06.2014

....

ABSTRACT

With the growth in technology, projects and organizations today, many companies are struggling with the project execution process. The project execution process have to be both cost- and time-effective for companies to survive in the oil and gas industry the way the market has evolved. The scope of this thesis is to analyze and evaluate how a chosen service company in the oil and gas industry can improve project execution in large complex projects, with main focus on the technical and organizational execution phases.

To be able to understand how projects are being executed, a large complex project from a oil service company has been selected and used as an example and basis for comparison. The challenges in the project process for the chosen company have been related to internal dynamics, available capacity, experience of the resources, and other internal changes.

Many different theories and methods have been developed in order to improve quality, safe and secure execution of projects, effective decision making, and the project organization. Some of these methods and theories have been explained, and in order to evaluate how the theory can be used in practice, the chosen methods and theories have also been compared to the chosen project. This has been done in order to create a clear picture of the differences between theory and practice. In addition to the comparison of literature and the practical project execution process, the opinions of the project resources have also been reviewed. The resources involved in the project have given feedback and experiences from the project execution, which has been evaluated and analysed in order to ensure that the most time- and cost-effective improvement suggestions are highlighted.

One of the main goals of the evaluation and analysis performed was to use the general theories and methods, the comparison with the project, and the feedback and experiences from the project organization to create recommendations for the chosen service company. The goal for the recommendations was to clearly highlight improvement areas in order to ensure more time- and cost-effective project execution in the technical and organizational project phases.

The recommendations are based on how to improve the day to day work situation for people involved in project execution processes. There is a focus on how to implement changes that can lead to great improvements for the employees. None of the recommendations suggested will lead to major costs for the company. The recommendations given will not only improve the day to day work for the employees, it will also be beneficial for the company in the market competition.

TABLE OF CONTENT

1 INTRODUCTION

1.1 BACKGROUND

Project execution is a big part of many oil companies' business, and there are often many different types of project going on at the same time. There are many ways of conducting a project, and often the project size and the organizations' structure is crucial for how a project is conducted. The project that is evaluated and analyzed in this thesis was said to be a "project bigger than the organization". This is an interesting way of describing a project, and it is some of the background for why this project was chosen for the thesis.

One of the biggest challenges in oil companies is that there are many projects with great variety in size going on at the same time. It would be easier for all parts if all projects could be conducted the same way, but this would seldom be profitable or a practically good solution.
Many of the companies that have experienced a great growth in business and employees over the last years are now struggling with the challenge of creating organizations that can handle both the small projects they are used to, but also the bigger projects that are starting to become more and more common in the industry.

For these types of companies there are two main choices;

- The organization can be left "as is" and more time can be spent on figuring out how to manage the bigger projects in a time- and cost effective way in the future.
- The organization can be forced to change to make it more suitable for the bigger projects and then risk making the small project more expensive to conduct, if not able to immediately handle the changes.

The above mentioned solutions are requiring changes to work conditions that are already familiar routines for the employees, and they are all solutions that will come with consequences. Re-organization processes will take time, it will be confusing and challenging, and it might not fit for everybody.

Even though it might seem like taking a risk for the companies that are facing this challenge, it might be necessary in order to survive in the market. If the company has experienced a rapid growth, and more and more big projects are coming up, it means that in order to keep up with the competition in the market, the company must be able to handle them.

1.2 PURPOSE AND SCOPE

The purpose of the thesis is to evaluate and analyze the way of which a specific service company in the oil and gas industry works in large complex projects, and to make recommendations for improvements. The thesis is written using methods and theories informal to a traditional project process, and the recommendations made are based on the informal methods and theories, as well as feedback from the resources involved in the project.

The thesis will focus on two aspects, the technical and organizational execution of a project. The project chosen as an example is the MEG Distribution project. A project that is interesting both due to the fact that it is a direct consequence of the Macondo accident in 2010, but also that it is a project that require a big project organization to work fulltime. The project was the first project to be run after a major re-organization of the business unit, and one aspect of the thesis is to evaluate how this might have affected the project in terms of role definitions, processes and work flows. The project chosen as an example in this thesis was said to be "bigger than the organization" when it started. This in an interesting statement that will be discussed further in the thesis.

The target of this report is to be able to give the service company a better understanding of their own work methods. The goal is to be able to evaluate the project in detail, and to be able to provide the company with clear and detailed recommendations so that the company will be even better suited to handle project of this size at later occasions.

1.3 METHODOLOGY

The method used for collecting data to this thesis is called the qualitative method. This method is built on theories from human experiences, and is usually collected through observations, conversations or written texts.

The data collected in this thesis is mainly collected through conversations with the personnel involved in the project. There has been performed a lot of meetings with people from different departments of the organization where they have all been able to speak freely about how they experienced the project, and what challenges they faced.

In addition to the conversations with the personnel involved directly in the project, the thesis is also based on my own observations. I was a directly involved resource in the project for ten months, and during this time I have done many observations. When writing this thesis, I have placed myself more on the outside of the project to be able to see all the different sides and roles better.

After meeting with all the personnel involved, the minutes of meetings has been compared to each other in order to find out what differences and similarities people had experienced.
Data has also been collected through reading contracts and scope of work for the project, as well as literature on project management.
This data has been evaluated against the project to find out the methods that has been used, and what methods that could have been used.

1.4 LIMITATIONS

Time has been a limitation for the thesis. If there had been more time, the whole project could have been evaluated and analyzed. With the given time frame it was decided that the two main focus areas for the thesis should be the technical and the organizational part of the chosen project.

The main area of concern in this thesis was chosen to be the engineering phase. This phase is one of few that has experienced a lot of changes during the last years, and the technical and organizational areas around the engineering phase can to a certain degree decided whether a project is successful or not.

The limitations in this thesis have been the possibility of getting hold of enough time with everybody involved in the project. This much due to the fact that the project is still ongoing, and the people involved are busy with the project and do not have time for longer conversations.

Other limitations have been that it is difficult to receive information from other companies about how they work, due to a lot of different methods depending on the project type and size. In order to cover this information best possible, different books and literature have been used as a source on project management.

The literature used has been read and evaluated. Due to this thesis focusing on a specific project in general, it has been somewhat difficult to find literature that is relevant for all aspects of a project, not only the project management.
The thesis has been limited to the use of methods and theories learned during the master program. Many of the theories used are informal, and they are used to describe the different methods that can be used to ensure quality and efficiency in a project.

1.5 THESIS STRUCTURE

The scope of work is divided into two main parts; one technical and one organizational.

In chapter two there is a listing of the “Status Quo”, both in general, but also with respect to the technical and organization aspect. Here some of the most relevant theories and methods in projects will be discussed.

In chapter three the technical part of the MEG (Mono-Ethylene Glycol) project will be explained and discussed. The main focus will be on the engineering job. The different phases of engineering will be explained in this part. A review of the literature in chapter two is given with respect to the MEG project.

In chapter four the organizational part of the MEG project will be explained. There will be a focus on the re-organization process and the consequences it led to, as well as it will analyze and evaluate the organization within this project. Main focus will be on roles, resources, changes, and the work itself. The chapter will end with a review of the literature given in chapter two with respect to the MEG project.

The section about lessons learned in chapter five will be divided into two parts; one technical and one organizational. This part will evaluate the project with respect to measurable results, and with respect to feedback from those who has been involved in the project. Much of the feedback is divided into what the resources in the project found working, and not working properly. The chapter ends with an analysis of the different opinions given in the MEG project.

The thesis will summarize with a Recommendation in chapter six. This chapter will contain a list over things that could have been avoided in the project, as well as an explanation on how it could have been avoided. This chapter is divided into three parts; general, technical and organizational.

At the end of the thesis there will be a discussion, a conclusion, references and appendices.

The structure of the thesis can be somewhat difficult to understand, figure 1-1 is included to give a better overview of the content. As seen from this figure, the thesis is divided into a technical and organizational part throughout the chapters.

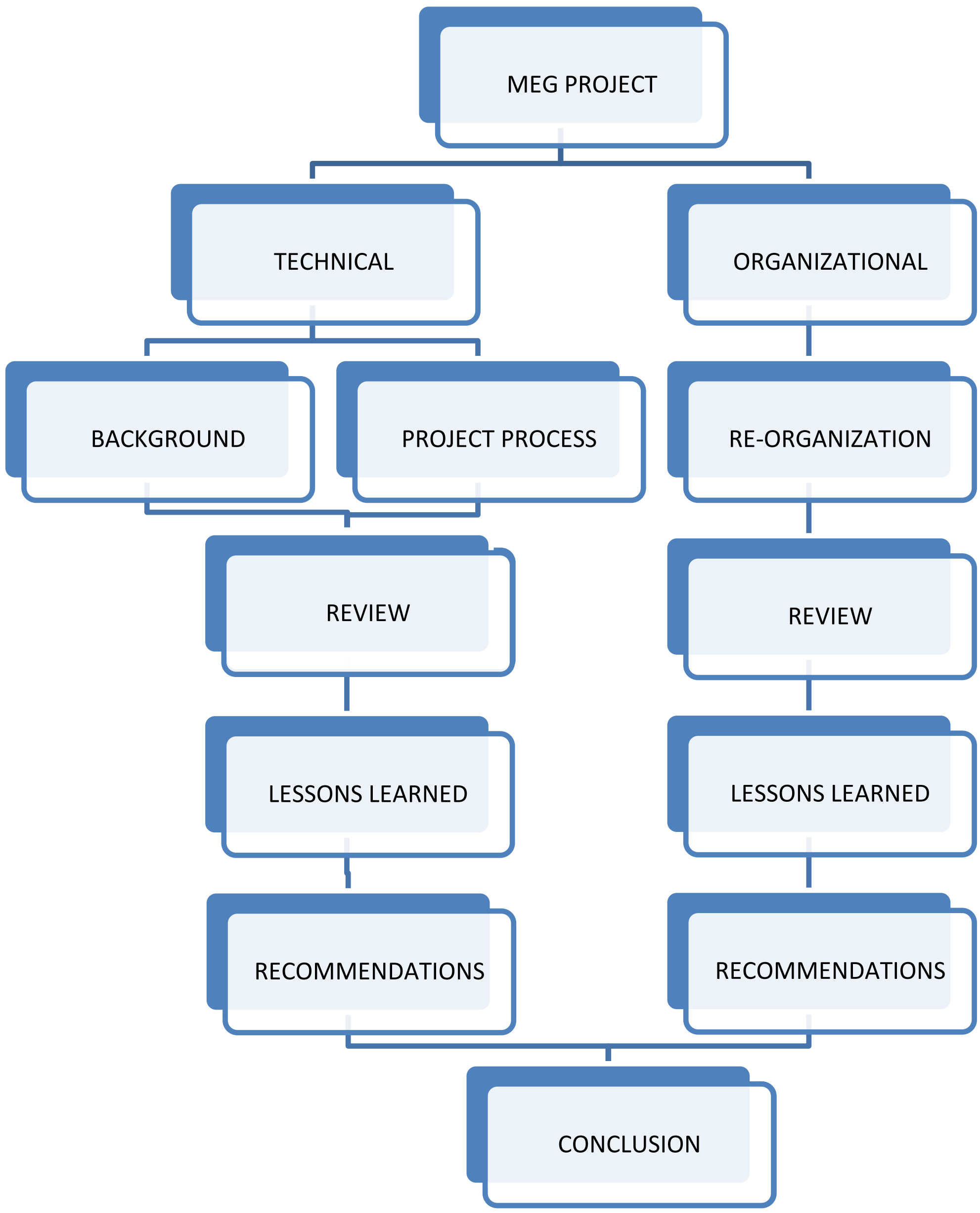


Figure 1-1: Thesis Structure

1.6 ABBREVIATION

ABBREVIATION	FULL NAME
AMOSC	Australian Marine Oil Spill Centre
BOD	Basis of Design
CDA	Chemical Distribution Assembly
CTTH	Coiled Tube Termination Head
FAT	Factory Acceptance Test
FLDR	Flying Lead Deployment Rack
GA	General Arrangement
GoM	Gulf of Mexico
HSE	Health, Safety and Environment
MEG	Mono-Ethylene Glycol
OD	Olje Direktoratet
OMM	Operation and Maintenance Manual
OPG	International Ossociation of Oil and Gas Producers
OSRL	Oil Spill Response Limited
PDCA	Plan- Do- Check- Act
PMI	Project Management Institute
QC	Quality Control
ROV	Remote Operated Vehicle
SMP	Small Medium Projects
SW	Solid Works
SWRP	Subsea Well Response Project
WBS	Work Breakdown Structure

2 STATUS QUO

2.1 GENERAL

There is a lot of good literature on project management today, the only challenge is that much of the literature only covers either small or large projects. The book “Prosjektledelse trinn for trinn” written by Svein Arne Jessen (2009) covers what the author calls “SMP” (small and medium size projects). This book gives a good picture of the differences between large and small/medium projects, but it also shows that very often, a large project is a combination of many small and medium sized projects.
Jessen states that some of the differences between large and small/medium sized projects are:

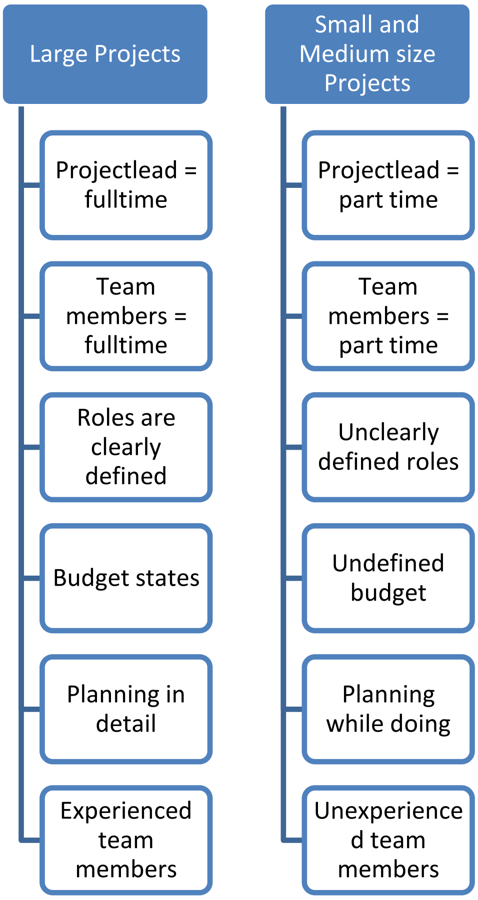


FIGURE 2-1: DIFFERENSES BETWEEN LARGE AND SMP (REF. JESSEN, 2009)

If reading figure 2-1 critically it is possible to say that small and medium sized project are projects that are often performed without control. This might be pushing it to the limit, but often in small projects there are fewer limits and those involved have more freedom in what they do.

Even though much of the literature differences large and small projects, it is often possible to see that in real life, they walk hand in hand. A large project often consists of several small projects. Like for instance the project this thesis is focused upon, the MEG project. This is a large project where a system is to be built, but it can also be divided into at least three small projects, one for each structure to be developed.

2.1.1 Standard project management processes

According to the PMI (Project Management Institute) (2004), project management processes is divided into five different groups:

Figure 2-2: Project Management Processes (ref. PMI, 2004)

The **initiating process** is defining and authorizing the project or a project phase. The **planning process** defines all actions that have to be taken for the project to fulfil the project scope and objectives. The **execution process** is integrating resources and people needed to be able to create the project management plan for the project. The **monitoring and controlling process** is used to find deviations from the project management plan, and the **closing process** is fulfilled when a project is being delivered according to scope and objective.

In addition to the five project management processes, there is also a standard used list for the project management knowledge areas required in the five process areas.

Process Groups	Initiating	Planning	Execution	Monitoring and Controlling	Closing
Project Integration Management		Project Plan Development	Project Plan Execution	Integrated Change Control	
Project Scope Management	Initiation	Scope Planning Scope definition		Scope verification Scope Change Control	
Project Time Management		Activity definition Activity Sequencing Activity Duration		Schedule Control	
Project Cost Management		Resource Planning Cost Estimating Cost Budgeting		Cost Control	
Project Quality Management		Quality Planning	Quality Assurance	Quality Control	
Project Human Resource Management		Organization Planning Staff Acquisition	Team Development		
Project communication Management		Communications Planning	Information Distribution	Performance Reporting	Administrative Closure
Project Risk Management		Risk Management Planning Risk Identification Qualitative Risk Analysis Quantitative Risk Analysis Risk Response Planning		Risk Monitoring and Control	
Project Procurement Management	Process	Process	Source Selection Contract Administration		Contract Closeout

FIGURE 2-3: PROJECT MANAGEMENT KNOWLEDGE AREAS AND PROCESSES (REF. PMI, 2004)

The two figures showed over are standard figures used in project management. They are a part of the PMIs' (Project Management Institute) guidelines, and the figures are used in project management training and education.

2.1.2 Key factors for project success

There are some key factors that one can read over and over again while reading about project management; communication, motivation, planning, and roles and responsibilities. These key factors are a big part of the project management processes and knowledge areas for successful outcomes. The key factors are given in much of the literature available, and the sections written here as based on literature from Jessen (2009), Gardiner (2005), Hendrick and Kleiner (2002), Redmill and Rajan (1997) and Mankin, Cohen and Bikson (1996)

Communication is the key to all successful projects. The larger a project is, the more important it is to have good and including communication. Communication must be in place to ensure that everybody involved in the project is informed about decisions and progress. It is said that "good communication is crucial for project success in all phases of a project".

It is important to remember that lack of communication often can be seen as a "human error" where the reason for the missing communication is simply that people do not remember to inform all those who should have been informed. This is a so called "simple" mistake, but it is also a mistake that is difficult to correct, and people that are working in teams have to practice on how to be better at informing and including others.

Motivation should be performed mainly by the project manager, but also by the other team members. Motivation is all about listening to others, give feedback, and supporting the project team. Motivation is important in all types of projects, but in advanced technical projects, and projects that lasts for a long period of time, it can be the one thing that determines whether the project is successful or not for the resources included. Humans are built in a way that requires them to be motivated. Without motivation and feedback people often gets bored, or they can easily feel like they are not doing a good job.

People in general are often good at focusing on the parts that did not go very well, we are better on focusing on the negative sides than on the positive ones. It is of course important to handle things that do not go very well, but (especially) in project work, there should be a bigger focus on motivation and positive feedback as well.

Planning is essential in order to ensure control of a project at all times. It is often said that "failing to plan is planning to fail" and this is the truth in many projects. Planning is essential in order to keep track of the different resources and tasks in a project, as well as it are often used to connect the resources and the tasks together. It is also used as a tool that can be helpful when having timeframes, deadlines or hours to relate to. To ensure that every part of the project is covered in the plan, a Work Breakdown Structure (WBS) can be used. WBS is a commonly used way of planning projects. It consists of breaking the projects down into small parts or phases. According to Gardiner (2005) WBS has six main purposes:

1) To echo the project
2) To be the organization chart for the project
3) It can be used to track cost, schedule and performance specifications
4) It can be used to communicate project status (for instance to customers)
5) It can be used to improve overall project communication
6) It demonstrates how the project will be controlled

Roles and Responsibilities

It can be difficult to create clearly defined roles and responsibilities in a project.
Accordring to Gardiner (2005), the main roles and responsibilities for a project manager is to plan, organize, control and motivate the resources involved in a project. The project manager is not supposed to do the work, but to delegate others to do it.

The book about Project Management by Jessen (2005) gives an example of a simple project organization structure looking like this:

FIGURE 2-4: SIMPLE PROJECT ORGANIZATION STRUCTURE (REF. GARDINER, 2005)

The figure above shows that the project managers' role is to do all the "invisible" tasks of a project. All the background tasks that the project team in many cases does not know exist. In addition to this, the project manager must not forget the tasks mentioned above; plan, organize, control and motivate.

Gardiner (2005) states that "*project management is first and foremost about people and then tools and techniques*"
From this statement it is possible to conclude that the project manager has to have good "soft skills", or in other words, good people skills.

The project team leader should be good at what is called "hard skills", meaning that he or she should be good at mechanical and technical skills. The roles and responsibilities of the project team leader are to supervise the project team on technical issues.
Even though the project team leader in many cases mostly is a technical lead, he or she also have to have some soft skills in order to create the best relationship possible in the project organization.

According to Gardiner (2005) the roles and responsibilities of the project team is to carry out the activities. In order to do that in the best way possible, they are dependent on having a project team leader and a project manager who can supply them with information, motivation and good leadership.

It is possible to merge all of the four most important keys to a successful project. By planning well, the plan can be used also as a communication platform, and it can be used to motivate people by letting them see their own progress in the project. It can also be used to describe the different resources' roles and responsibilities.

2.2 STATUS QUO – PROJECTS FROM AN INFORMAL TECHNICAL PERSPECTIVE

Projects have developed to be bigger, more complex, and more boundary-less over the last years. Due to the development in technology it is now possible to have a project team located at different parts of the world working together. The new project environment, and the complexity the development has led to, is part of why improvements of project execution are of great importance at many companies today. In order for companies to improve the project execution process, methods and models can be used to ensure cost and quality improvements, as well as safe and secure project execution and decision making

In this section, some of the theories and methods are explained and discussed with reference to projects seen from an informal technical perspective. The methods chosen as examples in this thesis are chosen because there is a number of methods and theories that can easily be included in standards, procedures and routines in engineering work, and because they are methods that are easy to understand and implement in already existing procedures and standards to improve the project process and quality. It is possible to execute a project in many different ways, and by adding specific methods and theories it is possible to ensure that all projects are following the same standard project execution method.

2.2.1 Quality assurance and improvement

There are many different methods that can be used to ensure that the project runs smoothly with respect to quality and efficiency. The PDCA (Plan, Do, Check, Act) circle is a common used method to ensure both quality, and customer satisfaction. The method ensures that no task is started without being properly planned, and that no task is ended without a detailed checking process has been performed. Christopher and Thor (1993) have developed a figure and some brief explanations of the PDCA circle, with reference to them each step of the circle is explained in more detail below the picture.

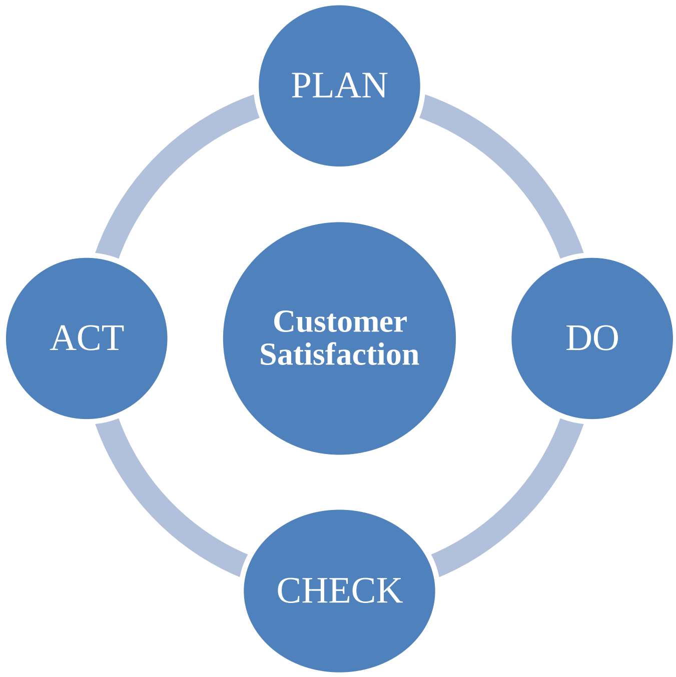


FIGURE 2-5: THE P-D-C-A CYCLE (REF. CHRISTOPHER AND THOR, 1993)

PLAN

Plan is the learning phase of the PDCA circle, and it is where most of the time is spent. The main principle here is that you have to completely understand the problem/situation before you can do anything about it.

In this phase it is important to ensure that the roles and responsibilities are settled, and that the plan created is clearly understood by the resources involved in it. To be able to create a good plan, it is important to involve the resources in the planning phase, both to make sure that they have a relationship to the plan, but also to ensure that they know what to do and when to do it.

When planning on how to solve a problem it is important to see the problem or challenge from all perspectives. This phase should be highly prioritized, and it should not be completed before everyone involved has agreed that the problem or challenge being faced is commonly understood and agreed upon. When looking at problems from different perspectives it is easier to discover alternative solutions that can be used. It can also be recommended to involve people with different backgrounds and experiences in this phase, as this will lead to a wider spectre of knowledge and possible solutions.

DO

Once the plan is established, this phase can begin. This step is preferably a training step and should unfold quickly with little or no rework (depending on the planning phase to be well done). Christopher and Thor (1993) states that "*this phase should unfold quickly with little or no rework"*. This is the preferable way to solve this step, but in practical situations it can often turn out quite the opposite. Even though a problem or challenge is well understood and defined it might not always be easy to solve. There are a lot of things that can affect the "do" phase, both external and internal influences like the ones explained in chapter 2.4.5, and technical challenges can arise during this phase.

Referring to projects in the oil and gas industry there are a lot of unknown factors and challenges that can be discovered after the planning phase is completed. New information can become available, or it is possible that the solutions found simply will not function in practice. This makes it even more important to perform a good and detailed planning phase, as it can ensure that these kinds of pitfalls does not stop the project process.

CHECK

Results and data from the "Do" phase are to be collected and analyzed in this phase. The results will be compared with the expected results. This phase will summarize what went well and what could have been done different

In this phase it is extremely important to spend as much time as needed in order to find all the things that could have been avoided and also find out how they could have been avoided. If a great focus is spent on analyzing and evaluating the tasks that has been performed in the "do" phase, it is possible to learn from own mistakes, and to learn what went well. Often, people are skipping this phase, or spending too little time on it. It is easy to think that the problem is now solved so it is time to move on to the next one, but spending time in the checking phase to evaluate and analyze as detailed as possible can become useful in later occasions. Not only will the lesson learned be greater, it will also help develop a way of thinking that can be both quality and cost effective in decisions and tasks performed at a later stage.

ACT

Improvement has been made and the circle now starts over again with new identified problems or challenges. When the circle is completed and starts over again, it is important to remember what was done in the previous circle. The more a person is able to learn from each time the circle is completed, the easier and more effective the next will be. Often, people forget what they did as soon as they are finished solving a problem or a challenge, but if time is spent on remembering what went well and wrong last time, it is possible to make improvements each time the circle is starting over again.

People with different backgrounds, experiences, and people who are working with problems every day should come together to make sure that the PDCA wheel continue spinning around like shown on figure 2-6. The PDCA circle can both be used internally in departments, but also as interfaces towards other departments.

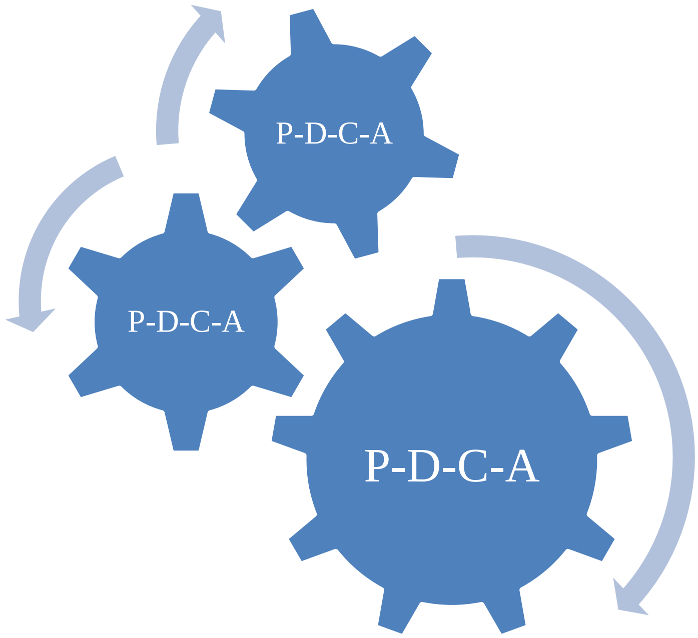


Figure 2-6: The P-D-C-A wheel (ref. Christopher and Thor, 1993)

2.2.2 Systems interfaces for safe and secure project development and execution

There are also many different methods that can be used during the design phase of a project for a safe and secure project process. An example of how it is possible to perform quality assurance on a design job is shown and explained below. This model is developed and explained by Sanders and McCormic (1992), and it is used to ensure that the interfaces to soft components are being taken care of in project execution.

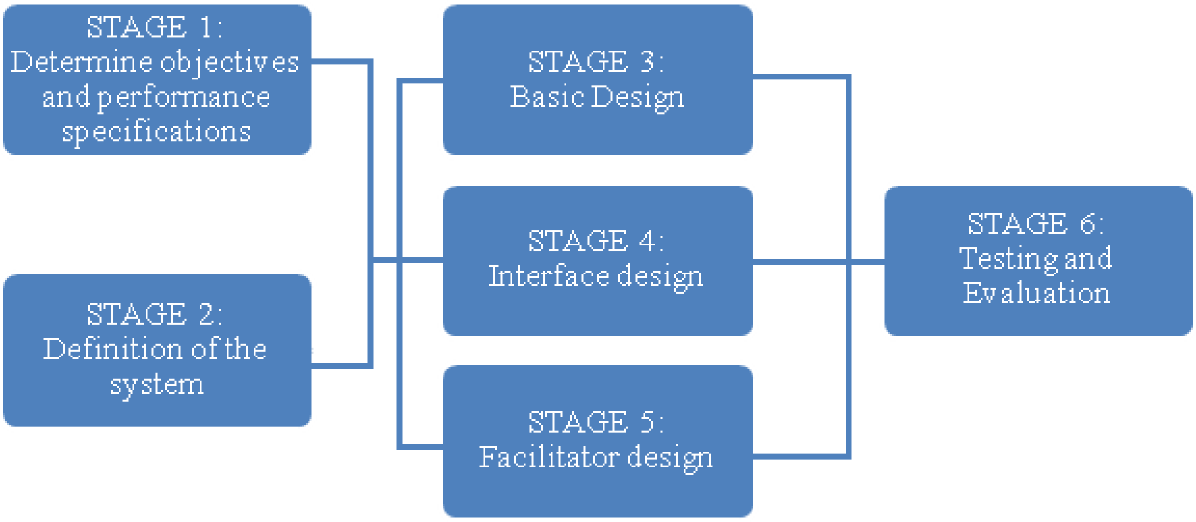


FIGURE 2-7: EXAMPLE OF PROJECT STEPS (REF. SANDERS AND MCCORMIC, 1992)

STAGE 1: DETERMINE OBJECTIVES AND PERFORMANCE SPECIFICATIONS

Before it is possible to start designing a system it is important to have a purpose (objective) and reason for why the system should be designed. When the objectives are stated it is the performance specifications that decides what has to be done for the system to meet its objectives. System performance specifications should reflect the context of the design, as well as skills available.

A specification can be either short and concrete, or it can be long and detailed. In the oil and gas industry there are specifications created for each tool being developed. Two different companies can order the same tool based on different specifications. The specifications are often based on customer, and not on product. To ensure that the objectives and scope of work are clearly understood, time has to be spent on reading the specifications. Without a clear understanding of the objectives and specifications it is difficult to develop a tool according to customer requirements.

STAGE 2: DEFINITION OF THE SYSTEM

The purpose of stage 2 is to define the functions the system must have or perform in order to meet the objectives and performance specifications. The purpose of this stage is not to define which hardware to use, or the exact detailed design, but more to figure out the functions, if they are instantaneous, prolonged, simple or complex.

In stage two, the use of functional flow diagrams are often used to create an overview of the system. Diagrams will create an understanding of how the system should work, and also create a vision of the different opportunities available.

When developing a system for the subsea industry it is often useful to create a system overview diagram at the beginning to be able to see the all components together. Often, it can be useful to create for instance a hydraulic schematic before starting on the design as this can give an image of how the components should be built up to interface each other best possible.

STAGE 3: BASIC DESIGN

During stage three the system should start to take shape. Some of the most important things to solve in the basic design process is the allocation of hardware, task analysis and job design. These different stages in the design are not just carried out once, but several times as the system will experience a lot of changes during the basic design stage. The allocation process is a difficult process. It is also a process that should be dynamic so that allocations also can be made during operation, not only in the design phase.

The basic design is created to get an image of how the system will look and function. As mentioned above, the selection of materials should be taken into consideration in this stage. In the oil and gas industry, the material selection can be a challenging job due to the fact that much of the equipment is being used on the seabed. Corrosion and how different materials act or react with each other is one of the things that have to be considered in the basic design.

STAGE 4: INTERFACE DESIGN

After stage three is completed and the basic design of the system is decided upon, the focus should be to define the interfaces. The engineers designing systems do not really have a specific way of deciding how the design should be formed. Studies have shown that engineer's often use experiences from earlier designs and their intuition when designing.

There are some standard rules that are used regarding interfaces in the oil and gas industry. Due to much of the equipment being placed under sea, there has been created a general rule that all ROV (remote operated vehicle) interfaces are to be painted orange. This is done to ensure that even though experiencing bad visibility, it is always possible to know where the interfaces are.

STAGE 5: FACILITATOR DESIGN

In this stage of the systems design process, the focus is to provide acceptable materials, user manuals, training programs and devices and performance aids.

User manuals and training are an essential part of safe and secure project execution. All products developed should be delivered with user manuals, and training should be performed before anyone is allowed to use the products. This to ensure that nothing can go wrong when operating it, and that all possible information is available for the operator. Without easy understandable procedures it is possible to operate products wrong, which again can lead to minor, or major consequences. Training is essential to ensure that everything is safe and secure both for the operator, but also for the people working nearby.

STAGE 6: TESTING AND EVALUATION

According to Sanders and McCormic (1992) *Evaluation of the system is to make sure that the system is doing what it is supposed to do*.

To summarize; testing and evaluation should be done in environments and settings as close to the real life settings as possible. This to ensure that there will be no surprises when the system is brought out to operation. Often it is preferable to not only test the whole system, but to also test each and every single component before the system is assembled. This will not only double the fail safe rate for the system, it will also make it easier to detect any errors if they occur.

2.2.3 Decision making for effective performance

While working in both small and large projects, there are always a lot of decisions to make. To get the best foundation for the decision making process, the basic pyramid frame for decision making (fig. 2-8) can be used.

Problem solving can often be a challenging process and it is easy to skip the problem definition and jump right to the solution solving. This often leads to a poor decision-making process. In most projects there are a lot of decision-making processes, and there is a huge focus on getting the process correct. When modelling, you often get so engaged in what you do that it does not seem like a solution to take a break to be able to consider the decision-making process. To ensure that the decision-making process is followed, the basic pyramid frame for decision making (fig. 2-8) can be used as the baseline of how decisions are taken. The figure is developed by Wang (2002).

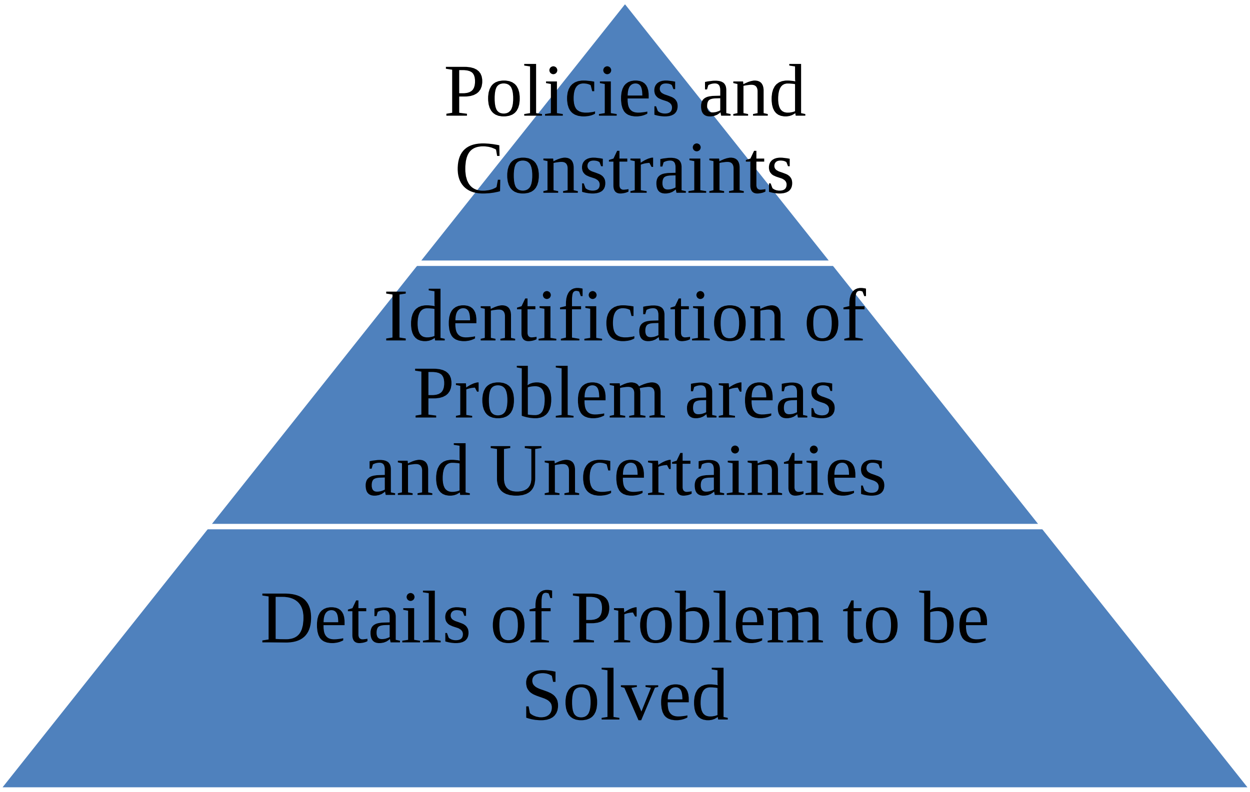


FIGURE 2-8: BASIC PYRAMID FRAME FOR DECISION MAKING (REF. WANG, 2002)

The most important factor to think about before making a decision is policies and constraints. The policies and constraints in projects are often given in the specifications, basis of design and scope of work. When all uncertainties in this frame are solved, it is possible to start identifying what the problem is, and how it has become a problem. There can be several reasons for why a problem occurs, for instance a challenge with making the component fit into the framework, or difficulties with finding a part that fits the requirements given in the basis of design.

When the problem is identified, the project organization should focus on the detail level of the challenge. In this stage (or frame) the main focus should be to go into the details of the challenging components and to find the best possible solution. If there are trouble deciding on which alternative to use, this can brought up in the project team, creating a discussion about the challenge, as well as pros and cons can be highlighted.

A method that is often used when struggling with problems about, for instance components, is to contact different suppliers or manufacturers, and collect as much data and information as possible. When all the alternatives have been created, a selection process of which to use and not can be started. It can be difficult to select out the best alternatives, and tools are often used to make the job easier. Example of tools to use is decision matrices and prioritization through cost-benefit analyses. Decision matrices enable the group to organize all the thoughts about the different alternatives or solutions according to criteria defined by the group. Decision matrices allow the group to identify the strengths and weaknesses of proposed alternatives or solutions. A decision matrix can include different factors, dependent of what the company finds important and not. Below is an example of a decision matrix.

Alternative	Revenue	Cost			Quality (1-10)				Totals
	Dollars	Piece	Investment	Shipping	Appearance	Assembly	Sale	Service	
Baseline	+350	-70	-80	-10	5	7	7	8	**217**
Alternative 1	+450	-75	-100	-86	4	8	6	4	**216**
Alternative 2	+500	-75	-160	-85	7	6	7	9	**209**
Alternative 3	+400	-30	-120	-60	8	5	9	6	**218**

FIGURE 2-9: DECISION MATRIX (REF. WANG, 2002)

As seen from the decision matrix above, alternative 3 will be the best solution to choose even though both alternative 1 and 2 have more revenue. This due to more expensive costs on alternative 1 and 2. Of course, the different items could also be weighted and this could change the results. If revenue is weighted lower than investment and service for instance, the result could end up differently as they would be affected by this.

Cost-benefit analyses show different outcomes and different goals compared to each other. Outcomes are listed with benefits and estimated costs. This method is preferred when maximization of goals is important. (Wang, 2002)

Decisions can be divided into several different types of decisions. For projects, we can look at two main categories: strategic and tactical. Frankel (2008) has explained these categories in terms of an organization, but as seen here, they can also be project related.

Strategic decisions in project are related to the overall goals for the project. An example of an overall goal can for instance be to reach a job profit of 35%, or to ensure that the project is executed without any delays in the engineering phase. Goals like these will ensure that everybody involved is working to reach the same level of success. Strategic goals are often dynamic, meaning that if a change should occur in the project, the strategic goals can be changed according to the change.

Tactical decisions are often based on the market. In projects it is often related to lead time or price of components. Tactical decisions are commonly used in both small and large projects, if it is possible to save time or/and money on buying alternative components (that still are according to requirements) this will in almost all cases be done. Tactical decisions in projects can also be related to how to use the different resources, or what technologies to use.

There are many known challenges related to engineering decision making processes. Lack of commitment, poor leadership and poor teamwork are some. To avoid conflicts in engineering decision making, Wang (2002) has provided six steps to follow to ensure good decision making.

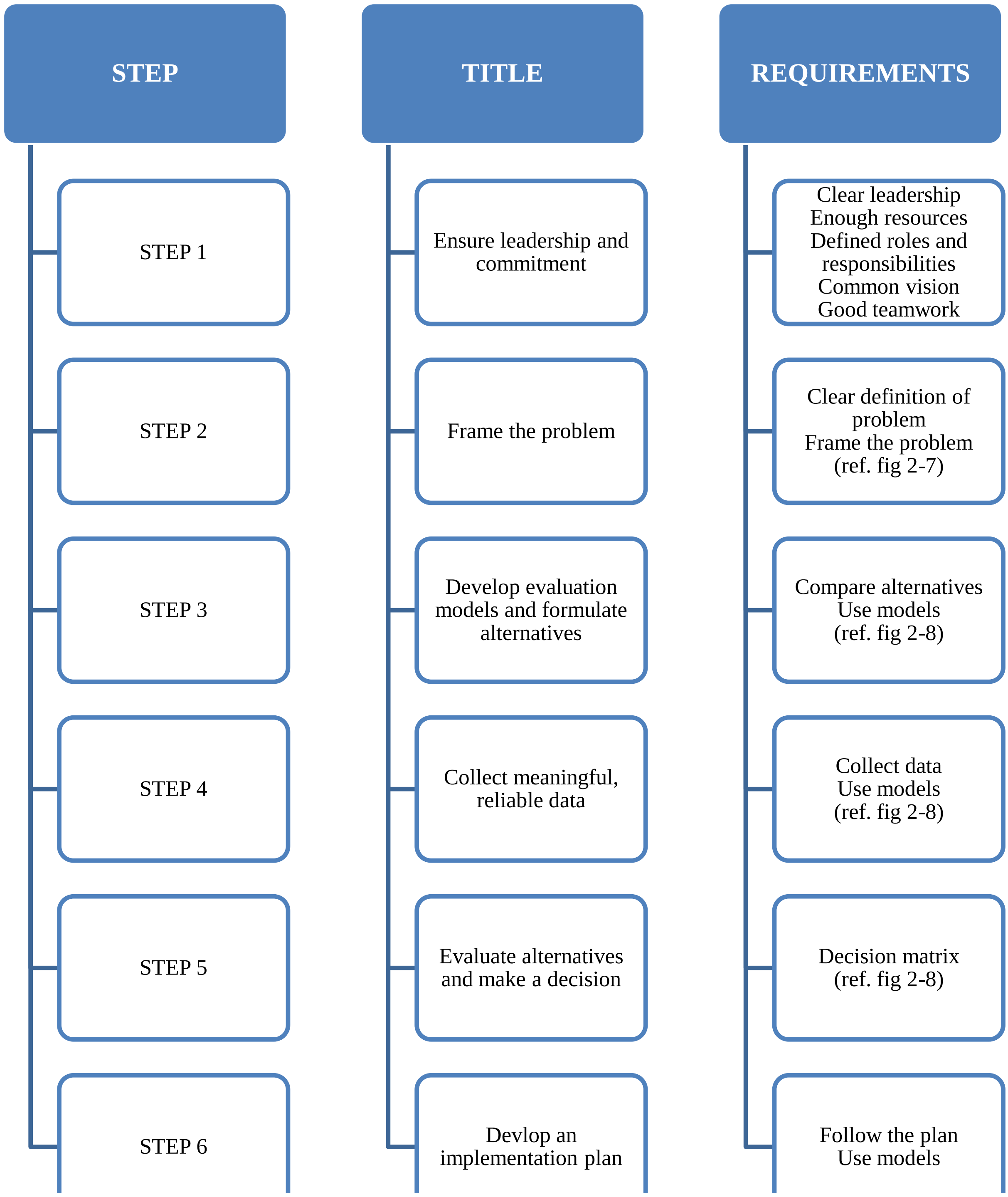


FIGURE 2-10: ENGINEERING DESICION MAKING IN STEPS (REF. WANG, 2002)

As seen from figure 2-10, it relates to both of the two figures explained earlier in decision making (figure 2-8 and 2-9). From this it is possible to state that decision making can lead to effective performance if the right methods and models are used in the process as help and guidelines.

2.3 EXAMPLE - YME

One of the greatest challenges in today’s oil and gas industry is to complete project on time, according to specifications, and to the correct price. To be able to do this, planning is essential, something all companies are aware of. Even though time, price and quality are some of the most important key words in project execution, many companies still have unsuccessful projects. An example of such a project is shown below.

YME is by most known as one of the biggest scandals in the oil and gas industry the last years. The platform that cost over 10 billion NOK to make will never be able to be used. The picture below shows the YME platform. When this photo was taken, major repairs were performed in order to try to make the platform safe enough to use it.

FIGURE 2-11: YME

OD (Olje Direktoratet) has evaluated the project to figure out where the project went wrong, and the solution is strongly connected to some of the key points mentioned earlier; Communication and Planning.

Helgesen (2013) writes that according to OD there were challenges in the design and building phases of the project, more work was added to the project in late phases, delays occurred and the cost estimate was reached long before planned. OD says that the project economy was underestimated from the beginning of, and that this, together with unexperienced operating personnel, caused a lot of problems for the project.

Helgesen (2013) also writes that little attention was paid to “what if” scenarios and the project were based on getting finished as soon as possible. This will in almost any situation affect the quality of the product(s) being delivered.

In addition to the things mentioned above, the contractors were missing basic knowledge about the Norwegian rules and regulations, including the NORSOK standards, which also created a lot of rework on different components.
OD concluded that the most important lesson learned from the YME project is to plan well from the beginning, and evaluate all decisions well. There should also be a significant focus on following up projects. This to be able to see challenges or changes at an early stage.

As it is possible to see from what is written about the YME project, it is very important to keep the key points (Motivation, Communication, and Planning) Jessen (2005) describes in focus at all times of the project. YME might be one of the most extreme examples to use when describing how wrong projects can turn out, but it is a good example of how important it to ensure that proper planning has been done, and that projects are being followed-up at all stages. If the YME project has used some of the methods explained in chapter 2.2.1-2.2.3 the result of the project could have ended different. If the PDCA circle had been used to check that all tasks were planned and checked properly, a lot of the re-work in this project could have been avoided. If the six steps for a safe and secure project execution had been used, they would have gone through the different standards and specifications at the beginning of the project, ensuring that the contractors understood all that was listed here. To summarize, if the YME project had used some of the methods explained previous in this chapter, they could perhaps avoided some of the things that went wrong in this project.

2.4 STATUS QUO – PROJECTS FROM AN ORGANIZATIONAL PERSPECTIVE

In this section, the main organizational perspectives in projects are discussed with reference to different theories and methods that are known and used in the industry. With the development of technology and the competition in the market of the oil and gas industry, having an effective organization is becoming very important for the companies in this industry. If the organization is unsuited, or not effective enough for the main amount of projects the company has, this can lead to consequences not only for the people in the organization, but also for the company and the market they are competing in. For companies to ensure that their organization is the way it should be there are many models and methods that can be used to ensure organizational improvement, some of them are explained below.

2.4.1 The main characteristics of the modern organizations

According to Mankin, Cohen and Bikson (1996) the old strictly rule based organizations are replaced by organizations consisting of integration and cross-functional teams. More dynamic and flexible organizations where broader categories and overlapping are becoming normal. A small desk in the office is replaced with home office, conferences, meeting rooms, and so on, for people to be able to work in more comfortable environments. Organizational boundaries are replaced with work relationship arising from interaction needs and functional interdependencies. Information is made available on intranet and in data bases so that people easily can get the information and tools they need whenever and wherever they need it.

As seen from the section above there are great changes in what we can call the general organization. Due to the development in the industries, the normal workday seen 10 years ago is slowly fading away. For many people this is a good thing, the society today often consists of families where both parents are working fulltime, and with a less strict organization the everyday life can be easier for them. Organizations where there is more freedom regarding work hours and where to work from, can suit many people in a good way, but it can also lead to some challenges.

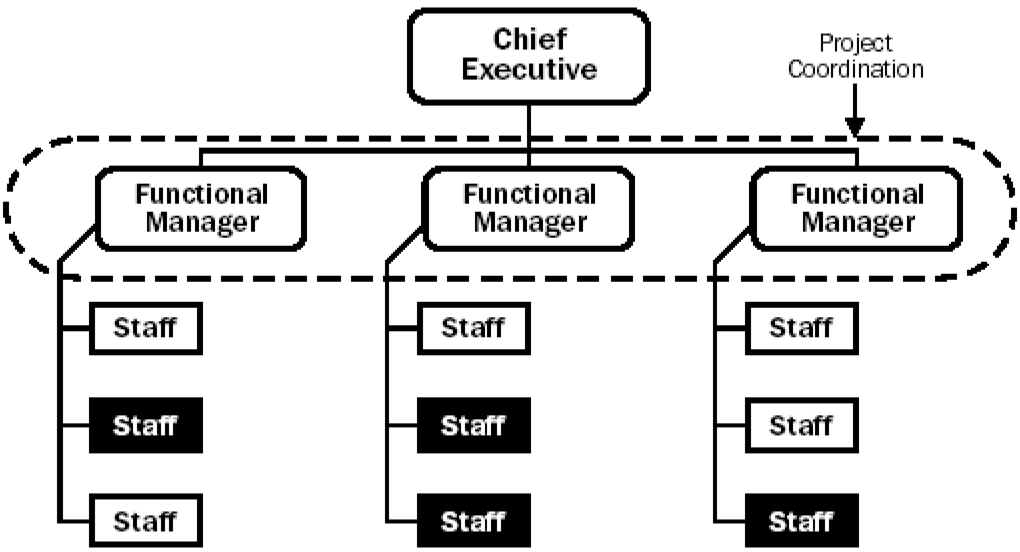
The modern organizations are in many ways a good thing, but we should also be sure not to take it too far. Working in projects should be a task performed with people you can have face to face conversations and discussions with. It is often an advantage to sit closely to the other project members in order to get to know them and the way they are working. If all members of a project would work from home, the learning curve could be reduced to a minimum.

2.4.2 Boundary-less organizations

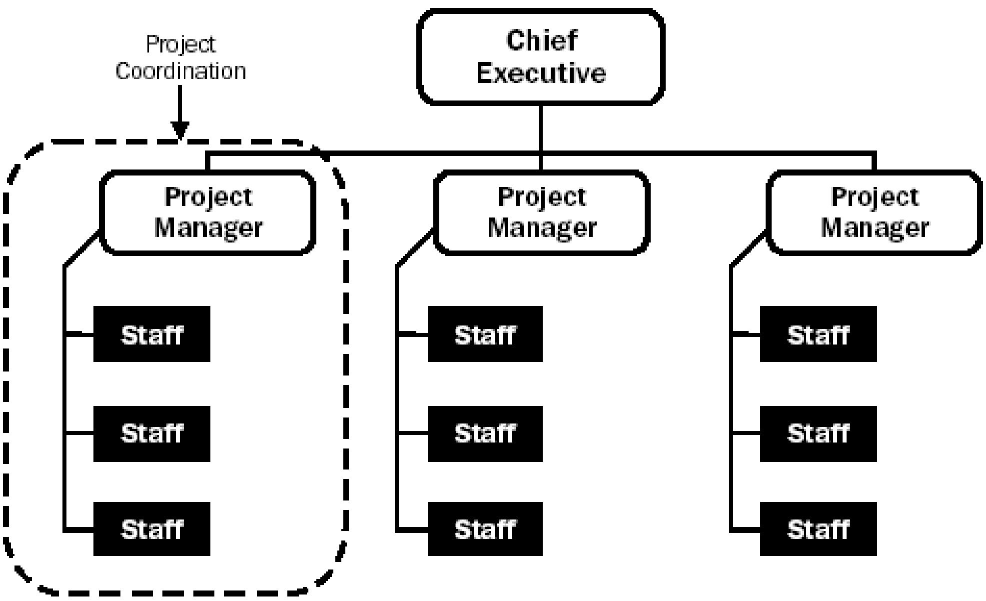
For an organization to perform effectively, the organization has to have a boundary-less environment. While organizations before often were bound to limits like departments, customers, clients and so on, the new modern organizations are more free to discuss problems open. The more available technology like computers also makes it easier to both suggest and discuss ideas with people in both close and large physical distance. For the boundary-less organization to function effectively, people have to move a little out of their comfort zone. In a boundary-less organization it is important to be open, sharing and receptive to constructive critic. This can be difficult for some, but the revenue of having a boundary-less organization is more creativity, more alternative ideas and solution, and a more open and free organization. In other words, a boundary-less organization is an organization without vertical or horizontal boundaries. (Frankel, 2008)

2.4.3 Traditional project organization

There are many different types of project organizations. The figure below explains some of the most regular project organizations today. The figure is borrowed from the Project Manager Institute, PMI (2005).

ORGANIZATION	EXPLANATION
FUNCTIONAL ORGANIZATION  (Black boxes represent staff engaged in project activities.)	Each employee has one clear superior. Groups are created by specialty. Engineers might be divided after specialty, such as electrical and mechanical. Engineering department independent.

PROJOCTIZED ORGANIZATION



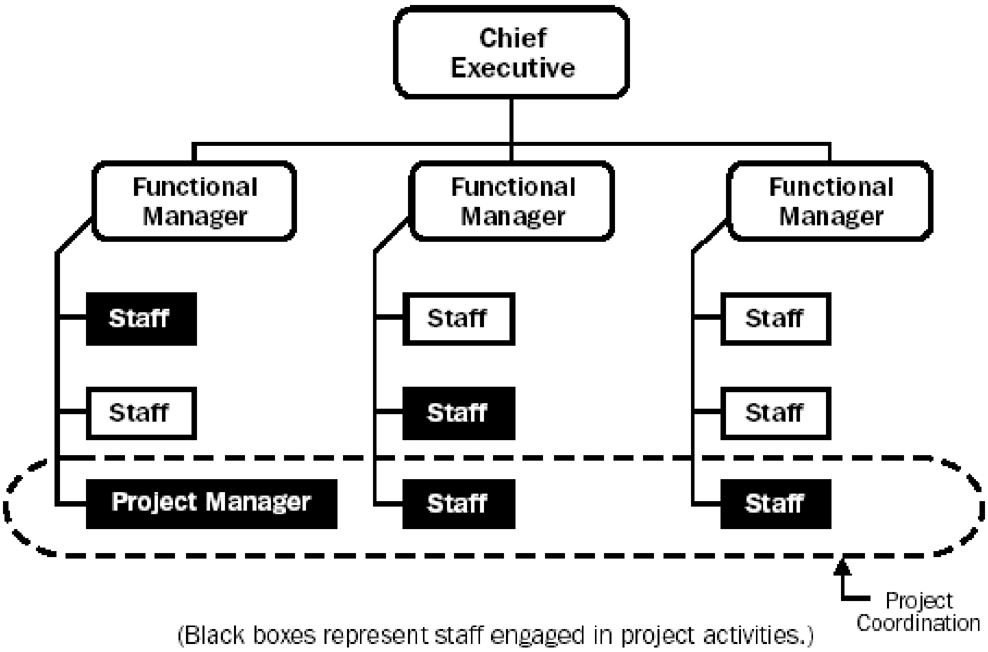
(Black boxes represent staff engaged in project activities.)

Often collocated team members.

Independent project managers.

Divided into different departments.

BALANCED MATRIX ORGANIZATION



(Black boxes represent staff engaged in project activities.)

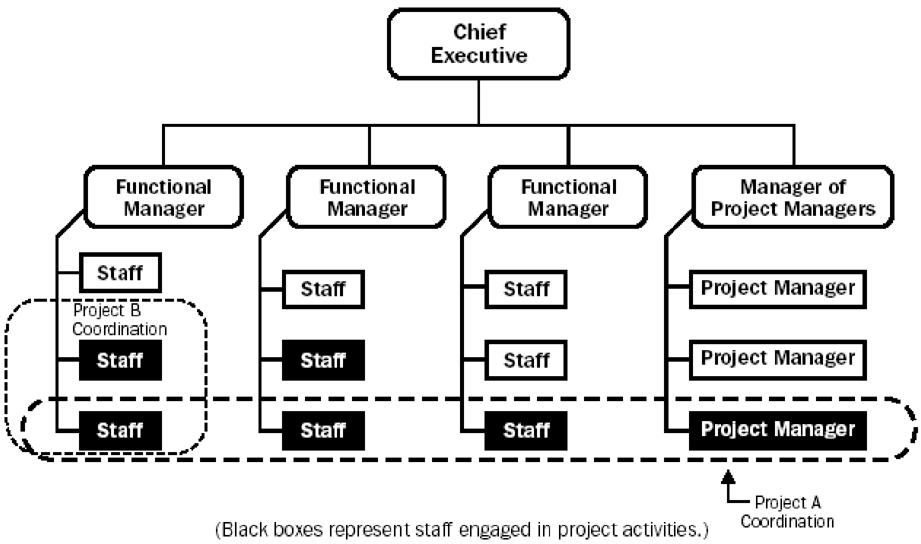
There are also weak and strong balanced matrix organizations.

They are all a blend of functional and projectized organizations.

Weak matrix is more similar to functional, and strong matrix is more similar to proctized.

<table>
<tr><td></td><td></td></tr>
<tr><td>

COMPOSITE ORGANIZATION



</td><td>The composite structure is a combination of all the structures mentioned above.</td></tr>
</table>

FIGURE 2-12: PROJECT ORGANIZATION STRUCTURES (REF. PMI, 2005)

As seen from the figures above, there are many different types of project organizations to choose between. They all have different advantages and disadvantages regarding roles and responsibilities, and some of those are mentioned in the figure below. The figure from PMI (2005) states the key project related characteristics of the different types of organizational structures.

Organization Structure	Functional	Matrix			Projectized
Project Characteristics		Weak Matrix	Balanced Matrix	Strong Matrix	
Project manager's authority	Little or none	Limited	Low to moderate	Moderate to high	High to almost total
Resource availability	Little or none	Limited	Low to moderate	Moderate to high	High to almost total
Who controls the budget	Functional Manager	Functional Manager	Mixed	Project Manager	Project Manager
Project manager's role	Part-time	Part-time	Full-time	Full-time	Full-time
Project management administrative staff	Part-time	Part-time	Part-time	Full-time	Full-time

Figure 2-13: Characteristics of Organizational Structures (ref. PMI, 2005)

2.4.4 A human performance perspective

To ensure that the organization is functioning as wanted, the human, activity and context circle should be followed. The organization should function in a way that ensures that the people in it at all times know the activity they are performing and the context of both themselves and the activity. The importance of having a strong link between the human, activity and context in an organization is explained in more detail below.

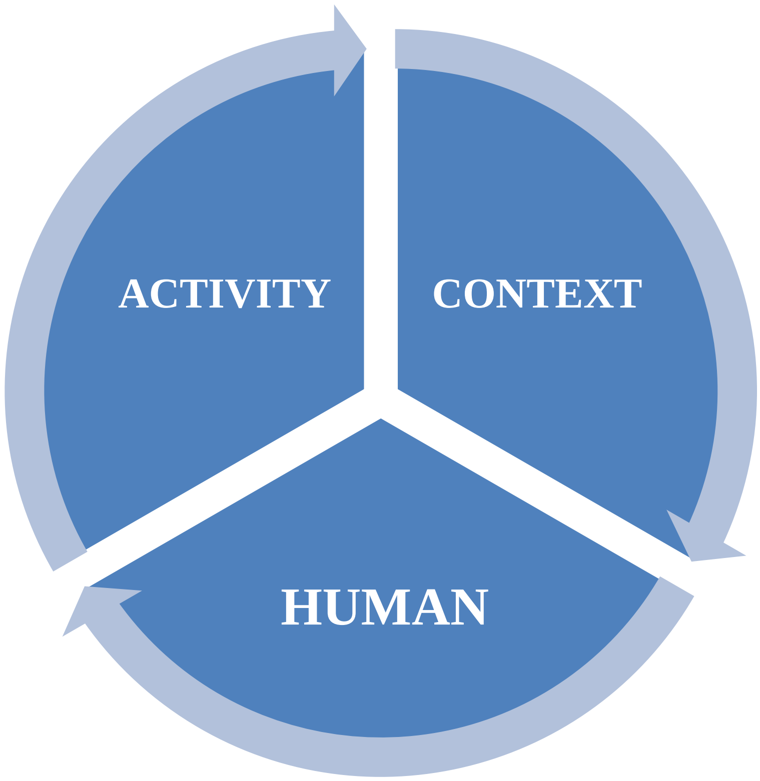


FIGURE 2-14: HUMAN, ACTIVITY, CONTEXT MODEL (REF. BAILEY, 1996)

According to Bailey (1996) there are different levels of performance. Most people will seek to perform perfect/optimal performance. In most industries, the designer of parts or systems does not have the knowledge, resources or requirements needed to be able to perform a perfect job. An acceptable level will have to be defined and used as a target to reach.

Bailey (1996) also says that a system designed to an acceptable level will experience errors, time delays, hang-ups and so on, it is therefore important for the designer to think about the human performance model when designing the system or equipment. The designer should have information and thoughts about the general state or condition of the humans involved, the activity (including equipment to be used) and also the context in which the activity is to be performed. One must also remember that it is not enough to just consider the human, activity and context separately; a combination analysis should also be performed.

As we can see from figure 2-14, human, activity and context are linked strongly together. In projects, everybody involved know that the other resources are someone doing something somewhere. It is important for a project manager to know the people involved in the project (the humans), the tasks they are performing (the activity) and also the context of the tasks and the context the task is performed in.

Human, activity and context have to be analyzed together in order to create a correct image of the human performance in projects. Humans are the most complex part of the model, as humans is easily affected by both what they see, hear and feel. Humans are often looked upon as the weakest part of a system due to many influences (ref. section 2.4.5.) the activities in project can vary a lot. There can be both easy activities, and activities that require much knowledge and experience. It is important for a project manager to see the human and the activity together and to analyze them to ensure that they fit together. If a resource in the project is only given either too advanced or too easy activities, this might affect the motivation and attention of the resource. The context can be divided into two main parts: the physical context (the work environment) and the context of the activity. The physical context is detailed described in section 2.4.5, and the context of the activity depends on the project. If the activity being performed is a small part of a bigger system it is important that the human are given information about this, so that he or she can study and find the information needed in order to make the activity fit the context as good as possible.

2.4.5 Performance influencing factors

The figure below shows a detailed presentation of performance-influencing factors. As we can see from the figure created by Redmill (1997), there are many “stresses” or combinations that can occur in a system, creating influences of the performance. Each single item in the figure is more detailed explained below, with reference to Redmill (1997).

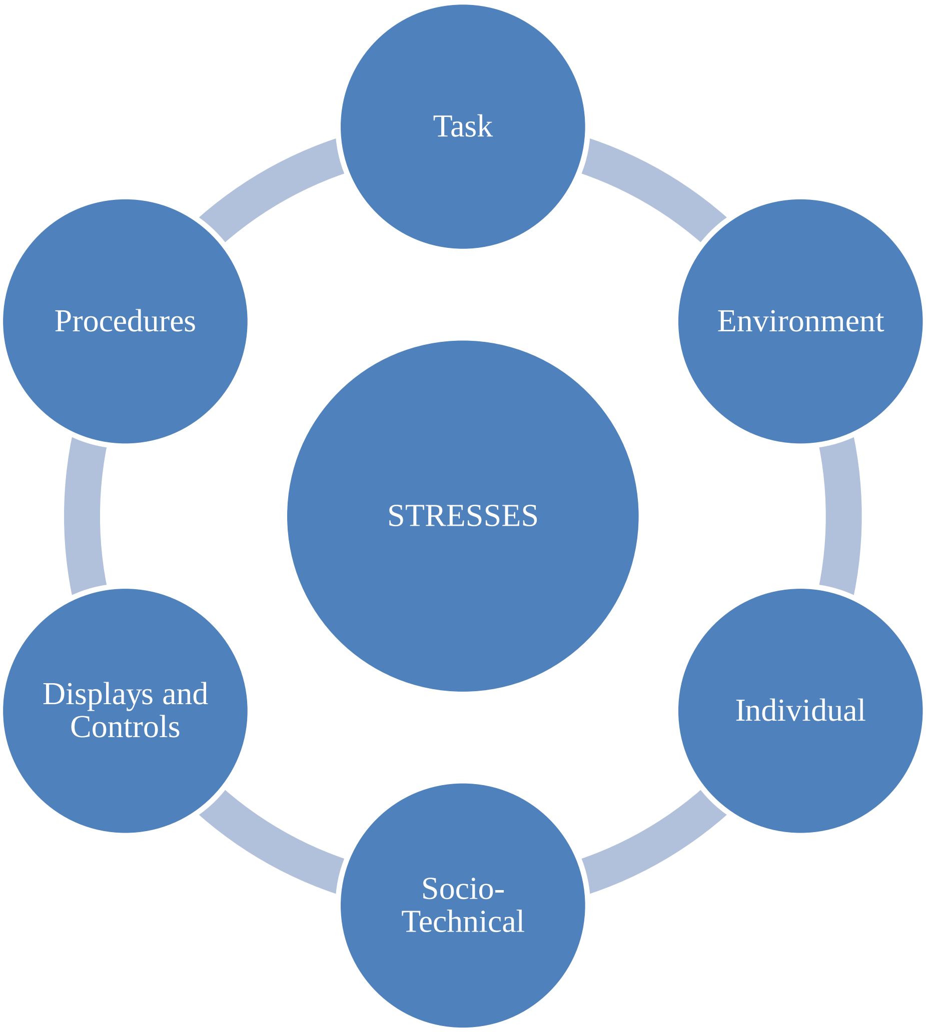


FIGURE 2-15: PERFORMANCE INFLUENCING FACTORS (REF. REDMILL, 1997)

Task

Performance influencing factors related to tasks can describe something about how much workload there is, how long the duration of the system/task is, how the task is integrating with other tasks, the memory of the task and also the attention the task requires.

All of the mentioned above will influence the performance. If a person has a workload that is too high, it can create stress, which again can lead to lack of attention to the task. In addition to having too many tasks, it is also possible to have tasks that are too advanced or technical for the persons knowledge and experience. This can lead to the feeling of not being good enough at what you do, and it can lead to frustration and lack of motivation.

If a person is working on too many tasks at one time, this can often lead to confusion, and it is possible to start mixing the different tasks together. This can again lead to rework and stressful situations.

Environment

Examples on performance influencing factors in the environment are related to temperature, humidity, noise, lightning, vibrations, workspace, and further on. When performing tasks, the environment has a lot influence on the performance. If you are to work by a computer all day, and you are being placed at a table too high with a chair too low and bad lightning, the result is often that you will not do the job as good or effective as you would with good lightning and a table and chair suited for your height and comfort.

In the new types of organizations, sitting in landscapes becomes more normal. This can for some be seen as a good environment, but for others it might not work at all. Humans are different, and the requirements different individuals have can vary a lot. While some might find it helpful working closer to others, and does not mind the extra sound level, this can be annoying for others.

Work environment should be suited for the individuals as far as possible. It is important to listen to the different needs people have in order to create work environments that people will be motivated and effective in.

Individual

Examples of performance influencing factors are skills, training, experience, knowledge, personality, physical condition, motivation and so on.

If humans are motivated by the work they are doing, they are often doing a better job than if they were not. Motivation is essential to perform a good job. Training, skills, experience and knowledge are also very important in a work situation. If a person is well trained it is more likely that he/she will perform the job in a more correct and effective way than a person with no training would do. The same counts for knowledge, skills and experience.
It is important to remember that all of the examples mentioned above can be related to each other. When working in teams it is important to respect each other's personality, knowledge and experience. It is important to find your position and ensure that you are not taking too

much or too little space in the team. It is also important to be humble and open to others even if they are different from yourself.

Socio-technical

Example of socio-technical factors that can influence the performance are work hours and breaks, recourse availability, communication, team structure, roles, responsibilities, and so on.

In order for projects to be executed in an effective way, all of the above mentioned examples are important. The different resources in a project should preferably work the same hours, they should all be aware of their own, and others, roles and responsibilities. Communication should be prioritized, and the number of resources dedicated to the project should reflect the amount of work in the project.

Procedures

Examples of factors that can influence the performance are the level of details, readability, ease of use, revision, format and so on

To have good procedures are one of the most important things to remember in a project. Without good procedures the parts are nearly useless. A good procedure should contain only the most important and relevant information, it should be easy to read and also create illustrations/pictures to make it easier to understand.

If the procedures for the work processes lack information or have bad formulations this can lead to people working on the same issues in different ways. In companies it is a goal to have as standardized work methods as possible to ensure that the different products developed are based on the same concepts and standards. Without clearly defined procedures and guidelines people will often find their own way of solving issues, leading to products being developed in an un-standardized way. To avoid challenges like this, all procedures and guidelines should be checked by at least two people to ensure that the quality is good enough.

Stresses

Examples of stresses are time pressure, workload, distractions, high-risk environment and so on.

Stresses will always influence performance, but not often in a good way. When there is time pressure, too much work to be done, and high risks, it is often not possible to avoid stress. Stress can also lead to individual influences, and often the performance will be affected in a bad way.

Workload is one of the most dangerous stresses there is. If a person has too much workload it will eventually lead to an enormous amount of stress, which again can lead to individual stresses. Not all people are comfortable telling their boss that they think their workload is too high, so this stress can go on for a long time period and eventually lead to sickness or even quitting the job.

3 MEG PROJECT, TECHNICAL REVIEW

This section will explain the technical issues in the MEG project, starting with the background for the project, and then continuing into the different project phases. This chapter will also include status quo review with project relevant examples from the methods and theories given in chapter two.

3.1 MEG SPECIFIC BACKGROUND

The MEG project consisted of a system consisting of five structures being developed and designed. The system layout is shown in figure 3-1.

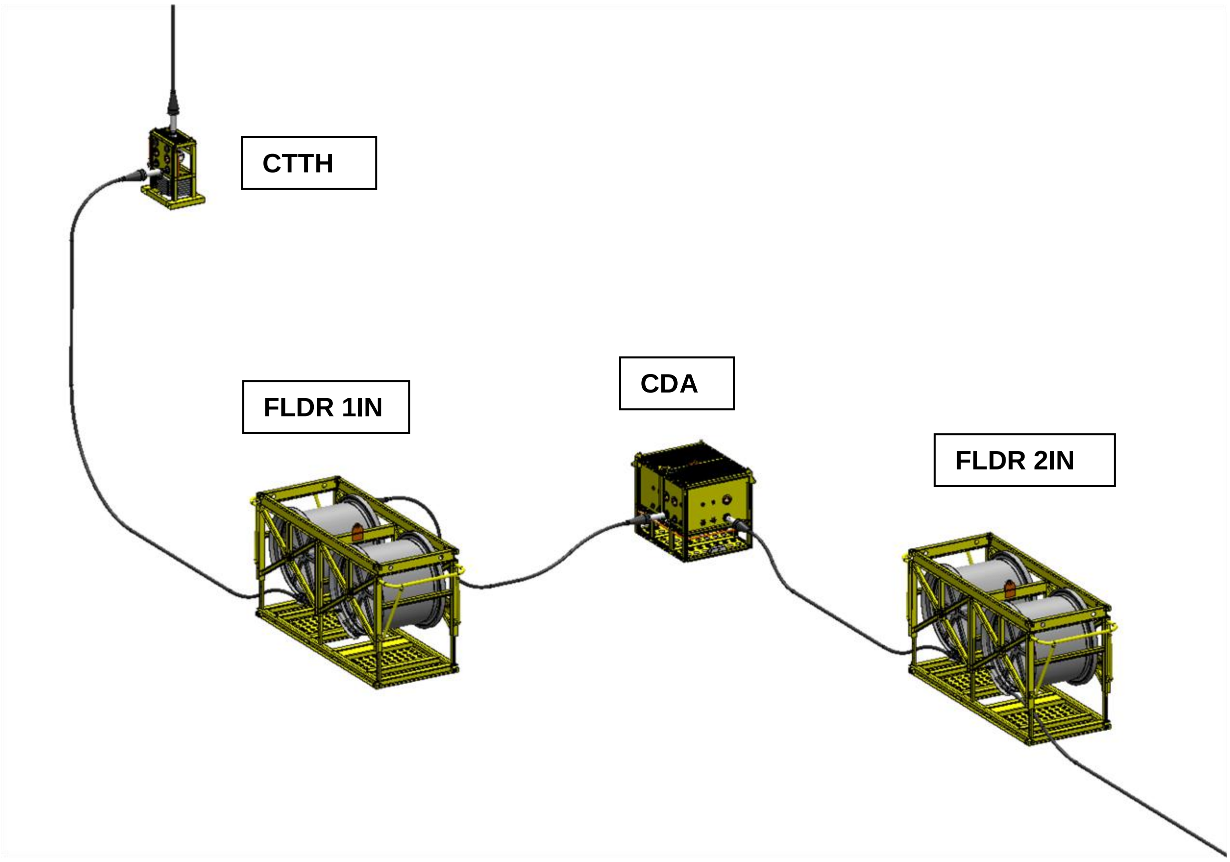


FIGURE 3-1: THE MEG PROJECT- SCOPE OF WORK

The MEG Distribution project is one of many projects that were developed after the accident in the GoM (Gulf of Mexico) in 2010.The accident led to a lot of changes in the offshore industry regarding safety and accident handling. The government got more involved in the safety, and also in how the companies prepared themselves for accidents that can occur. As a result, there were created new and stricter rules for the industry to follow.

After the accident in 2010 OPG (international occasions of Oil and Gas Procedures) demanded that emergency kits had to be created and available all over the world. From this demand, SWRP (Subsea Well Response Project) was created.

SWRP is a project group with members from 9 different oil and gas companies around the world. Their only mission is to create emergency packages from the specifications given by OPG. The formation of SWRP is given below, and it is an excerpt from their own homepage.

> *"The formation of SWRP shows the resolve of major oil and gas companies to work together to strengthen existing capabilities and enhance the industry's subsea well intervention capabilities.*
>
> *Together, we are addressing the complex and significant task of identifying and implementing capping and/or containment solutions that can be used in different regions across the world." (subseawellresponse, 2014)*

"What is the Subsea Well Response Project?

The Subsea Well Response Project (SWRP) is a non-profit joint initiative, led by technical experts and senior management from several of the world's major oil and gas companies. Operated by Shell on behalf of the other participating companies, SWRP's core objective was to manage the selection and design of caps and associated equipment to enhance industry capabilities to respond to well control incidents. This includes recommending a model for the international storage, maintenance and deployment of this equipment." (subseawellresponse, 2014)

As mentioned above, the objective of SWRP was to ensure that emergency packages were created. The emergency equipment that has been created as a result of the accident is created so that it will cover most of the accident scenarios. Even though the different scenarios has been evaluated, analyzed and tested in theory, one can never be 100% sure that they will work in real life practical situations or accidents. Also, all things needed in addition to the equipment itself (ROVs for example) are not part of the scope, and needs to be available for the equipment to be operated.

Below, SWRP has explained how the Deepwater Horizon accident has played a big part in developing new emergency equipment.

"Recent well control incidents have highlighted the need for the oil and gas industry to be able to cap and/or contain flowing wells with greater speed and efficiency. The Macondo response involved the design and deployment of new technologies and methods, and the industry is now focusing on how to apply these to a range of potential circumstances in different regions of the world." (subseawellresponse, 2014)

As mentioned above, SWRP consists of people from 9 different oil and gas companies. The company is a great example of how the industry has come together working towards a common goal: to response faster and better if an accident occurs. The fact that the equipment being created is to be placed at different locations around the world, and that SWRP is working closely together with OSRL and OPG shows that the industry is cooperating in a very good way. Below is a figure from SWRPs' homepage showing how they see the industry working together.

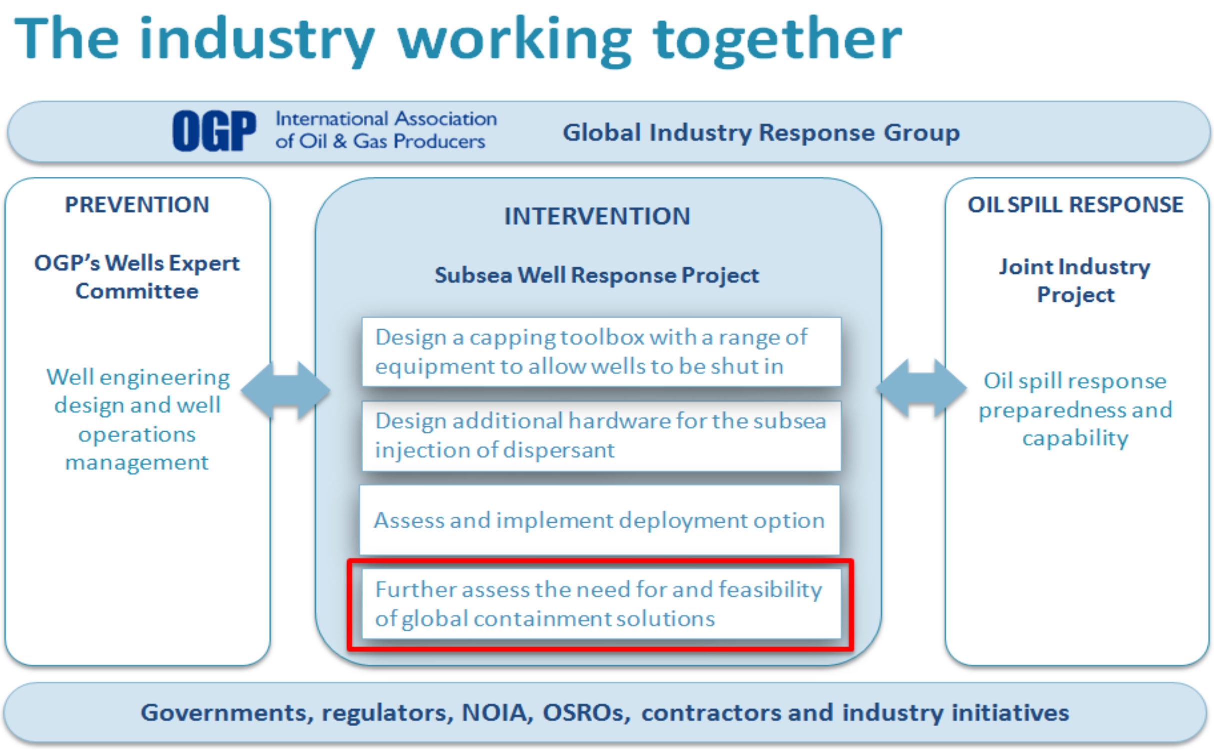


FIGURE 3-2: SUBSEA WELL RESPONSE; THE INDUSTRY WORKING TOGETHER

When the emergency equipment is finished, emergency teams will be developed. Teams that knows the systems and equipment, and teams that are specially trained in handling unwanted situations. The figure on the previous page shows how the industry is working together in developing both the emergency packages, and also the knowledge needed to use them.

After SWRP had worked on the emergency response project for about a year, it was decided that OSRL (Oil spill Response Limited) was to buy all the systems and ensure that they are stored, placed and maintained according to plan. The SWRP project group is a temporary group that is to be finished after all emergency packages/systems is ready and delivered.
When it was decided that OSRL was the company to own the systems, they expanded their company to include a new subsea department, as well as building up new facilities around the world.

OSRL is a company working primarily with oil recovery on the surface. They are owned by approximately 42 oil companies, and in the MEG project, they are the company that is going to purchase the system and be responsible for storage and maintenance of the equipment.

The chosen service company for this thesis was awarded the job based on the experience the company gained after the accident in GoM. The company has delivered 3 packages: SWRP (OSRL), AMOSC (a company similar to OSRL), and MEG (SWRP/OSRL) (to be delivered September 2014). SWRP and AMOSC (Australian Marin oil spill Centre) were similar deliveries.

Even though SWRP is now ensuring that the equipment is being built and tested, this is not enough in the long run. People also have to be trained in how to use it, and how to react/act if an accident occurs. As mentioned above, SWRP was created after the Deepwater Horizon accident in 2010. Figure 3-3 shows the development after the accident occurred. It explains when SWRP was created, and when ORSL became a part of the emergency “team”.

Timeline

July 2010 — OGP establishes Global Industry Response Group (GIRG).

February 2011 — Major oil and gas companies come together to commence the Subsea Well Response Project (SWRP).

May 2011 — GIRG publishes recommendations on well incident prevention, intervention and response.

SWRP is publicly launched.

April 2012 — SWRP unveils its plans for an integrated intervention system to enhance international incident response capabilities.

April 2012 — SWRP announces collaboration with Oil Spill Response Ltd (OSRL) to make the system available to the industry through membership of OSRL and a supplementary agreement.

OSRL signs procurement contracts for the manufacture of new subsea capping and dispersant equipment. In total, the intervention system includes four capping stack toolboxes and two kits for debris clearing and the subsea application of dispersant.

January 2013 — The first equipment is ready for use from vendor sites, in the event of an incident. OSRL is responsible for owning, storing and maintaining the equipment.

March 2013 — The first capping stack and dispersant hardware is publicly unveiled at OSRL's Stavanger storage base.

2013 — All equipment is stored across four international storage locations and available for industry use, in the event of an incident.

Summer 2013 — SWRP continues plans for a containment toolkit for international use.

FIGURE 3-3: SUBSEA WELL RESPONSE, TIMELINE

3.2 THE PROJECT PROCESS

The process of this project can be divided in three; the pre-study, engineering phase and production and testing phase. In large complex project this is a standard way of dividing a project. In smaller project the pre-study is often not necessary. The pre-study and the engineering phase does not have to include the same resources or teams, and the production phase often involves less engineers due to follow up can be assigned to one or two people, making the other resources available for new projects.

Pre-Study

The pre-study was performed before it was decided that the service company chosen for this thesis would “win” the project. Included in the pre-study is the bid phase, concept design and concept review.

Engineering

The purpose of the pre-study was to create new specifications out from the ones made by a consultancy company, and also to create concept models of the structure the project consisted of; the CDA, CTTH, and FLDR, to better show SWRP how they would look. In addition to this, it was also focused upon limiting the number of unknowns in order to decrease the end price of the project.

The purpose of the engineering phase was to develop the concept models further, and to create complete products. It was in this phase that all the detail engineering was performed, and all parts, drawings, and documentation was created. The engineering phase consisted of detail design and design review.

Production

The purpose of the production and testing phase was to be a support for the sub suppliers when they produced the different parts and structures. It was important that the engineer and the sub supplier had close contact in projects of this size, to ensure that everything was going according to plan. The testing phase consists of test of both single components, and also of the whole system.

This process is regular to use in big projects like this. In smaller project, a pre-study is not always necessary. The process is also dependant on how the project is, what the customer wants and how the schedule looks.

The project process explained above is illustrated with figure 3-4. This figure gives an image of how the project was executed.

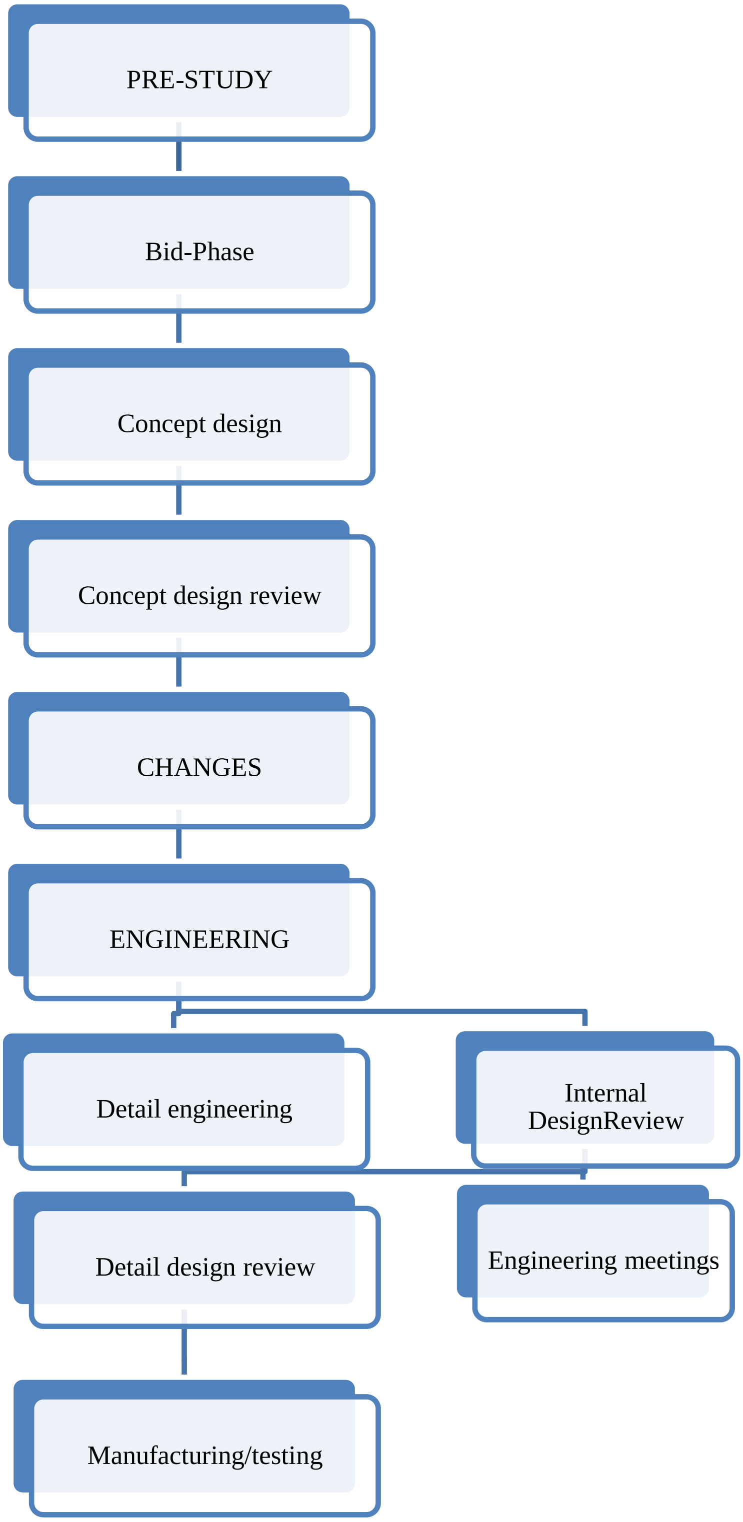


FIGURE 3-4: WORK PROCESS, FLOW CHART

3.2.1 Pre Study

The pre-study consisted of three phases; bid phase, concept design, and concept design review. The bid-phase often involves people from different departments like for instance sales, development and engineering. This to ensure that all the information from the customer is clearly understood and accepted before an offer is sent. The concept design phase is mostly focused upon understanding the scope of work and the specification, as well as creating concept models. The execution of the phases in this project is explained in the following sections.

Bid Phase – Customer Requirements

This chapter will go over some of the basic information written in the different specifications. All of this is information that all involved personnel at the service company had to be familiar with. A consultancy company was engaged by the customer to create the specifications for the MEG project.

The specifications had to be detailed due to the fact that the equipment created had to follow different rules, regulations and standards from all over the world. Since the consultancy companies' scope of work only consisted to create the specifications, not following them, they created them as bullet proof as possible. There were references to all standards available, and each and every pit fall was covered so that the customer would take no responsibility at all.

Goal with pre-study: create new specifications.

As mentioned above, the MEG Distribution project came with a lot of specifications. And even though a lot of them were re-written or modified, the amount of procedures and specifications in the project was still enormous.

Overview of specification content

A chronological order of the most important content in the specifications is fully given in appendix A.

- Before the project was started, milestones were created as to when the different phases of the project was expected to be complete. Each milestone represented a certain percentage of the total payment in the project.

- The customer required HSE (Health, Safety and Environment) and Progress Plans to be sent in each week, and they also required the service company to have scheduled meetings internal in the project each week. In addition to this, a WBS (Work Breakdown Structure) of the plan was to be sent to the client each month.

- As well as the things listed above, the specifications listed that all organizational changes inside the service company should be reported, all communication with subsuppliers reported, and a strict template for all meetings and reviews should be followed.

- A monthly progress report was also specified, containing information from all departments involved in the project.

- All sub suppliers used had to be approved by the client, and audits should be performed where client and/or Service Company found it necessary.

- For the tools to be developed by the service company, a BOD (Basis of Design) was created listing all standards to be used during design, assembly and testing. The BOD also listed materials approved for use, and the different alternatives of valves, hoses and receptacles that were approved for usage. The BOD is a specification created by the service company in cooperation with the client as a final deliverable in the pre-study.

3.2.2 Concept Design

As mentioned above, the purpose of the pre-study was to create new specifications.
In addition to creating new/revised specifications, the service company also created concept models of the tools and a basis of design where technical information and requirements was listed. The information given below is with reference to Appendix A.

The pre-study was estimated to take 740 hours (560 hours on engineering, 150 hours on management and meetings, and 30 hours on creating 2D models). The project team consisted of ten people, most of them senior engineers working as developers. The first plan was that the pre-study would be finished by the end of March 2013, but this was later changed to the end of May 2013. The change of the time period was a result of a meeting held at the end of march 2013, where the scope of work was changed, leading to re-design of both the CDA (Chemical Distribution Assembly), CTTH (Coiled Tube Termination Head), and FLDR (flying Lead Deployment Rack). The main causes for the redesign were that some lines were removed, and that the FLDR was too high for the new requirements. This lead to the pre-study being extended to the end of May instead of March.

According to the proposal for the pre-study, another aspect of the concept was to refine the design in order to minimize the number of hoses, improve manufacturability, decide the final concepts to make it ready for detail design, and to be able to order long lead items in advance of the project. For the FLDR's the main purpose in the concept design phase was to optimize the internal diameter of the hoses according to flow rates, to minimize the total number of hoses, and to optimize sizes and weights of the structures due to airfreight ability. The figure below shows how the FLDR looked in the pre-study.

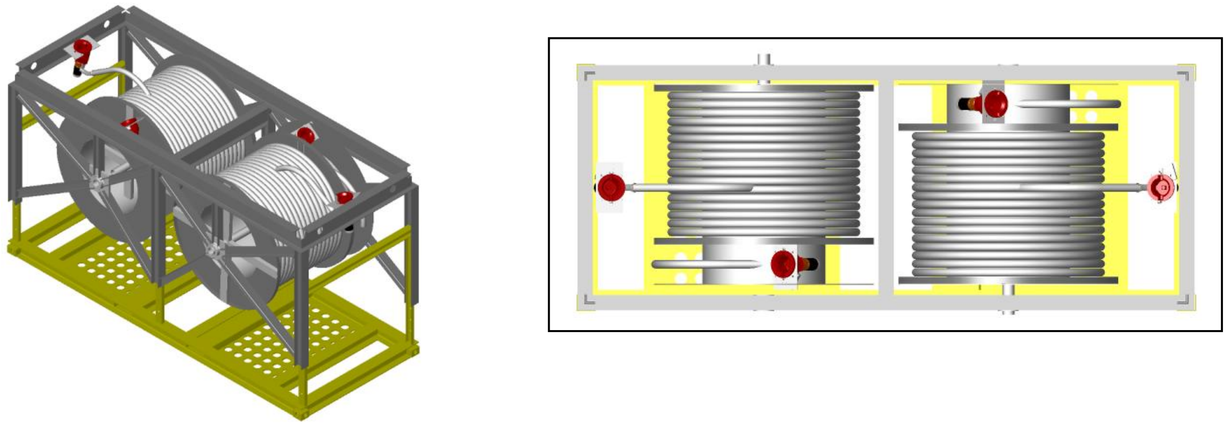


FIGURE 3-5: FLDR – PRE-STUDY

3.2.3 Changes

After the pre-study was finished, still some uncertainties about some of the components to be included in the different structures were present.

Some of the components were changed during the pre-study, some had more than one alternative supplier, and others were not changed before the detail engineering had started.

3.2.4 Engineering

As mentioned in chapter two, there are a lot of different methods that can be used to ensure that the design and the quality is as good as the customer expects.

At the service company, the detail engineering phase is divided like shown in the diagram below. The diagram is only presented as guidelines, not as rules to follow.

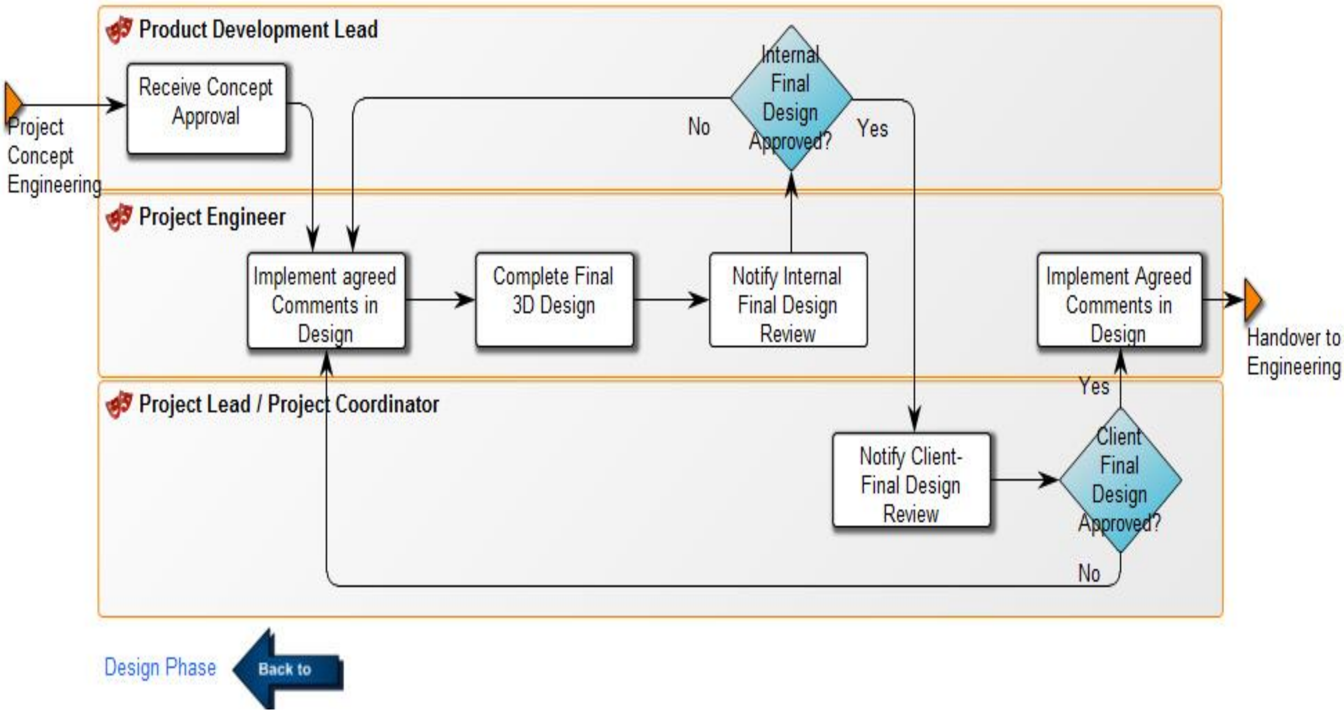


FIGURE 3-6: DETAIL DESIGN PROCESS

From this figure it is said that the concepts have to be finished before detail design is to be started. It does not state what a finished product should be, and therefore it is possible to experience that key components are still not decided upon when the detail engineering phase is started.

This figure shows the different roles and responsibilities in the detail design phase. Who is performing the different tasks and who is responsible for contacting for instance the customer when the design is ready for design review. The figure does not include any information regarding methods to be used when designing the models. This is often up to the individual engineers, or the project to decide.

A large focus was put on quality, and correct models in this project. Many of the methods explained in chapter two were used in this project without actually knowing that the way the project was executed was according to many of the methods.

3.2.5 Detail Design

When the project started in august 2013 the engineers assigned to the FLDR thought that the pre-study would give them the information needed to continue build up the structures. This was not the fact as to a decision made about removing one of the key functions of the FLDR. This decision was taken including or informing the engineers properly. These changes lead to a “new” pre-study phase, where most of the original ideas had to be thrown away.

The consequences of the new scope were that the engineering phase took much more time than first planned. When the 3D models (a total of five) finally started to look like they were supposed to, a challenge was discovered; The SW (Solid Works) models were too big and it was nearly impossible to open them. Even worse was it to work with them. After some time the engineers figured out that they needed help from the drawing department to be able to continuing working on the models. The result of this was that all five models had to be built up new from scratch. This could have been avoided if the drawing department had been involved in the project earlier.

All of the engineering resources on the project agree that both the drawing department and the structural department should have been a part of the team from the beginning of. This to avoid setbacks and to ensure that modelling was done correctly the first time.

One of the greatest challenges in the engineering phase was to agree upon solutions. The frame took a long time to build due to challenges considering size and forces, which again lead to the engineers spending a lot of time waiting on this to be solved, unable to continue with their work.

The engineers working on the FLDR also experienced some difficulties against the structural department, as they were struggling with getting the structure strong enough. The structure was changed a number of times, not all of which the engineer was informed of. This lead to difficulties due to the fact that all components had to fit into the structure. Another issue that was experienced was that the structural department did not save their models in the database, which lead to the engineers not being able to see or check the structure while the structural department was working on it. This could have been avoided by either having a short meeting each morning where it was decided who was going to work in the model that day, by having better communication between those involved in the project, or by having all models in the database at all times.

Another great challenge has been that all components were linked together in a way that made it impossible to finish up one and one part. All the different sub-assemblies and assemblies were linked together in a way that everything had an effect on the parts surrounding it.

Engineering Meetings

During the project, engineering meetings was held each week. As discussed in the status quo review, the meetings consisted of planning new tasks to be performed, and also checking that tasks had been performed according to plan.

In this section some of the main tasks on the FLDR will be described. This is done because it is important to see how the different tasks were connected to each other, and to see the consequences if a task were not completed according to plan. The figure below shows a timeline over the main tasks to be performed, they are also explained in more detail afterwards.

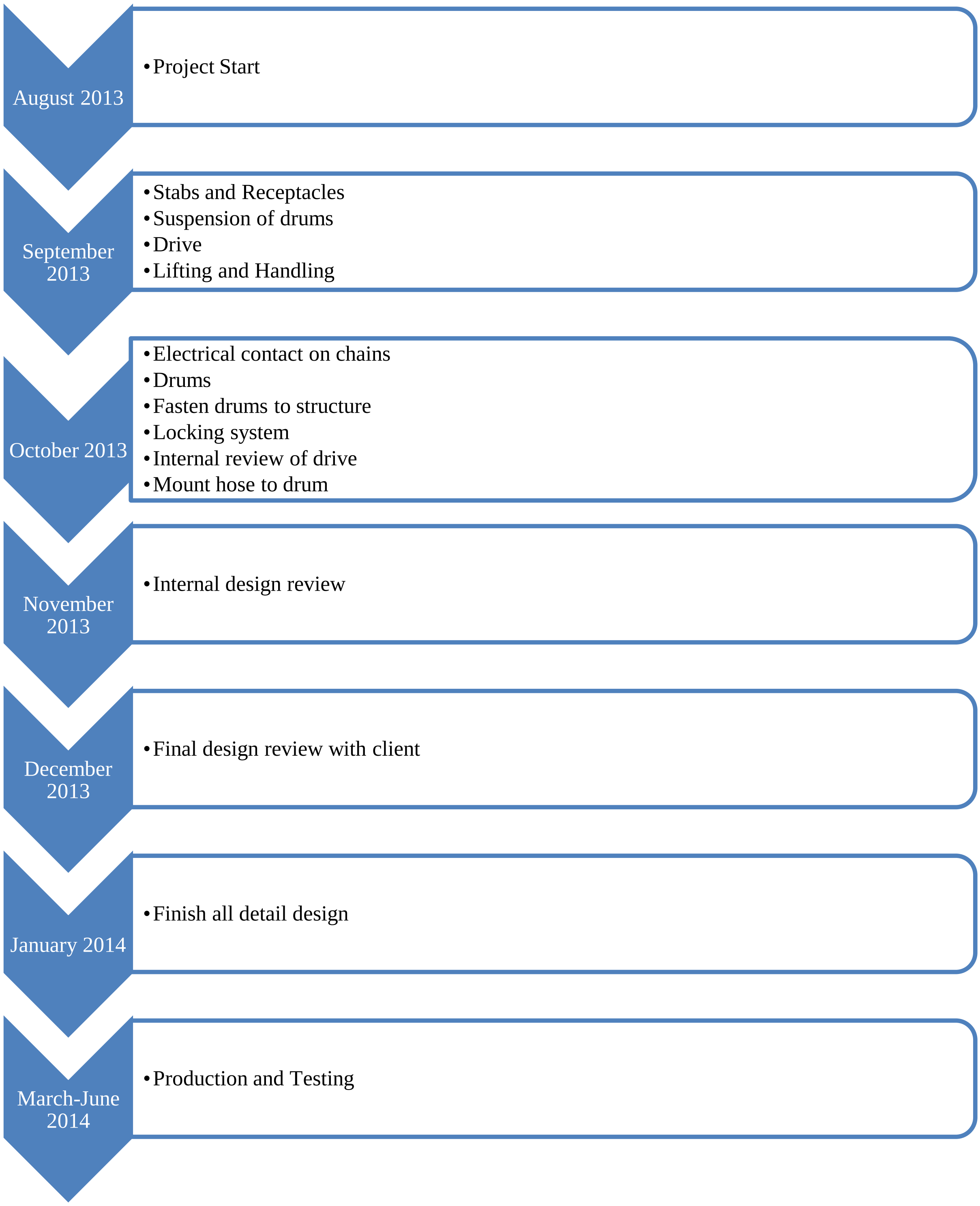


FIGURE 3-7: TIMELINE, ENGINEERING MEETINGS

The project started up in August 2013, and it was already then decided that the design review on the FLDR was to be pushed to late autumn/early winter the same year. The first goals (milestones) that was set for the FLDR was the concept design of the Parking Receptacles, as well as design of the structure.

From the beginning, the engineering deadline was set to be at November 1st 2013, and resources on the draft department were booked.

The first internal design review was held in the beginning of September (Parking Receptacles). At this time it was also decided to add two extra resources to the project, as well as an estimated 100 hours for drafting.

During the rest of September the main goals was the following:

- Decide upon the number of stabs and receptacles
- Concept design on suspension of drums
- Finish the drive
- Decide upon lifting and handling

In October more goals were added even though those from September were still ongoing. This mostly due to the fact that all of the parts in the structure were connected to, or dependent of each other. The new goals in October were:

- Chains- electrical conductivity
- The drums (including internal design review)
- How to fasten the drums to the structure
- Design the locking system used to lock the drums
- Internal design review on the drive
- Decide how the hoses were to be mounted onto the drum

In October it was also decided that the date of internal design review was to be scheduled at the November 18th, and that the design review with the client should be held at November 25th.

The focus in November was to hold the internal design reviews needed in order to be ready for the review with the client at the end of the month. In the middle of the month it was decided to move the final design review to December, as well as getting a resource from the drafting department to work on the drawings of the structure.

The goals for December were to have the final design review with the client, as well as start producing the prototype of the structure and the drums.

In January the work after the design review started. More hours on engineering and draft had to be added to the plan, and all the assemblies had to be built. Much of the detailed decisions were still unclear, and needed to be decided upon. A list was created, and January and February was used to finish up all parts and assemblies, as well as to start on the documentation.

3.2.6 Detail Design Review

After the final design review with the client in December 2013 a lot of work still had to be done. The GA's (General Assemblies) had only been built for information for the review (with the customers' approval), so approximately two months was spent finishing up all components and creating the correct GA's.

A lot of this time was spent on finishing up the last components, and adding the correct information in the data card of each part. The data cards had to be filled with correct information for the expeditors to be able to order the correct components. If this had been done correctly the first time, it would not have caused so much extra time and work.

In addition to creating data cards, all the 2D drawings had to be checked and approved. This required that at least three engineers had reviewed and verified the drawings before they were approved. All drawings had to be approved before the drawing of the GA's could start. The GA drawings were a challenge due to huge models.

3.2.7 Manufacturing/testing

It was decided that the FLDR's should be built in Poland. This would save the project a lot of money, and it would be time saving as well. The company located in Poland also estimated a lot of assembly processes into the price, which again led to fewer assembly hours back at the base in Norway. For a long time, the idea of building the FLDR's in Poland looked like a good and cost effective solution, but after the first inspection this changed dramatically. The HSE standard at the company was of poor quality, and the production of the FLDR's was put on hold immediately.

The service company contacted SWRP and told them that they would not continue the production before they could ensure themselves that the HSE standards in Poland were good enough. This was very much appreciated as too many companies in the field often try to "hide" these types of issues. A plan was created and sent to Poland with instructions on how and what they had to do to be able to start the production again. To ensure that the instructions were followed, both the service company and SWRP arranged several trips to the supplier in Poland to ensure that they followed the HSE policy in the project.

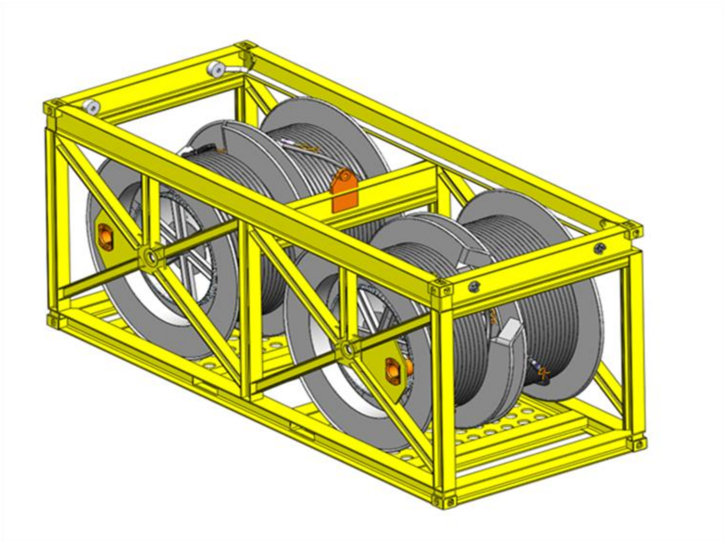


FIGURE 3-8: FLDR PHASE 1 – TOP VIEW

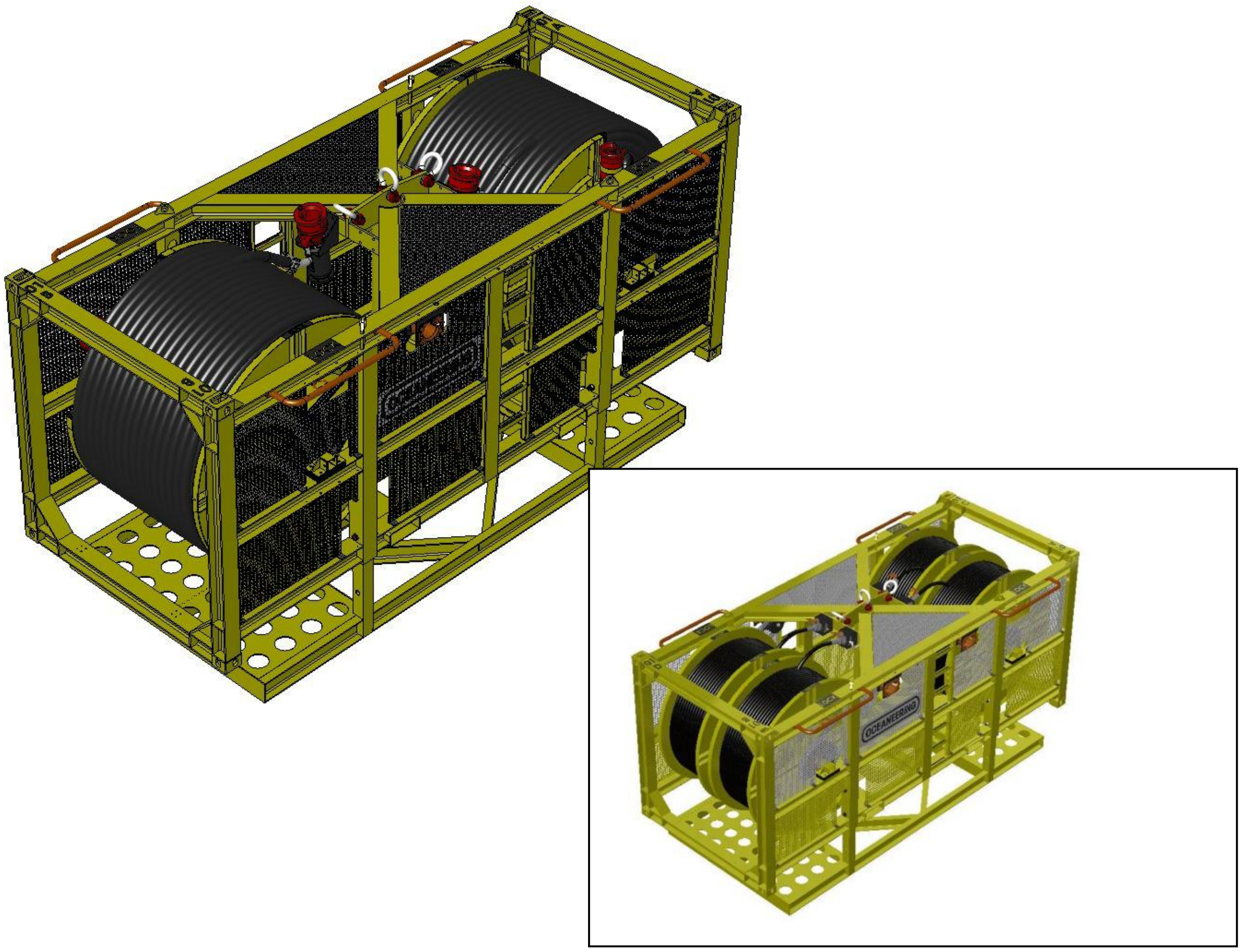


FIGURE 3-9: FLDR – DECEMBER 2013

Figure 3-8 and 3-9 shows the changes made to the FLDR during the engineering phase from August to December 2013.

3.2.8 CTTH/CDA

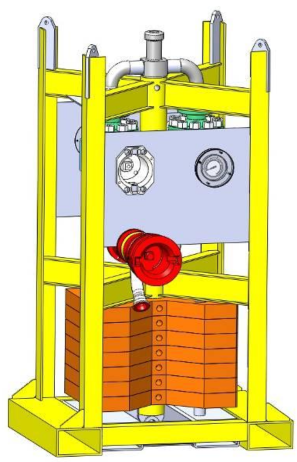
In addition to the FLDRs', the MEG project also consisted of two more structures; the CTTH and the CDA. These two structures have not been given that much attention in this thesis, due to them being more straight forward and easier to create than the FLDRs'.

Below is a brief summary of the two.

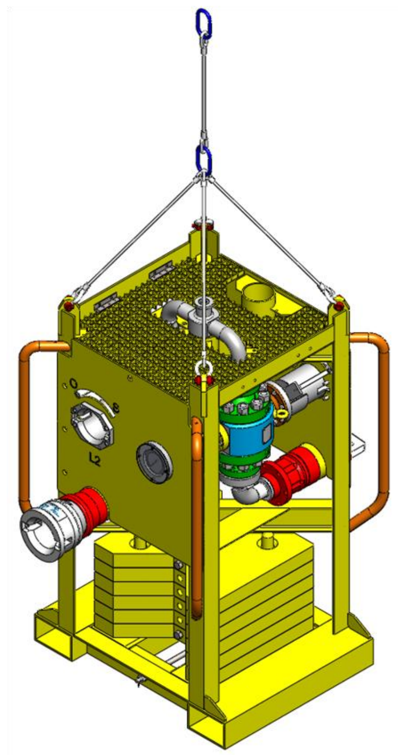
CTTH

The CTTH was more or less finished after the Pre-study. After a month or two with detail work, it was decided to change suppliers on the valves, receptacles and the stabs. This resulted in a new engineering phase, where the CTTH had to be changed due to the size and weight differences on the valves (ref. Figure 3-10).

The BOD on the CTTH was well defined and explained the structure in great detail. This made the work fairly easy. There were also very little design that had to be developed on it, as the number of the different components included was given in the specifications, and the overall design was dependent on the size and weight of the valves and receptacles.



CTTH Engineering Phase

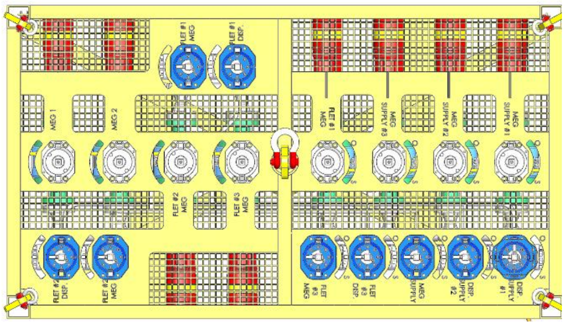


CTTH Final Design

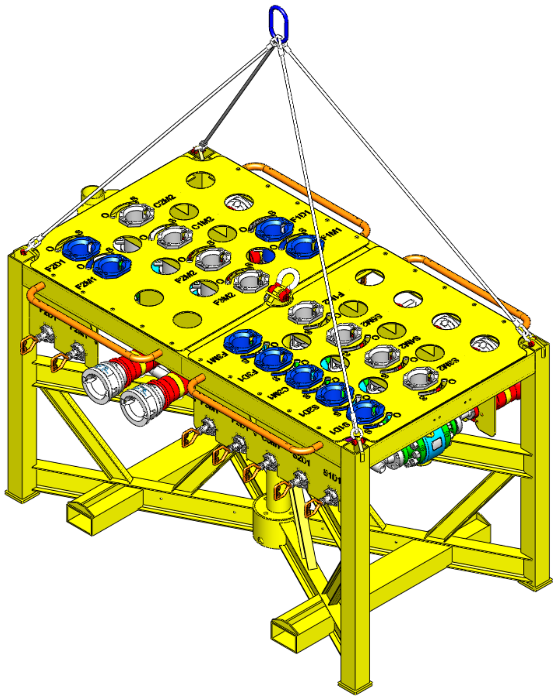
FIGURE 3-10: CTTH

CDA

The CDA was, as the CTTH, more or less finished after the pre-study. The changes made to the CDA consisted of building up the structure and figuring out how and where to place all the different components to allow easy access, logical paths, and enough strength to the structure.



CDA Pre Study



CDA Final Design

FIGURE 3-11: CDA

3.3 TECHNICAL REVIEW OF THE MEG PROJECT

This chapter consists of a technical review of the MEG project with reference to chapter 2.2 (Status Quo). The different methods and models described in this project has been evaluated and implemented into the MEG project, and a review of the project has been done.

3.3.1 Review with respect to Quality assurance for continuous improvement process

There are a lot of different ways to execute the engineering phase, one of them is presented below; the PDCA wheel. The main theory behind this method was presented in chapter 2.2.1. The PDCA wheel consists of four steps; Plan, Do, Check and Act. This is a method that is used in both small and large projects at the chosen service company. The method ensures that all work is planned before started, and that it is checked before approved. In projects like this, he PDCA wheel is used several times, all throughout the project. More about this is described in figure 3-12.

PDCA	CONSIDERATIONS IN MEG PROJECT
PLAN	In this project it is possible to look at the pre-study as one of the planning phases. In the pre-study time was spent on trying to completely understand the specifications and the project scope. The project team spent a lot of time on creating the Basis of Design, which meant that they had to dig deep into the specifications of the project to figure out the scope and where there were challenges or not.
DO	The engineering phase can be considered as one of the "Do" phases in this project. Even though there were a lot more work than what this phase refers to, a lot of that would not have occurred if the management did not decide to change som key-parts. In the engineering phase the knowledge learned in the planning phase was used to develope the structures.
CHECK	Some of the checking phases in this project can be related to internal and customer design reviews. Before the client design review a internal review was held to ensure that everything was correct. The checking phase has to be together with the customer on projects like this, to ensure that all their expectations are met.
ACT	In this project the first "act phase" was to set all parts in production. Setting the parts in production marks the ending of the engineering process, and also the beginning of the next process: purchasing.

FIGURE 3-12: THE PDCA IN THE MEG PROJECT

As mentioned above, the PDCA wheel was used a lot during the project, especially in the engineering phase.

As this project contained development of new techniques and tools, the PDCA circle had to be used on a detail level in order to ensure that all the solutions and components would present the best possible solution. It can be said that the PDCA wheel was used at least once a week during the engineering phase in project meetings held every week. In these meetings one planned actions to perform that week, and in the next meeting one would check that the different tasks had been done and that they worked, as well as plan for new tasks for the next week.

To keep the wheels spinning in this project they went from the engineering phase to the purchasing phase. A plan had to be created for when the different parts had to be delivered, they had to order the parts, check that they were on schedule, and to receive them. In this phase the engineering team were also involved in supporting both the purchaser and the suppliers.

After receiving the parts a new wheel started; the assembly and testing phase. This phase started with creating a plan over how long it would take to build the different structures and how they should be built. The structures then had to be built and tested before being ready for delivery. In this phase the purchaser followed up on the lead time for the parts, and the engineers had to support the technicians when building and testing the structures.

Comment: *The PDCA wheel is a good way to ensure that all tasks are planned and checked properly before and after they are performed. The method is used not only in the engineering phases of a project, it is used throughout the entire project. This method is ensuring both quality and continuous improvement, and it is a method that should be used even more, not only in projects. The method is easy to implement into almost all processes, and it can also be used as the connection link between processes or departments.*

3.3.2 Review with respect to System interfaces for safe and secure development and execution

Another method that was used in the project was the design process that matches the interfaces to soft components described in chapter 2.2.2. It was not known to the project that they followed this method, but they actually did.

When the project started it was important to get a complete overview over what should be done. The six stages explained below explains how the project has been executed during the different stages.

STAGE 1: DETERMINE OBJECTIVES AND PERFORMANCE SPECIFICATIONS

In this project stage 1 was given in the specifications, basis of design and the scope of work. These documents told the resources the reason for why the system should be designed, and how it should function.

STAGE 2: DEFINITION OF THE SYSTEM

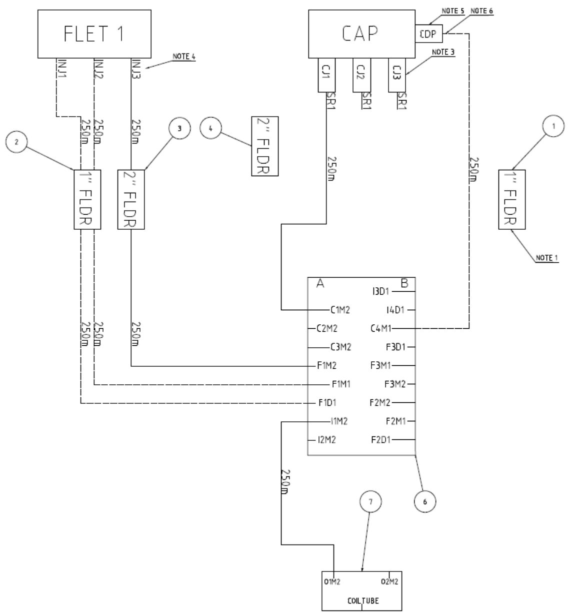


FIGURE 3-13: SYSTEM LAYOUT MEG PROJECT

In this project the field layout was given and used to decide how to create the different structures. The field layout diagram created a vision of how the system would look like when finished, and it started the thinking processes on how these sketches could turn into real models.

STAGE 3: BASIC DESIGN

The basic design here was to ensure that all requirements were held, and that the structures were able to perform the tasks they were designed for. The design phase was the phase given the most time in the project. Here it was used a lot of time evaluating different solutions, as well as trying and failing on different designs to ensure that the best design was chosen.

STAGE 4: INTERFACE DESIGN

The different interfaces were to a certain degree decided upon before the project started, so the engineers job was to ensure that the interfaces could be reached by the ROV, and that the design they created was both interface- and ROV (Remote Operated Vehicle) friendly. It was important to ensure that all interfaces were easily accessible for the ROV.

STAGE 5: FACILITATOR DESIGN

When the basic design and interface design is decided upon it is important to pay attention to what materials to use. In the subsea industry this is one of the most important phases due to the fact that all systems are to be placed in harsh environment. Materials have to be protected from corrosion, they have to fit together, and materials that could react or damage each other should be avoided. What kind of coating to use is also important here, as well as colours to use. All ROV interfaces should be painted orange, and all structures yellow. These things might seem like details for people not working in the industry, but for those who do, it is extremely important to find the right materials, coatings and colours to a design. There are different standards that are used in the industry that explains coating and colours on different components so that they are the same everywhere.

User manuals and test manuals are also an important part of the design. Often are these two paid much attention to, and in the oil and gas industry both the Operation and Maintenance Manual (OMM) and the Factory Acceptance Test (FAT) procedure has to be approved by the customer before they receive the finished products.

There is certain “rule of thumbs” to follow when writing an OMM or FAT:

- Less is more, only include the relevant information.
- Use only concrete information.
- Concentrate on how’s, not why’s.
- Remember that learning will come from doing.

In addition to the rules mentioned above, the use of pictures and/or illustrations is a good way for the reader of the procedure to be absolutely sure that he/she understands what he/she is reading. (Sanders and McCormic, 1992) It is often easier to explain something with the use of pictures than with words.

STAGE 6: TESTING AND EVALUATION

The testing of the MEG components was performed at different levels. All the components were tested separately before they arrived for assembly. The different structures were tested one by one, and a system test was then performed.

When performing tests at so many levels it is easier to find possible errors if they occur.

Due to the fact that this equipment is to be used subsea, a system test has to be performed under water.

3.3.3 Review with respect to Descision making for effective performance

Like written in chapter 2.2.3, good decision making processes is important for effective performance. In this project, several months was used to read and understand the different specifications to the project. All specifications included references to standards and regulations that also needed to be fully understood. With reference to figure 2-7: Pyramid Frame, this reflects the top frame of the pyramid. While working on the specifications, problem areas and uncertainties were found (frame two) to consist of requirements that made the project difficult to execute for the chosen service company. In order to figure out how it would be possible for the service company to execute the project in a way they found acceptable, the problems was analyzed in detail (frame 3) and a decision was taken to write the Basis of Design like explained in chapter 3.3.1.

A lot of the components in the project had several alternatives regarding supplier. A decision matrix was used to decide which supplier to use in the project. The main weighting was the commercial parts of the products (50%), then followed the technical parts (35%), and QA/HSE was weighted 15%. Some of the components chosen led to significant changes in the designs of the structures, and it can therefore be said that the decisions taken was tactical. They would lead to more work for the designers, but it also saved a lot cost for the company. An example of a weighted decision matrix used by the chosen service company in this project is given in table 3-1..

TABLE 3-1: DECISION MATRIX MEG PROJECT

COMMERCIAL (50%)	BIDDER 1	BIDDER 2	BIDDER 3	BIDDER 4	TOTAL
Price (50%)	30%	5%	60%	5%	100%
Delivery time (20%)	40%	25%	25%	10%	100%
Acceptance of T&C (5%)	25%	25%	25%	25%	100%
Credit rating (5%)	25%	25%	25%	25%	100%
Service (10%)	15%	40%	30%	15%	100%
Flexibility internal (5%)	20%	40%	20%	20%	100%
External suppliers (3%)	25%	25%	25%	25%	100%
Project management (2%)	25%	25%	25%	25%	100%
Total	**29,25%**	**17,25%**	**47,75%**	**10,75%**	
TECHNICAL (35%)					100%
Qualified equipment (20%)	33,30%	0%	33,30%	33,30%	100%
Product experience (15%)	30%	10%	30%	30%	100%
Weight (25%)	25%	40%	25%	10%	100%
Size (10%)	25%	40%	25%	10%	100%
Can deliver all parts needed (15%)	0%	33,30%	33,30%	33,30%	100%
Engineering hours at service company (15%)	25%	40%	25%	10%	100%
Total	**23,66%**	**26,50%**	**28,66%**	**21,16%**	
QA/HSE (15%)					100%
Traceability OK (50%)	25%	25%	25%	25%	100%
Measurement (15%)	25%	25%	25%	25%	100%
Low sick leave (5%)	25%	25%	25%	25%	100%
Non conformance system implemented (15%)	25%	25%	25%	25%	100%
Documentation (10%)	25%	25%	25%	25%	100%
ISO certified (5%)	25%	25%	25%	25%	100%
Total	25%	25%	25%	25%	
SUM TOTAL:	**26,66%**	**21,65%**	**35,15%**	**16,53%**	

In the example matrix shown above, the systems that are used are giving the highest weighting to the best alternative. Bidder 3 has for instance been given 60% weighting on the price, because the other suppliers products were a lot more expensive. When using a decision matrix like done here, it is easy to find out which supplier to use, and to ensure that all the different weighting is considered.

4 MEG PROJECT, ORGANIZATIONAL REVIEW

In this chapter the MEG project will be explained from the organizational view. There will be a short presentation of the re-organization process that was performed before the project started, followed by the project organization, its resources and how it was said that the project was "bigger than the organization". The chapter will end with a review with respect to the methods and models described in chapter 2.4, Status Quo.

4.1 RE - ORGANIZATION

In the chosen service company, the growth over the last years has been enormous. In 2004 the company had 242 employees, and in 2014 the number of employees is 1054. This growth is caused both by new employees being hired at the company, but also through buying up other companies. In order to keep up with the market it was decided that a re-organization was necessary. While the organization before could be seen as what Chambers (1989) and Gardiner (2005) describes as a typical Product Structure (see figure 4.1) with different teams for each type of products, and only one manager to relate to, the re-organization process should lead to a organization that was more comparable to the Matrix structure (figure 4.2) where the aim is to give greater visibility and management control to projects.

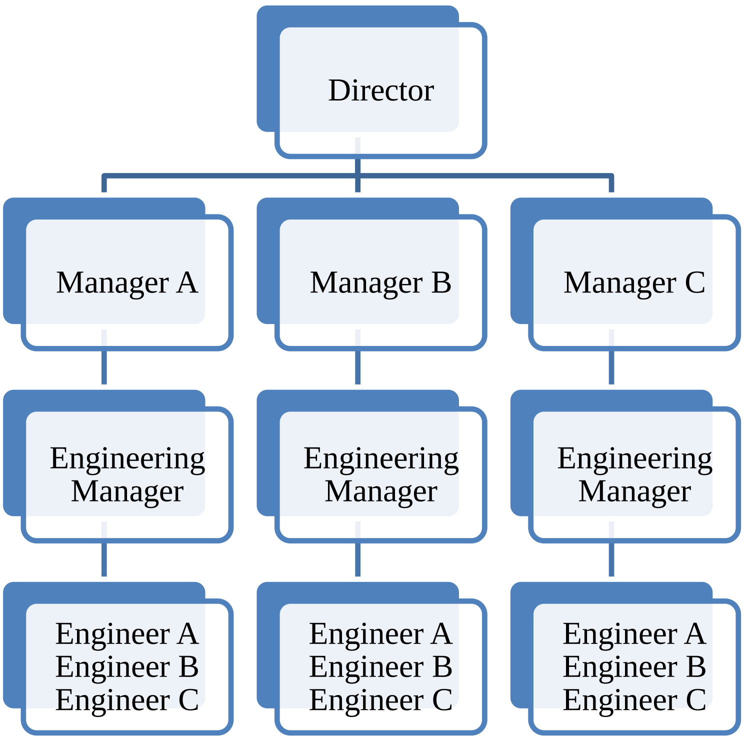


FIGURE 4-1: PRODUCT STRUCTURE (REF. CHAMBERS, 1989 AND GARDINER, 2005)

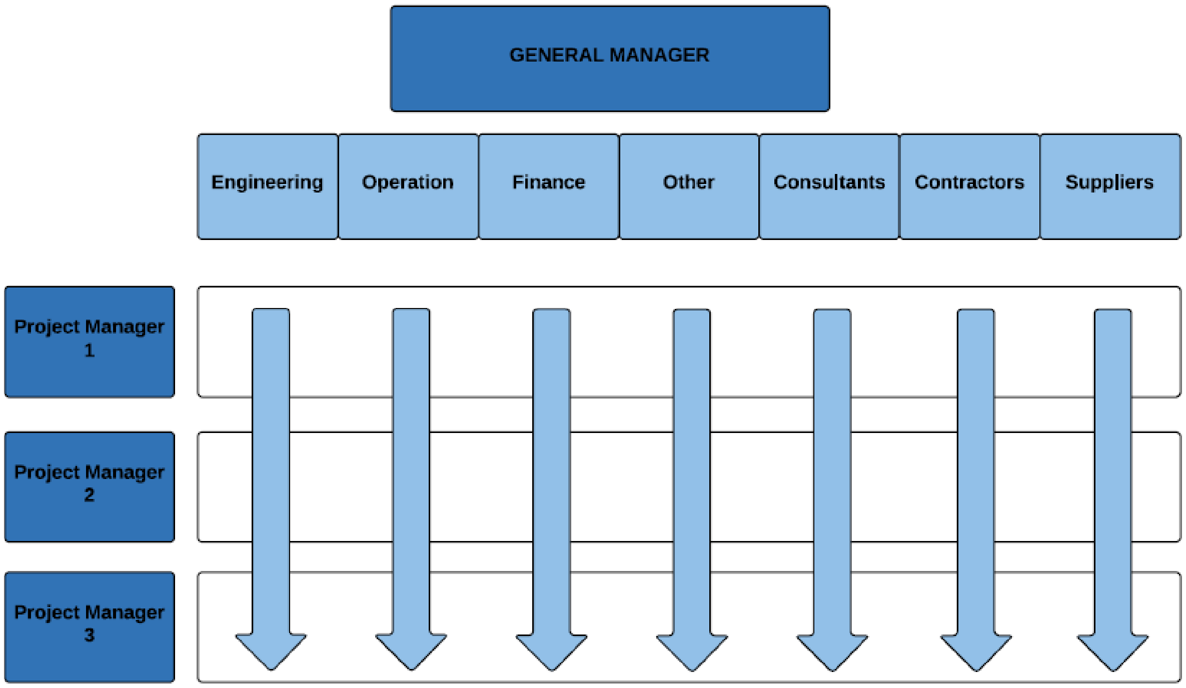


FIGURE 4-2: MATRIX STRUCTURE (REF. CHAMBERS, 1989 AND GARDINER, 2005)

The greatest change in the re-organization process was that the engineering group was to be divided into three new groups: development, engineering, and operation

OPERATIONS

The operations department consists of the project managers. This group is responsible for leading all customer related projects. They are responsible for the economy, the resources and that the project follows the plan.

This department mainly consists of people who used to work as project engineers before (approximate 50% of those working there now have been working as project engineers in the company earlier). This is both an advantage and a disadvantage. It is an advantage due to the fact that they know how the work day to an engineer usually is, they have a good feeling about how many resources and hours needed in projects, and they know all the routines. This makes them better project managers in many ways, because they know how it is like to "be on the other side". Another advantage is that the operations department has been able to build up and form the department the way they think it will function optimal.

What might be a disadvantage, is the fact that many of the people now acting as project managers does neither have the education or experience to perform this job as good as they might want to. Of course, the people that have been given this new employment have been given courses and training in how to perform the job in the best possible way, but many of them might still lack knowledge about leadership, and perhaps especially soft skills, and financial management.

ENGINEERING

The engineering department was the department that experienced least changes during the re-organization process. The only difference here was that some resources were transferred to other departments, and that the responsibility area in projects got smaller.

Even though the engineering department did not experience so many changes in the re-organization phase, they have experienced a lot of change in the time after the re-organization was initiated. A lot of new ways of working, new procedures, guide lines, and specifications has been created for the engineers to follow. Even though this has led to a great change in how they work, it has all been improvement tools to make the job better. The main disadvantage in the engineering department now is that they are too protected from the pressure regarding dates, cost and client.

DEVELOPMENT

The development department was also created during the re-organization process. This department was created to ensure that there should always be enough focus on developing new tools and solutions. This to be able to keep up with the industry.

The development department is also responsible for many of the pre-studies, due to the fact that projects that require pre-studies often are projects where new technology and solutions are to be used.

Even though the old engineering department was divided into three new groups, the different departments are still working closely together. It has been a great advantage that people have been working together before, and it has also made it easier for new employees to get to know both the people and the systems in a more detailed way due to the knowledge everybody have regarding the different departments.

The purpose of the re-organization process was to be able to run projects on a more formal way, with more established role definitions, responsibilities and a better control over the project. The re-organization process was based on how to handle medium sized projects in a better and more effective way. The new organization is too detailed to handle small projects effective, and too simple to handle large complex projects like the MEG project well.

Another background for the re-organization process was to be able to develop people to be better in their job and not having to run every part of a project from beginning to end. In other words, the company wanted their employees to gain more specialized knowledge.

According to the management in the department, the re-organization process started as a result of the growth in the company, the growth in ongoing activities, results on satisfaction surveys and internal feedbacks, and the demand for more detailed knowledge on the different groups of tools.

The project handled in this thesis was one of the first projects that were conducted after the re-organization was completed. It was also one of the biggest projects that the chosen service company has been awarded in Norway, and therefore it was a great example to use when finding out how the organization is working together towards reaching a common goal.

The size of the project makes it unsuitable to use as a foundation for changes in how the company works. The size and requirements in this project has never been experienced in other projects before, and it is the first of its kind. Even though it cannot be used as a foundation for project execution now, it can still be evaluated and analyzed in order to execute similar projects better in the future. When analyzing the first large complex project, it can make people aware of typically pit falls in other projects as well.

4.1.1 Project Organization

The project organization for the MEG project included people from many departments at the service company. When the project started, it was a customer requirement to know who the project organization consisted of, and also to be informed whenever, or if, the organization changed.

When the project started the project organization consisted of the following:

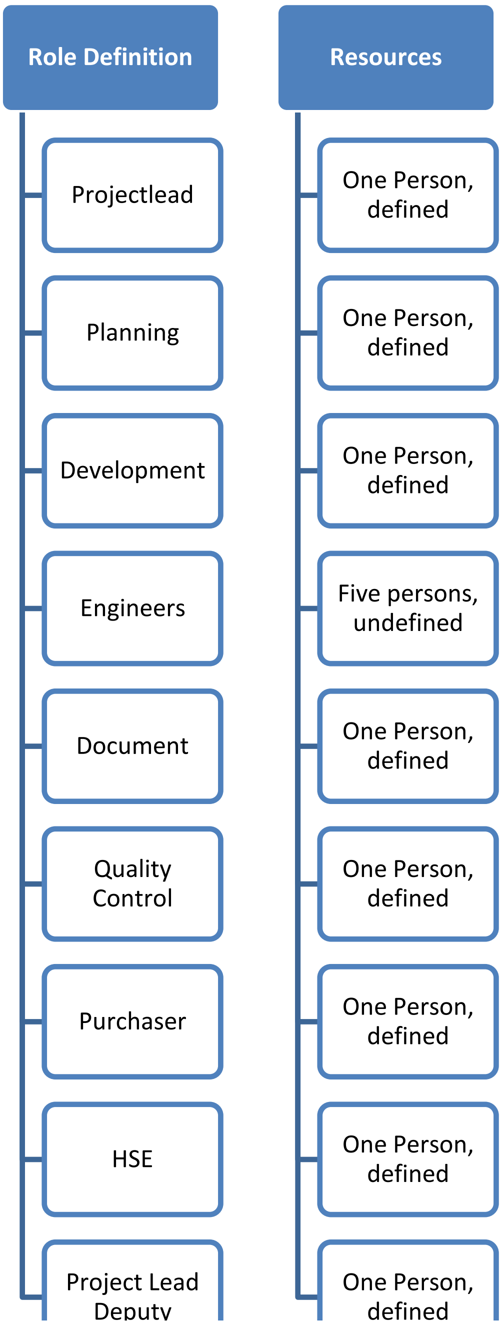


FIGURE 4-3: PROJECT ORGANIZATION

Figure 4-3 shows how the project organization looked in June 2013. A brief summary of the changes in this organization follows. Even though there are not a lot of direct changes in the personnel, there have been some changes from the original plan that is considered worth mentioning.

- There have been a total of three different project leaders in the project due to paternity leave (including the project lead deputy). They have functioned as project leaders at different times during the project.

- The person dedicated from the planning department has remained the same all through the project.

- The dedicated resource from the development department has changed, and also been re-named to technical project leader. This due to change in positions internal in the company.

    - In addition to the change of the technical project leader at the service company, the technical project lead at SWRP also changed during the project.

- The engineering resources started out with three persons, then four, and at some time in the project there were a total of five engineering resources working full time.

- The project started out with one document controller, but this was soon changed to two. There have been no replacements here.

- The QC resource has remained the same during the project.

- The resource from SCM has changed, but this change was done before project start so the resource has been a part of the project since day one.

- The HSE resource has been replaced during the project.

Even though there has been some changes in the project organizations resources, the weekly meetings for the whole project has made it easy to keep an overview over who you are working with and not. The weekly meetings have focused on all aspects of the project, and everybody has received information regarding both themselves and others.

4.1.2 Resources

The project started up with three engineering resources, one for each tool to be created. Already in the beginning of September two more resources were added, primarily to work on the FLDR because it early became clear that this was the most challenging tool to be developed.

Adding resources after the project has begun, is something that should be avoided as far as possible, this due to the lack of knowledge they have because they have missed the kick-off meeting and the starting phase of the project. In this project, the need for additional resources was reported before the project started, but as mentioned, these were not implemented until September.

Of the two resources added, one of them joined in on the FLDR at the end of September, while the other one worked on many different tasks and functioned as an "emergency helper" (meaning that this resource helped out where it was needed).

By the end of September the engineering resources consisted of five people dedicated like this:

- Two people fulltime on FLDR
- One person fulltime on the CDA
- One person fulltime on the CTTH
- One "all-rounder" helping out the rest of the group

This way of working functioned well for the team, and the resources on the CDA and CTTH worked a lot together due to the two tools being quite similar and based on the same concept.

When having five resources dedicated to the same project there were always people to turn to for help and discussions. This, together with group meetings every week made the group create a close relationship to all of the tools being developed.

The CTTH and CDA were ready for production in the beginning of December. The two resources dedicated to those tools then started working on the documentation, while the other three continued on the FLDR. In January, the FLDR reached a critical phase related to the time schedule, leading to all five resources working on it together to get it ready for production as soon as possible. One of the resources functioned as checker of all drawings, while the other one helped out with the design and documentation. Due to the close cooperation throughout the project this was possible to do without any major challenges.

4.1.3 "The project is bigger than the organization"

One of the greatest challenges in this project has been that the project is "bigger than the organization" meaning that the project requirements was at a different level than the company was used to, as well as it required several positions fulltime for over a years' time.

Even though the expression "bigger than the organization" is used, this was not the fact. The project required five of a total of 20 engineers. The expression is more or less based on the fact that it required fulltime personnel in positions where there often is not the need for it (like for example quality control, purchaser and HSE). This made the project special in the way that it had to be managed using unknown methods and theories to ensure that the project organization was managed and kept up to date on all information and decisions at all times.

It is possible to see from appendix A and B how detailed the project was. The summary from the minutes of meetings, and a brief introduction to some of the content in the specifications and contract is given here, and it shows the complexity and the time frame issue in the project clearly.

4.2 ORGANIZATIONAL REVIEW OF THE MEG PROJECT

This chapter consists of an organizational review of the MEG project with reference to chapter 2.4 (Status Quo). The different methods and models described in this project has been evaluated and implemented into the MEG project, and a review of the project has been done.

4.2.1 Review with respect to modern- and boundary less organizations

As written in chapter 2.4.1- 2.4.3 many organizations are moving towards modern and boundary-less organization structures. This was also done at the service company during their re-organizations process (as described in chapter 4.1.)

The organization changed to become more clearly defined regarding roles and responsibilities, with a much better opportunity for people to work at their core area of interest and knowledge, as well as better opportunities for training and learning more. The new organization at the service company makes it easier for all resources to develop more knowledge about their main area of work, and they are given the opportunity to specialize themselves in some areas.

4.2.2 Review with respect to a human performance perspective

As mentioned before, this project included more resources than usual in projects at the service company. The human, activity, context figure explained in section 2.4.4 was therefore very important, and vulnerable. All the resources in the project were connected to one or more activities, all being performed in the same context.

This project required a lot of the project organization and its members, it required technical understanding and knowledge at a high level, it required that the communication was performed in a formal, respectful and including way, and it required teamwork where everybody should be able to help each other regarding both technical and other relevant challenges. With background in this, the main objective regarding human performance for the project members was to ensure that all their team members were performing at their best, and to ensure that they received the help needed to be able to execute the project successfully.

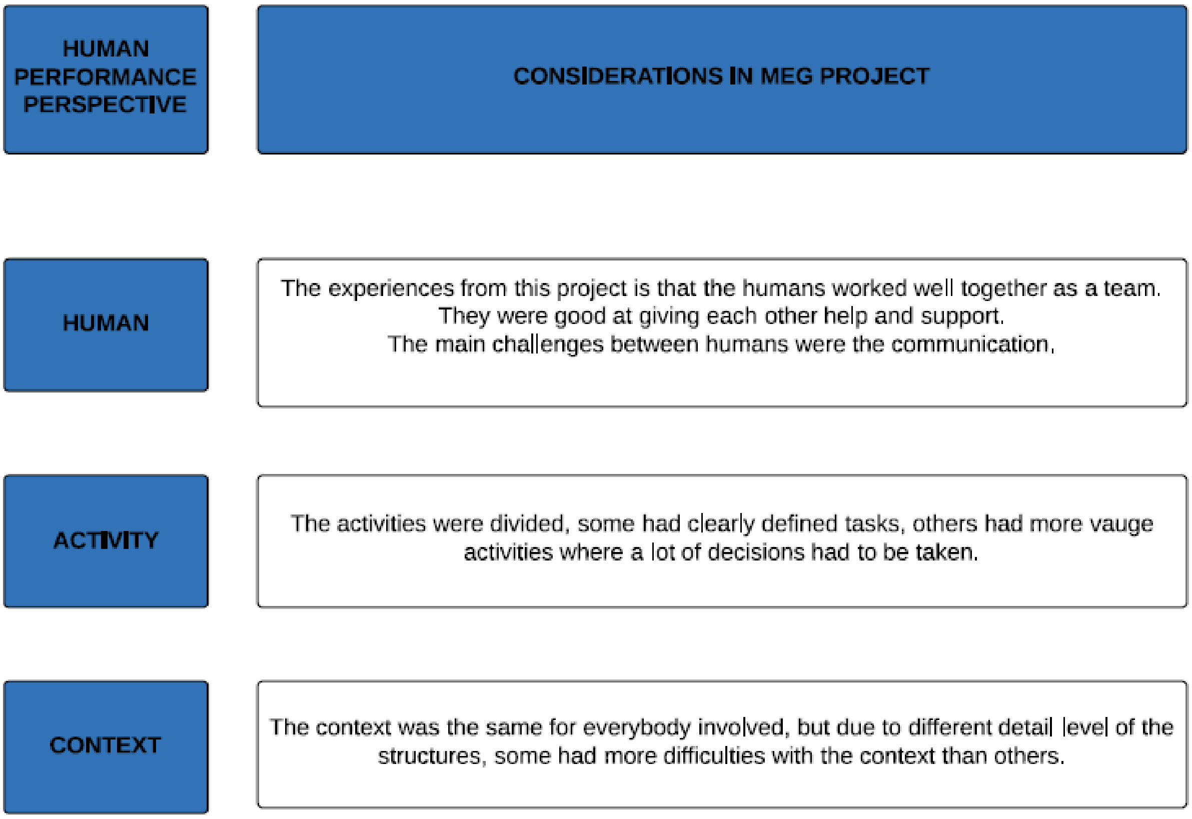


FIGURE 4-4: HUMAN PERFORMANCE PERSPECTIVE

4.2.3 Review with respect to performance influencing factors

As mentioned in chapter two, there are many performance influencing factors in a project. In this project there are many different reasons as to why the performance has been influenced. The project has lasted over a long time period, which enables the time for different factors to affect the motivation. Below is a table showing some of the performance influencing factors that has been experienced in the MEG project.

	CONSIDERATIONS IN MEG PROJECT
TASK	The main challenge in this project has been related to the tasks that falls besides the regular tasks. The regular tasks are the tasks that the engineers perfom in every project; design, drawings, orderlist, documentation and so on. The tasks that has been challenging in this project is related to customer requirements that goes outside the service companys' regular routines, for instance review of subsuppliers documentation, writing of system documentations and other tasks that has arised during the project. These types of tasks can be confusing as nobody know where they belong, and they can be a stress due to the fact that they might touch areas where there can be lack of expertice or knowledge.
ENVIRONMENT	In this project there was made an attempt to make the work environment as good as possible, the project manager was placed in the same landscape as the engineers and the technical lead, in order to gather the project together. This was successfully in the way that it made it easier to communicate on a daily basis. The disadvantage of this was that the project now was gathered in the same landscape as the rest of the engineers, so that they had to keep this in mind and avoid having too many discussions out loud, as this easily could interrupt the rest of the work environment.
INDIVIDUAL	This project consisted of a lot of relatively new engineers, this led to the technical lead having to perform closer follow up on some of the resources to ensure that they clearly understood their tasks and assigned work. It was to a certain degree difficult for the new engineers to be a part of this project, both due to how technical advanced it was, but also due to the fact that they became a part of the project at a late stage.
SOCIO-TECHNICAL	The greatest socio-technical challenge in this project was the communication. The project consisted of many resources and this sometimes led to information getting lost in the path. This can be frustrating for people, and if it happens more than two or three times, some of the resources can feel like they are not being included in the project. They then might feel that they do not have an important role in the project, and that the are worth less than the others involved. This is why it is so important to ensure that information reaches out to everybody involved.
PROCEDURES	In this project it was important that all procedures were written in cooperation with each other. This mostly due to the fact that all the different procedures were small parts of the system procedures, meaning that all procedures had to contain exactly the same amount and type of information.
STRESSES	This project can be categorized as a "dangerous" project, meaning that with a deadline over a year from project start, it is easy to be overfocused on the time frame, and therefore prostpone some tasks for the benefit of others. The experiences where the plan was compressed and then again spread out also led to what perhaps can be called unnecessary stresses. Also, the lack of short-time milestones caused extra stress.

FIGURE 4-5: PERFORMANCE INFLUENCING FACTORS

5 LESSONS LEARNED FROM LARGE COMPLEX PROJECTS

This chapter will explain the different opinions and feedback given from the resources involved in the MEG project. The lessons learned and experiences are divided into a technical and an organizational part, which again is divided into sub-sections. At the end of the chapter, an analysis of opinions is performed to ensure that the most cost- and quality effective solutions are highlighted.

5.1 TECHNICAL ASPECTS

The technical aspects consist of feedback and experiences given by the project organization. It is divided into engineering resources (including technical and project manager), and support departments. The lessons learned and feedback consists of general feedback, good experiences, and lessons learned.

5.1.1 Lessons learned and experiences from the engineering resources on the project

One of the greatest challenges for some of the engineers in the project has been to get an overview of the project and the scope of work. This mostly due to the fact that resources has been added to the project over time, so not everybody has been a part of it from the beginning.

When resources has been added in the middle of the project this has been done due to immediate need, this way, the resources has not been given time enough to read the specifications or been briefed in the scope of work. Adding resources in the middle of projects are often done due to lack of resources at the beginning of the project.

In addition to the difficulties with the specifications and scope of work, it has also been a big challenge to work with the FLDR's in the systems the service company use. A lot of unnecessary time been used to wait for the system (the Internet, the database and the 3D modelling program) to function properly. This due to the fact that some of the modelling design was complex and had to be built up correctly from the beginning of for the system (the 3D modelling program) to function properly.

The two main engineers on the FLDR estimated that if the concept design had been better defined from the beginning of that would have saved them for approximately 25% of the work. With better defined they mean that all COTS parts (valves, receptacles, and other products that are bought in "as is") should have been decided upon (locked), all small changes should have been avoided, and that the engineers themselves should have done more work alone instead of asking others for their opinion before the work had begun.

They also estimated that the time spent on building the models could have been reduced with 1/3 if the drawing department had been involved from the beginning of helping them build up the models correctly the first time. This estimate includes the time it would take to build up the models, as well as the time spent on waiting on the system to react.

Good experiences

- The fact that the resources involved learned a lot from being a part of the project. You got the opportunity to learn new things yourself, as well as getting in touch with other people and departments and learn things from them.

- As this project was based on team work where all the different tools were linked together, you had a lot of people to discuss challenges with.

- A common to-do list on the FLDR made the work a whole lot easier.

- Involving the support departments in "engineering work" has been a good experience.

- You learned a lot about different sub suppliers.

- Many of the resources in the project learned a lot about contractual issues, both towards the customer, but also towards sub suppliers.

- The people engaged in the project learned a lot about different standards, materials, and other things that are relevant for all types of projects.

Lessons learned

- In projects like this, where the customer requirements are greater than what is covered by the company's DRL (Document Requirement List), one must always ensure that the customer requirements are written down clearly on the drawings or in the DRL/specifications listed on the drawing.
  The general DRL's that are used on the service company's drawings might not cover customer requirements in these types of projects. It is therefore recommended that it might be a good solution to create project specific DRL's in order to ensure that customer requirements are met in these cases.

- To ensure that people always receive the information they need if someone is out of office for any reason, handovers with both general and technical information should be created, and followed. If the resources in the project had been better at this, a lot of questions and re-work could have been avoided, and a lot of time saved.

5.1.2 Lessons learned and experiences from support departments

Support departments include the following departments: planning, document, structure, drawing, purchasing.

- The other departments involved in the project all agreed that they would prefer to become a part of the project from the beginning of. This mostly due to the close work between the engineering department and the support departments. The support departments did not get the opportunity to be a part of the whole process, and thus a lot of things that could have been solved different and even better, caused a lot of time.

- If the drawing department consisted of more resources it would have been preferable to have one dedicated resource working fulltime on the project. This way this person could have been more involved, and he or she would also have been able to assist some design jobs.

- A lot of error and re-work could have been avoided if the support departments had been involved earlier. The support departments have knowledge the engineers are missing, and they could have been involved in decision making processes throughout the project.

- The support departments had some trouble knowing what information to rely on and not. They often experienced that two persons gave them different information regarding the same issue. It was not clearly defined contact persons, and the communication had trouble reaching everybody.

- The comments from the support departments were that they were impressed of how fast the engineers turned around and solved issues. They had the impression that the engineers wanted to learn as much as possible during the project. They also feel that the people making decisions were willing to make changes that would save the company a lot of money without affecting the quality. This is a thing that should not be worth mentioning, but one can experience that if someone has decided upon a solution that they think is the best, they are not willing to consider other alternatives.

- The drawing department are also pleased with the way they have been involved; that they have been included in the design phase as well as the drawings and calculations. This has given them a better view of how the engineers are working.

- Some of the support departments feel like they have been down prioritized. Information has not reached out to them, and they have not received the information they needed in time. Both the planning and the documentation department are dependent on the engineers, project managers and purchaser to give them information. This has not always been optimal.

- The document department struggled a lot with not receiving information about the different documents that were to be sent to the customer. People changed the requirements and the names of documents without informing them. They often felt excluded from important information.

In addition to this, there were a lot of unknown processes for the document department to handle. Documents from the service company's' sub suppliers was to be reviewed before being sent to SWRP, this was a completely new routine that nobody had practiced before.

- The planning department felt that the plan often was the last thing being prioritized. They got the feeling that the plan was only important two days before the monthly report (including the plan) was to be sent to the customer, and forgotten the 28 other days. When information regarding purchases and delivery times changed, the plan department often did not get this information. This could have resulted in a useless plan but it did not as to observant and information seeking planners. With better communication and more focus on the plan this would never have been an issue at all. In other words, if the plan is used like it is supposed to, like a tool for the execution of the project with regular updates, these situations could have been avoided.

- There was a change in which type of planning program to use short time before the project started. This led to the plan also being under some development during the project. This created some challenges. The greatest challenge was connected to learning people how to use the plan as a helpful tool.

- The purchasers had some difficulties with the customer requirements listed on drawings. Often, not all the requirements were written on the drawings. The result of this could have been that parts were delivered without the necessary documentation the customer required.

5.2 ORGANIZATIONAL ASPECTS

One major challenge for the engineers working in this project was the lack of handovers between the pre-study and the engineering phase. While the pre-study had its own project team and resources, the project team started from scratch with a whole new project organization and resources. In the transition between these two phases there was no communication between the engineers in the development team and the engineers at the engineering department.

The new project team was never told who had worked on the different structures in the pre-study, so they did not know who to turn to for questions and information about why the concept models looked like they did. This led to some challenges along the way about parts that were assumed to be correct but turned out not to be. When asking about handovers the engineers were told that all the necessary information was available in the pre-study project located in the database. The overwhelming amount of documents located in this folder made it difficult to find the documents with the correct information needed. These situations show how important it is to have good communication all through the project, and not only between the people that are involved in the different phases. It would be easier to receive a "summary" from the pre-study, rather than having to use several hours on searching through a big amount of documents.

The challenge with missing handovers also continued throughout the project itself. When the technical lead was replaced, there were no handover given. The same was the case for some of the changes of project managers. There was an attempt to create handover in the engineering group, but the result of this was that there were no response to whether the handover had been followed or not, and no follow up when the person that had written the handover returned to work.

During the project, it was soon realised that more minor milestones should have been implemented from the beginning of. This to ensure even better control over the different tasks in the project. With more milestones one could also have avoided "burning" situations where overtime became the only solution to be able to reach the goal.

Another lesson learned during the project was to plan "external" resources in to the project early in the process. One of the things that happened over and over again was that there was no decided resource available on the drawing office, which again resulted in a lot of extra stress, frustration, and time spent.

5.2.1 How has the project organization been able to deal with the project

- Due to the fact that this project was the “pilot” project for the new organization, it has proved that the new organization can be a great success as long as there is a great focus on the communication and roles.

- The new organization was able to handle the project in a good way with discussions about roles and responsibilities.

5.2.2 Challenges

- Adding new resources into the project in the middle of it without letting them get the chance to get to know the specifications and scope of work.

- There have been a lot of challenges with the communication in the project. This is strongly connected with the fact that there has been a lot of “interfaces”. Even though it has been a new, and very positive experience to have a technical project leader in addition to the “regular” project leader, this has also led to confusion sometimes. With a total of three different project leaders, one technical leader, five engineers, drafters, purchasers and so on, the communication is nearly doomed to cause some trouble and confusion. The planning department and the documentation department experienced a lot of challenges with the communication. They were not always notified about changes, and often they had to go get information that should have been given to them. It is a known case that communication is difficult in itself, but in big projects like this there should be an even bigger focus on this.

- One of the greatest challenges has been to include those who should be included, both in decisions and information sharing. When purchasing parts for instance, both the purchaser, the project leader, the plan department and the inventory controller have to be informed about the lead time and when the parts needs to be reserved to the project. If this information does not reach the entire chain of involved people, challenges will occur and the result can in worst case be that parts are given to other projects.

- Roles have been a challenge in the project. With a new organization, and new positions it has not always been clearly defined who is performing what tasks. This should have been better informed during the re-organization process so that everybody had a clear picture of their roles and responsibilities.

5.2.3 Good experiences

- Letting people work closely together and also letting people that have not worked together before be able to do that. This lead to new experiences, learning new ways to work, and it also led to new friendship growing up.

- Letting the project leader take place in the engineering landscape is one of the best decisions made in this project. The project leader felt that being physically a part of the team was very helpful, and it made the job easier as there were short distance to everybody involved in the project (at that time).

    - This experience did not last for a long time in this project, but it showed clearly positive responses in short time, so it should be performed in other projects as well.

- Having a dedicated technical project leader has been good for the project. It has been helpful for both the project leader, and also for the engineers. The technical project leader functioned as a binding connection between the project leader and the engineers working on the project.

5.3 ANALYSIS OF OPINIONS

Since all the lessons learned and experiences given in this project, is given with background in feedback from the resources directly involved in the project they are all subjective. Decisions taken to make changes in processes or routines should not only be based on subjective opinions and feedback. To see if the feedback that has been given is the only or best solution available, a consequence analysis has been developed. The consequence analysis is built up to suit the feedback given in this project. It reflects the statements received, what department the statement came from, and how the statement has been solved in this project. The positive and negative consequences are then listed, before an alternative solution is proposed.

By making an analysis like this it is possible to compare the actual solution with the proposed one, and then look at the different positive and negative consequences. This information can then again be implements into a decision matrix, or the solutions can be decided upon using the consequence analysis alone.

STATEMENT	ENG.	SUP.	SOLUTION IN PROJECT	CONSEQUENCE POSITIVE	CONSEQUENCE NEGATIVE	ALTERNATIVE SOLUTION
Drawing dep. included earlier	X	X	Included at the end of engineering phase	Less rework Time saved Less frustration Less waiting	Remove resource from drawing dep. Affect other projects	Train/course engineers
Structure dep. included earlier	X	X	Included at the beginning of the engineering phase	Less rework Less waiting	Remove resource from structure dep. Affect other projects	Make structure a project phase
Difficult to know what the correct information is		X	Conflicting information	-	Wrong info can be given conflicting info rework Time consuming Costly	Better defined roles and responsibilities One responsible for information given and received on each tool
Review of supplier documentation		X	Find resources when its needed	Ensure good document quality New knowledge	Much time spent on learning and training Too little detailed knowledge about doc. content	Assign dedicated resource
Lack of communication	X	X	Non-existing communication at times	-	Resources disapperars Frustration De-motivation	Better routines and processes for communication inclusion and paths
Lack of information sharing	X	X	Some information was not shared with those it affected	-	Re-work Non-effective work De-motivation Time consuming Costly Frustration	Handovers and better defined information paths (Responsibility matrix)

FIGURE 5-1: ANALYSIS OF OPINION

As seen in the table, a lot of the feedback that is given has been given from both the engineers and the support departments. Many of the statements are statements that would have made this project better, but it is not sure that it would be beneficial for the organization in general.

The first statement given states that the drawing department should be included earlier. As said, this would be beneficial for this project, but it would also affect other projects in a negative direction. It would also not be correct if the drawing department had to help the engineers build up models in every project when it is the engineers' job to design and build up models. This is some of the main reasons as to why the alternative solution is to course and train the engineers in how to build up large and heavy models more stable and efficient. If a course had been given in how to build up big and heavy models correct, the engineers would not only be able to perform this themselves, it would also encourage and lead to a more standard way of building up tools, which again is beneficial if others are going to work on them at a later occasion. Choosing the alternative solution here would in other words be both time and cost effective, as well as it would lead to a standard way of building up models.

Statement number two states that the structure department should also be involved in the project earlier. The alternative solution suggests that the structural department should be a separate phase in the engineering phase, preferably before the detailed engineering is started. This way it would be possible to avoid situations where the engineers have to wait on the structural department and opposite, as well as it would be possible to avoid a lot of the re-work that had to be done in this project, and thus also a lot of time.

The issue in statement number three could be solved by training someone up to be able to review supplier documentations. This should be people with good knowledge about for instance welding and testing. By training some of the resources in the department to this, it would be possible to ensure that the documentation received from supplier is correct and contains the information needed.

Statement number four, lack of communication is the most difficult statement to solve. Communication is something personally, and it is the people themselves that have to train on becoming better at this. Even though it is difficult to know exactly how it is possible to make people better at communication, it is possible to provide guidelines for them to follow regarding the subject.

Statement number five is lack of information sharing. This statement is highly related to statement number four, and also challenging to solve. A bigger focus on handovers could help ease this problem, the same would be possible with the use of to-do lists.

6 RECOMMENDATIONS FOR IMPROVEMENTS IN COMPLEX PROJECTS

This section consists of recommendations in general, related to the technical part, and related to the organizational part of the project. The recommendations are based on the information given in chapter 5, Lessons Learned, meaning that the recommendations are a summary of the observations I have done, and also the observations and experiences given by the resources in the project.

These recommendations are based on projects that are of large scale from the very start. Often, projects at the chosen service company start out as small or medium size projects, and then increases over time until they become large complex projects. It is more difficult to give projects like that recommendations, as it is often very difficult to see the increase before it is happening.

6.1 GENERAL RECOMMENDATIONS

The general recommendations consists of job-aids or methods the chosen service company can use and implement into their project work in order to make it more cost and time effective.

6.1.1 Responsibility Matrix for more effective and including communication

To ensure that communication is a focus area, and that the person who needs/should be notified have received the information, a responsibility matrix could be created in the beginning of each project. Andersen, Grude and Haug (2012) explains that if a responsibility matrix had been created, it would then have to be followed not only during mail correspondence, but also in face to face communication settings.

An example on how the responsibility matrix could look like is given in figure 6.1.
The example given in figure 6-1 shows the WBS of the project, as well as those who have to be informed about decisions and/or changes regarding the different tasks. This matrix can help the project team to ensure that all information reaches out to those who are dependant of it.

As mentioned in chapter 4, the responsibility matrix could be included in the plan (WBS), and then ensure that information reaches those who need it. This is performed to a certain degree today, as each milestone and activity has a resource that is responsible for updates and completion of the activity or milestone.

WBS ELEMENT	PROJECT TEAM MEMBERS						
	Lead	Tech.Lead	Engineer	Engineer	Planning	Purchasing	Document
1.0	R	r					
1.1			P	P	N		
1.1.1	R			r	r	N	
1.1.2	P						N
1.2	R	P	N	N	N	N	N

Figure 6-1: Responsibility Matrix

P= Performing the task/work

R= takes the resolution

r = be a part of / informed about the resolution

N= Must be notified/informed

6.1.2 To-Do List to improve communication, roles and responsibilities

Another way of ensuring good communication and clearly defined work tasks is a to-do list. The experience from this project and others who have tried to use the do-to list is that it is more user friendly than the minutes of meetings. The to-do list could either be created in the database as a living document, or it could be created through Google drive (which is available for everybody in the company). The advantage with creating it in Google drive is that everyone can read it and edit it at the same time. By replacing the MOM with such a to-do list one could divide the list into for instance; resources, weekly meetings, purchasing, documents and so on (ref. Figure 6-2).

The to-do list can also be implemented into the plan under each activity, this would make it easier to report hours spent on each sub-activity, but it would not cover comments or other thoughts around the activities.

This way everybody can arrange their own to-do list they way they prefer to have it, comments can be written, and the project manager can easily see the status and the progress of the project.

A list like this would also be an advantage for resources being added in the middle of a project as they can see how the progress has been, and who is responsible for what. It would also be an advantage as a "handover" or a document to follow if people are away from the project for a period.

This will also be a benefit if for instance a person has been sick, on vacation or something else. When this person gets back, he or she will be able to read the log and find out what others have been working on while he/she was away. This way everybody can ensure themselves that no information is lost.

FIGURE 6-2: TO-DO LIST

The to-do list would also be beneficial to define all the “lessons learned” and “what went wrong” situations in these types of projects, as it can function as a logging system available for the different resources. When letting the to-do list also functioning as a “diary” or logging system everybody would have one place to gather all information, all comments and all ideas throughout the project.

6.1.3 PDCA Circle to ensure quality and improvement

To ensure that all tasks in the project have the right quality, the PDCA circle should be used even more. The circle is often used in the engineering phase of projects executed now, but it should also be introduced to all the other phases of a project.

The PDCA circle has been explained earlier in the thesis, both in general and with respect to the technical part of the project execution. If the PDCA circle had been used even more both internally in the different phases, but also as interfaces and transitions to other department and/or phases, the project could be even better on quality assurance and improvements. The circle should be explained with examples for the project organization, and everybody should be encouraged to use it both in their own work, and towards the other resources in the project.

6.1.4 Human Performance for better understanding of the tasks to perform

As described in chapter 2.4.4, human, activity and context are strongly linked together. In order for people to perform their best, they have to have a good understanding of the activity and the context of the activity. Knowing the activity and the context will make the resources in the project closer connected to the tasks they are to perform, and they will feel closer to not only their own tasks, but also the other tasks in the project.

It is important that people in the project organization not only knows what they should do, but also why they should do it, and what difference the task will make for the context of the project.

6.1.5 Be aware of the Performance influencing Factors and how they can affect the project

Chapter 4.2.3 lists some of the main performance influencing factors in this project. It is important that the project manager is aware of the different influencing factors that can occur in a project.

If the project manager is aware of the most critical influencing factors that can occurs, he or she can prepare for this, and find out how to avoid them, or how to solve them best possible. As mentioned many times already, the project manager has to have good soft skills, meaning that performance influencing factors should be familiar and known to him or her.

If the project manager is aware of the different influences it is much easier for the project team to discuss them openly. Often, challenges like this are kept from the team, only leading to frustration and de-motivation for the people who are experiencing them.

If the performance influencing factors are openly discussed in the project both before and after they occur, this can make the team more open, and it can increase the feeling of safety within the project.

6.2 TECHNICAL ASPECTS

This chapter is divided into two parts; what could have been avoided, and how it could have been avoided. The purpose is to highlight some of the main challenges that the project faced, and also to suggest solutions on how to avoid them from happening again in other projects.

6.2.1 What could have been avoided

- Unnecessary time spent on building the models in the 3D modelling program.
- A lot of "working in the dark" scenarios.
- Unclear role definitions.
- A lot of uncertainties and re-work.
- Re-work for the support departments.

6.2.2 How could these things have been avoided

- *Training/course the engineers*: a lot of time could have been saved by doing things right the first time. The models in the 3D modelling program should have been discussed with the drawing department from the beginning of, so that one together could have figured out the best way to build them. This could have saved approximately 1/3 of the time spent on building the models. As suggested in the consequence analysis in chapter 5.3, the engineers should be coursed in how to build up big and heavy models more effectively.
- *Knowledge about project scope*: a lot of the "working in the dark" scenarios occurred due to the fact that not everybody got the same opportunity to get to know the project and scope of work the same way as those that were a part of the project from the beginning. A lot of the working in the dark scenarios could have been avoided if a workshop had been held in the beginning of the project like explained below.
- *Role definitions*: unclear role definitions created some challenges between departments, i.e. who is doing what and when. Knowing the different roles it would be easier for everybody to better know and understand others deadlines and scope of work. Role definitions should be even better stated by the management at the different departments, and it should also be a part of the kick-off in the project. This way it would be clear from day one.
- *Courses/ training*: a lot of the uncertainties and re-work occurred as a result of discussions involving many people with different opinions. As mentioned in the

consequence analysis in ch.5.3, there are different alternatives on how to solve this challenge, either involve the support departments earlier, or spend more time on coursing and training the engineers.

- A lot of re-work and uncertainties would also have been avoided if critical components had been locked in the Pre-Study.

- *Communication*: also, much of the re-work could have been avoided if the communication had been better. When many resources are working together on one system it is important that everybody involved receives the same information, regardless of how "big or small" the information is.

- *Communication*: if everybody had followed their role definitions a lot of the re-work done by the support departments could have been avoided. If the communication had been better with both the drawing, structure and purchasing department instead of engineers doing things on their own, a lot of time and money could have been saved.

In addition to the points given above, all of those involved in the project agreed that a workshop where the specifications, scope of work, resources and other relevant technical information should be discussed and given, it would be beneficial for the project. These days or week should preferably be held in the beginning, after the resources have had some time reading the scope of work.

The outcome of a workshop would be related to a common understanding of the specifications and scope of work. Often these documents consists of much information, and by reading and discussing them together with others it is easier get a better understanding, and the project organization would be able to create a common understanding of the scope of work. This could also lead to the engineers involved in the project being more able to support each other with both help and discussions about different solutions.

A workshop could also be beneficial for the role definitions, as a workshop would bring the project organization closer together from the beginning of, and it would bring out a more clearly picture of the different roles needed throughout the project.

6.3 ORGANIZATIONAL ASPECTS

This chapter is divided into two parts; what could have been avoided, and how it could have been avoided. The purpose is to highlight some of the main challenges that the project organization faced, and to suggest how it is possible to avoid challenges like this in other projects.

6.3.1 What could have been avoided

- Unclear role definitions and who does what situations.
- Time spent on searching for people, missing communication and not enough close cooperation.
- Too much pressure on single resources.

6.3.2 How could these things have been avoided

- *Communication/training/better defined roles and responsibilities:* like mentioned above as well, a suggestion on how to avoid situations where the job scope is unclear is to involve the project in a workshop at the project start. This workshop could typically involve all resources (also drawing, structure, planning, document, etc.) and the purpose should be to go through all the specifications and scope of work together so that is was ensured that everyone involved had the same knowledge about the project.
- *Close connection:* the experience with the project physically sitting together should be used on all bigger projects. There are many advantages with connecting the group at one place. It will make it easier to cooperate, communicate and to use each other's knowledge. It will also reduce the noise level in the landscapes, and the project members will not have to walk around to find, and talk to the others involved. Sitting together will also connect the group on a whole different level with respect to communication and team work.
- As well as the engineering and project managers, some of the support resources should also be placed together with the rest of the team (for instance the purchaser, document controller and more if seen upon as necessary).
- *Roles and responsibilities*: as mentioned, it has been a good experience to have a technical project leader in the project. This is something that should be done on all bigger projects. What the service company can learn more about, is how the roles of the project leader and the technical project leader should be divided. They should have separate focus areas, and perhaps also weekly meetings where they can discuss issues that might appear.

    - This is especially important in the new organization where there are both project managers with, and without, technical experience.

- It is also important that the technical lead resource has been provided with a clear line on what he or she should do, and what should be delegated over to others. This to avoid that the technical lead is overfilled with (unnecessary) work.

7 DISCUSSION

“The project is bigger than the organization”. The sentence that made me want to write about this subject, and this project. A project that is bigger than its organization is a statement that scares me, it is for me a statement that is judging the project to failure before it has even begun. One of the main goals for this thesis was to figure out the background for this statement. That the project is bigger than the organization does not mean that it requires more than any other projects has done before, it means that the project is so large and complex that it requires more resources from other departments than normally. It means that the project also have to include resources that normally does not become a part of the project as a fulltime resource. That the project is bigger than the organization means to me that we are facing a large and complex project.

It is a known thing that projects are complex, and to a certain degree difficult to execute. When starting on this thesis I had a picture in my head of how it would be to write it, how I would gather information and also what I would find out. Even though many of the things I have figured out is close to what I had thought of in advance, I have learned a lot during these months!

During different courses regarding projects, project management and project execution, the words planning and communication has always been mentioned a lot. I have somewhat agreed that those are important factors in order to execute project in a good way, but when “diving” into a project the way I have done now, communication and planning really is the two key factors that to a significant degree decides whether a project is successful or not!

When going into the depth of a project the way I have done here, it is easy to see the everyday struggles that many projects experiences. These are both struggles regarding systems and processes, but also the human struggles that affect projects in a great way. Many of these struggles are human related, which again makes them difficult to solve.

It has been both a joy and frustrating to get the opportunity to get this much insight in a project. As I have only worked on one of the “sides” in a project myself, it has been an experience filled with learning and being able to watch all the other sides of a project as well.

Humans have a tendency of being selfish without even knowing it themselves. This is often the main reason for lack of communication, we can be happy with the fact that we have received the information we need, and not think that others also might need the same information.

One of the most important things I have learned while working on this thesis is to be more aware of the way I communicate. I have learned that I should always think both one step forward and one step back regarding information and communication both received and given. This is lessons that I think will make me a better person to cooperate with, and I also think that it will make me a better person in general.

Seeing how the different departments in a project are struggling with different challenges, I have reflected much upon one thing; all new employees starting in a company should join the different departments involved in the job they are starting for a certain time period to be able to see the different challenges at the different departments. I know that this is being practiced at some of the big oil companies, but in my opinion it would be very beneficial for the company if their employees had a better understanding of the different challenges experienced other places than at their own department. For me this has been the part that has brought the most thoughts into my head, however I have never thought over the challenges elsewhere than in my own department before.

This thesis made me more aware of how projects normally are executed, and how they perhaps should have been executed. It made me aware of the things that are frustrating for people, but it also taught me a lot about the things that people appreciate in projects.

All together, working with this thesis has given me much more than I had expected when I started writing it. I have received new knowledge both about theoretical and practical issues, and I have learned to think in new directions. If I should mention one thing that I have missed during this process, it is more literature based on not only project management, but the execution of projects itself. Knowing how projects has expanded over the last years, and how complex the work environments now have become, literature facing real projects, and the whole project process from different views is something that could be very beneficial for most industries today.

The most challenging parts of the thesis have been to write it in a way that will not offend anyone. When your main sources are people, it is difficult to write the thesis in a way that is fair and general for all parts covered. There will always be subjective meanings when it comes to a topic like this, and I have felt the need to get many of the sections approved by the different departments before publishing them.

Hopefully, those who read this thesis will find it interesting and meaningful. I hope that the company (or companies) will see the thesis as useable in the ways that it can be used to improve some of the challenges in projects. My wish it that this thesis, which contains the honest opinions and feedback from those involved in projects on a daily basis, can be used in a way that makes the everyday work situations better for them.

8 CONCLUSION

Throughout this thesis, theories and methods based on literature has been explained both in theory and compared to the chosen project. As explained throughout the thesis, it is often difficult to be able to compare the different methods and theories to the reality. The difference between theory and practice is very clear in project execution. The human part of project execution is wide and broadly explained in literature, but it cannot be directly compared to the real life influences, communication challenges, and the way people act and think.

The purpose of the thesis was to evaluate and analyze the way of which a specific service company in the oil and gas industry works in large projects, and to make recommendations for improvements.

The recommendations are based mainly on the feedback given by the different resources that were a part of the project, they have also been corrected according to the consequence analysis given in chapter 5.3, to ensure that the service company is recommended the most cost and time effective improvements and changes. There are also recommendations given based on the methods and theories informal to a traditional project process. Some of the theories discussed in the thesis are recommended to the service company due to visible opportunities for improvements. Even though the chosen service company already has made great improvements after the re-organization process, there is still room for improvements in many areas. The most positive thing for the service company is that rather small changes can lead to great improvements for the employees. Some of the recommendations that are assumed to have the best effect on time and cost are listed below.

Coursing the engineers better in 3D modeling and generally in design is assumed to have a great effect for the time and cost picture. Almost all the time spent on rework could have been avoided if the models had been built up more correct the first time. The estimated time savings are 40%, which would have reduced the cost of the engineering hours in the area of 800 000-900 000 NOK.

A better defined transition from the pre-study to the engineering phase would be beneficial for the company. Ensuring that handovers are used, and that the resources in the engineering phase understand the work that has been done in the pre-study, would save a lot of the time spent on searching for answers and explanations. It would also reduce the possibility of making the wrong decisions based on lack of knowledge.

A workshop in the beginning of the project would lead to a better understanding of the project scope, the different requirements, and the roles and responsibilities. If the project lead and the technical project lead had gone through the specifications in detail together, and then informed the rest of the project team (either together or department by department) it could led to a more common understanding, a better owner feeling of the project, and it could have detected possible pitfalls and unclear areas earlier. This could further more led to significant savings of time (and then also money). By letting the project team discuss the project and the project scope in advance of the engineering phase, it can lead to better teamwork where the resources know each other’s strength and weaknesses, and they can learn more from each other.

In order to solve many of the challenges related to communication, training, resources and experiences, the company should define what needs to be done in order to create a better culture for the employees. With a better culture, many of these challenges would be improved automatically as a natural consequence, and the company would also create a better safety feeling and environment for their employees.

To conclude, it can be said that if the chosen service company chooses to implement some of the recommendations given above, and in chapter 6 into the project execution process, this will not only be beneficial for the employees and the cost and time effectiveness, it will also be beneficial for the company in the market competition. In order to meet the customer requirements and the market competition, more effective project execution processes are required. The competitors are strong, the technology is developing rapidly, and effective project execution processes can quickly be the difference between success or failure for a company like the one chosen in this thesis.

9 REFERENCES

Andersen, Erling S., Grude, Kristoffer V., Haug, Tor (2004) *Målrettet Prosjektstyring 6.ed. 2012*

Bailey, R.W., (1996) *Human performance engineering, Prentice Hall. Human engineering acceptable performance*

Bradly, G. (2002) *Human factors & Ergonomics. Information and Communication technology (ICT) and changes in work life: Macroergonomic considerations by Bradley, G*

Christopher, W.F., Thor, C.G., (1993) *Handbook of productivity measurement and improvement, Productivity press, Total quality: An integrating concept by Earl C. Conway*

Helgesen, Ole Kjetil (2013) *Dette gikk galt på YME*
http://www.tu.no/petroleum/2013/10/14/dette-gikk-galt-pa-yme
(read 07/05-14)

Hendrick, H.W., Kleiner, B., (ed. 2002) *Macroergonomics: Theory, methods, and applications*

Jeffrey K- Pinto (2013) *Project Management – Achieving Competitive Advantage 3 ed. 2013 (2007)*

Jessen, Svein Arne (2009) *Prosjektledelse trinn for trinn 2ed. 2009 (2005)*

Mankin, D., Cohen, S.G., Bikson, T.K., (1996) *Teams and technology: Fulfilling the promise of the new organization, Harvard Business School Press. Organizations without boundaries: New forms for the twenty-first century*

Project Management Institute (2004) *A Guide to the Project Management Body of Knowledge 3rd edition*

Project Management Institute: http://www.pmi.org/About-Us.aspx (read 15.05.14)

Redmill, F., Rajan, J., (1997) *Human factors in safety critical systems, Butterworth-Heinemann. Part-1: Section-2: The causes of human error*

Sanders, M.S., McCormic, E.J. (1992) *Human factors in engineering and design, McGraw Hill. Chapter-22: Human factors in systems design*

SWRP (2011) *Challenges*
http://subseawellresponse.com/about-swrp/challenges/
(read 19.03.14)

SWRP (2014) *Timeline*
http://subseawellresponse.com/about-swrp/timeline/
(read 19.03.14)

SWRP (2011) *Frequently asked questions*
http://subseawellresponse.com/faq/
(read 19.03.14)

SWRP (2011) *Indutry working together*
http://subseawellresponse.com/files/2011/06/Industry-working-together.png
(read 19.03.14)

Wang, J.X.,(2002) *What every engineer should know about decision making under uncertainty, Marcel Dekker, Engineering: making hard decision under uncertainty*

10 APPENDICES

APPENDIX NO.	TITLE
APPENDIX A	Short summary of contract and specifications content
APPENDIX B	Summary; engineering weekly meetings
APPENDIX C	Presentation of Recommendations
APPENDIX D	Thesis plan

APPENDIX A

Short summary of Contract and Specifications content

INTRODUCTION

This document contains a short briefing of some of the specification and contractual content. The appendix is intended to be a short introduction in some of the requirements given in the MEG project. The content is a summary of some of the notes that were taken during the background study for the thesis, and it listed as an appendix to show some of the detail levels of customer requirements.

1 CONTRACT OSRL/0041

A pricelist was created in advanced for the CDA, CTTH, and the FLDR.

Before the project was started, milestones were created as to when the different phases of the project was expected to be complete. The table below shows an overview of the main milestones and also how much of the project sum the service company would get paid when reaching the milestones.

Table 1-1: Milestones and payment

Item	Date	Task	% of total sum
1	23/5-13	Contract awarded	20
2	2/7-13	Hydraulic hose approved for fabrication	15
3	23/9-13	CDA/CTTH approved for fabrication	10
4	30/9-13	Deployment basket approved for fabrication	10
5	20/3-14	CDA/CTTH ready for FAT	10
6	18/4-14	Hydraulic hose ready for assemble to basket	15
7	2/7-14	FAT + FI (Factory Acceptance Test and Final Inspection)	15
8	1/9-14	All documents approved	5

1.1 Section 4: Scope of goods and services

In this section the contract scope was listed. Some examples from the scope are written below.

- All work handled by crane or similar shall be designed according to DNV 2,7-1 or 2,7-3
- The design shall be standardized
- Tooling for installation shall be provided
- Procedures for installation, operation and retrieval shall be provided
- Interface engineering for equipment and tools
- Risk shall always follow ALARP (as low as reasonable practical)
- HSE standards and policies shall be followed
- HSE plan to be sent in each month
- Quality plan to be sent in each month
- The service company shall have at least one interface meeting each week

1.2 Section 5: Admin instructions

- All changes in the organization shall be notified to the customer
- All communication with third party shall be copied to customer
- Customer requires meetings each week
- Issues relevant for meetings (the agenda) shall be sent to customer three days before the meeting
- Additional meetings require notification two days before the meeting is scheduled.
- The monthly report sent to customer shall contain
  - Highlights/management overview
  - HSSE
  - Technical integrity
  - Risk management
  - Planning & progress
  - Cost
  - Commercial & contractual
  - Quality assurance and inspection
  - Subcontracts and logistics
  - Information management
  - Interface report
- Reports and follow-ups after reviews shall be sent to customer within five days

1.2.1 Appendix 1C: Project organization OAS (per May 2013)

- Person A (project lead) changed two times
- Person B (planning)
- Person C (development) changed one time
- 5 engineers
- TBN (doc)
- Person D (QC)
- Person E (SCM) changed one time
- Person F (HSE) changed one time
- Person G (Project lead deputy)
- TBN (workshop)

1.2.2 Appendix 15: Required docs and due dates

Table 1-2: Milestones and payment

item	what	due date
1	Proposed project organization chart	at kick off meeting
2	Proposed list of key personnel	at kick off meeting
3	Proposed project spec planning procedure	30days after effective date
4	Proposed contractor WBS	30days after effective date
5	Level 1: Master schedule	at kick off meeting
6	Level 2: management schedule	at kick off meeting
7	Level 3: Detailed schedule	30days after effective date
8	Progress S-curve	30days after effective date
9	Weekly report	every week

10	Draft register listing all types fo information	30days after effective date
11	Monthly progress report	By the 7th each month
12	Schedule + progress s-curve	By the 7th each month

1.3 Section 6: HSSE

- HSSE Standards
  - The service companies' HSSE standards
  - Standards specified in contracts and specifications
  - Relevant international association of oil and gas producers (OGP) guidelines
- HSSE Leadership course shall be performed for those involved in the project
- Risk assessment matrix (RAM) shall be sent to customer for review
- HSSE plan shall be sent to customer for review

1.4 Section 8: Performance test

- Qualification test programs, schedules, and test data shall be provided to company
- FAT shall include all necessary tests required to verify that assembled permanent work meet the requirements of the purchase contract
- The contractor (the service company) shall submit EFAT procedures for approval by the service company's independent verification party prior to undertaking EFAT testing
  - Report to be sent to customer within 2 weeks of EFAT completion

1.5 Section 10: Quality management

- 2: Quality Standards (minimum)
    - ISO 9000
    - ISO 9001
    - ISO/TS 29001
    - ISO 10005
    - ISO 10007
    - ISO 19011
    - ISO/IEC 90003
    - EN 10204
- All applicable quality standards for the work shall be listed and sent for review
- Quality management system requirements
    - QMS shall be used systematically to plan and control th work
    - The service company shall have its own Project Quality Manager (PQM)
    - A finalized and detailed quality plan shall be submitted for review no later than 10 days AFTER contract award.
- QC reports shall be sent to customer each week
- Design, execution, records & audits
    - Design activities according to ISO9001:2008
    - Design activities shall be documented and organized in 7 steps (ISO 9001)
        - Planning
        - Inputs
        - Outputs
        - Review
        - Verification
        - Validation (qualification)
        - Control of design changes
- All approved suppliers shall be recorded on a rated approved supplier list (ASL)
- Suppliers of critical equipment/services and critical suppliers shall be physically audited by the service company
- The service company shall submit their internal & external audit plan(s) including sub contractors/suppliers audits to company within 10 days after contract award

2 TECHNICAL INFO VOLUME 1

2.1 Basis of Design

2.1.1 Design Basis Summary

- Water depth: 3000m
- System pressure: 5000 psi (10 000 psi differential)
- Flow capacity 2” line: 3000 bbl/day (331,25 l/min)
- Flow capacity 1” line: above 40 l/min
- Operating temp: -18 to +60 deg. Celsius
- Storage temp: -18 to +40 deg. Celsius
- Storage design life: 20 years maintainable
- Design life hoses: 8 years
- Operating design life: 2x6mnd
- Max weight /unit: 12 000 kg
- Max size (transport) LxWxH: 6058x2438x2591 mm

2.1.2 Materials

- Line piping, flanges, hoses, fittings = super duplex PREN > 40
- Structure: S355
- Nuts and bolts: stainless steel A4-80 & L7

2.1.3 Welding

- Structural steel fabrication & line piping fabrication according to NORSOK M-101

2.1.4 Cathodic Protection

- DNV-RP-B401
- minimum:
- structural components
    - fittings
    - nuts & bolts
    - pipe work

2.1.5 Surface treatment/Corrosion protection

- Carbon steel: NORSOK M501, system 7
- Moving parts: Xylan
- Fasteners: A4-80, EN10204-3.1 cert.

2.1.6 FLDR 2”

- The frame is designed with the same measures and type of locking system as a 20” offshore container
- Operation + transport mode (height difference)
- Capable of handling 2x125 m hose
- Handled by TT cl.4
- Recommended storage diameter = 30% bigger than the bending diameter for the hose
- Bottom structure is designed as a mud-mat with fork lift pockets

2.1.7 FLDR 1”

- Similar to 2”
- Able to handle 1000m hose (4x250m)

3 MATERIAL SELECTION REPORT

3.1 Design Standards

- Material Selection NORSOK M-001 / DNV 2.7-3 / DNV RP F112
- Welding NORSOK M-101
- NDT NORSOK M-101
- Coating NORSOK M-501
- Cathodic protection DNV-RF-B401

3.2 Material Selection Philosophy

- FLDR structure: S355
- 1” FLDR Hose: SS304L, Inconell, LLDPE LF1040, Nylon PA11 P40, Kvlar, Nylon PA11
- 2” FLDR hose: SS316L, Inconell, LLDPE LF1040, Nylon PA11 P40, Kvlar, Nylon PA11

4 FLYING LEAD TECHNICAL SPECIFICATION (SWR-OC-UA-SPE-20005)

4.1 Jumpers General Requirements

- Manufactured in accordance to ISO13628 part 5
- Requirements:
    - Shall be previously developed and operating in a similar environment with proven components and design
    - Hoses will be typically aramid fibre braided and over-sheated for mechanical protection
    - The hose ends will be permanently swaged female swivels or flange connections
    - The hose liner material will be low permeation
    - Shall be maintenance free over the design life
    - The bending radius and overall stiffness shall be minimized whilst maintaining full functional performance
    - Jumpers shall be bundled and securely fastened
    - Jumpers shall be designed to be interchangeable wherever possible
    - Shall be delivered with long term protective caps → plastic to be avoided
    - Supplied filled with a suitable preservation fluid
    - Unique marking

5 HOT STAB, TECHNICAL SPEC (SWR-OC-UA-SPE-20006)

5.1 General Design Parameters

- Used for chemical delivery
- Service conditions:
  - Water depth: 3000m
  - Max pressure: 5000 psi differential
  - Min temp: -18 deg. celcius

6 PIPEWORK WELDING & NDT FLDR/CTTH/CDA (SWR-OC-UA-SPE-20016)

6.1 Production Documentation (minimum):

- Material and welding consumable certificates
- Visual and dimensional inspection
- NDT and pressure test records
- Isometric drawings marked up with weld numbers
- Details of repairs
- Welding procedures
- Welding record sheet
- Welding and welder operator qualification test records
- Authenticated copies of NDT operator certificates
- Records of agreed concessions to fabrication standards

7 STRUCTURAL FABRICATION SOPEC FLDR/CDA/CTTH (SWR-OC-UA-SPE-20017)

7.1 Engineering and Procedures

- The engineering and internal procedures shall minimum include the following:
  - Site facility plan, detailing offices, stores, messing facilities and toilets
  - Steelwork receipt, storage and handling
  - Materials tracking and reconciliation
  - Dimensional control
  - Fabrication/welding/NDT/coating
  - Structure assemblies
  - Load testing/lifting/weighing
  - Load out

7.2 Lifting

- All structures designed according to DNV 2.7-3
- Lifting in accordance with National Regulations (LOLER or NORSOK R-003)

7.3 Design

- The structure shall be designed and manufactured in accordance to NORSOK N-004, DNV 2.7-3 and specification (this document)
- All structure members, parts, and welds shall have the appropriate levels of NDT according to NORSOK M-101 and DNV 2.7-3

8 STORAGE, TRANSPORT & MAINTENANCE PHILOSOPHY (pre study) (SWR-OC-UA-SPE-20801)

8.1 Transport and Storage ISO 20” container

- Size LxWxH: 6058x2438x2591mm
- Weight empty: 2500 kg
- Pay load (airport limitations): 9500 kg
- Max gross weight (airport limitations): 12 000kg

9 TECHNICAL INFO VOLUME 2

9.1 Value drivers and givens

- Key Value Drivers:
  - Response time (contain & deliver one system)
  - System performance (effective containment, reliability, operability)
  - Reputation (license to operate)
  - Cost (to develop and maintain)
- Given: HSE
  - Deliver safe response to subsea well blowout
  - Reduce/minimize environmental impact
- Driver #1:
  - Maximize containment solution space
- Driver "2:
  - Minimize the pre-investment (CAPEX) and to eliminate a need for the dedicated "containment hardware storage"
- SWRP containment system, field architecture.

9.2 Design data

- The SWRP containment system performance shall be analyzed versus the representative environment data for each of the main operating regions considered as follows:
  - East Africa (incl. offshore Tanzania and Mozambique)
  - West Africa
  - Brazil
  - Mediterranean
  - India (incl. Arabian sea and Bay of Bengal)
  - South east Asia (incl. south China sea)
  - Western Australia (incl. North West seas)
- Out of scope:
  - Gulf of Mexico
  - Ice covered Areas

APPENDIX B

Summary; Engineering weekly Meetings

28TH OF AUGUST 2013

Item	Minutes	Action	Due date
1	The concept of the FLDR 2IN is decided upon regarding handling of the hose on the frame structure.	Info	
2	Design review on the FLDR to be moved after the CTTH and CDA instead of before. This due to more challenges.	Info	
3	Everything is to be approved by the DNV.	Info	
4	Goal week 35: finishing concept design on Parking receptacles for the FLDR		
5	Concept of structure is started.		

4TH OF SEPTEMBER 2013

Item	Minutes	Action	Due date
1	Engineering deadline 01.11.13	Info	
2	Estimate remaining hours for the draft department on the FLDR.	Team Lead	05.0913
3	Look into the option of having a four leg sling used to handle the structure onshore, as well as several single point lifting point for subsea handling (due to different configurations).		
4	Concept design on Parking Receptacle is ready for design review.		
5	Concept design for the structure has started. Want to have close communication with supplier in Poland during the design phase.		
6	Two more resources added onto the FLDR work.		
7	Need to finish the concept of the drums.		

11TH OF SEPTEMBER 2013

Item	Minutes	Action	Due date
1	Estimated 100 hours of draft work for the FLDR	Technical lead	18.09.13
2	Meeting to be arranged due to lifting and handling (four pint and single lift)		

18TH OF SEPTEMBER 2013

Item	Minutes	Action	Due date
1	Have to figure out how many 2" Stabs and Receptacles we need on the FLDR (including test equipment)	Tech lead	20.09.13
2	Finish the concept on drums	Engineer	20.09.13
3	Finish the chain	Engineer	25.09.13
4	Figure out the threads on the Stab and receptacles.	Engineer	20.09.13
5	Make a decision regarding lifting and handling (four point/single lift)	Technical lead	25.09.13

25TH OF SEPTEMBER 2013

Item	Minutes	Action	Due date
1	1 In Umbilical Solution Hose ready to be ordered.	Info	ASAP
2	Decide if drums should be turned 90 degrees. To be decided during a separate meeting	Technical lead	26.09.13
3	Update and create a plan for the FLDR towards the design review.	Project manager	26.09.13
4	Design of gear. One resource added 100%	Info	ASAP
5	Awaiting feedback from the structural department on when the design on the structure can be «locked»		

2ND OF OCTOBER 2013

Item	Minutes	Action	Due date
1	Ref. Item 2 on previous meeting. Structure OK, no need to turn 90 degrees.	Info	
2	Check chain experience subsea.	Engineer	03.10.13
3	Measure electrical contact on chain.	Engineer	03.10.13
4	Decide on how to build up drums for 1” and 2” FLDR.	Engineer	09.10.13
5	Decide on the mounting of the drum.	Engineer	09.10.13
6	Decide on the drive.	Engineer	09.10.13
7	Decide how to fasten the drums to the structure.	Engineer	09.10.13
8	Design the locking system	Engineer	25.10.13
9	Decide how to lock the drum	Engineer	25.10.13
10	Schedule design review meeting for different components	Engineer	Info
11	Design of interface brackets.	Engineer	18.10.13

9TH OF OCTOBER 2013

Item	Minutes	Action	Due date
1	Check if stabs are to be delivered compensated.	Tecnical lead	10.10.13
2	Order stabs and other equipment.	Purchaser	11.10.13
3	Schedule design review with customer on CDA, CTTH and FLDR.	Project manager	10.10.13
4	Lifting and handling chapter in the OMM have to be finished by the 10th of October. Is to be sent to DNV for approval.	Engineer	10.12.13
5	Schedule design review for 1” and 2” drums.	Engineer	15.10.13

6	Measure electrical contact on chain.	Engineer	15.10.13
7	Design review on drum	Engineer	
8	Decision to be taken regarding chain	Engineer	16.10.13
9	Schedule design review on the drive.	Engineer	11.10.13
10	Design interface brackets.	Engineer	18.10.13
11	Design parking for stab	Engineer	

16TH OF OCTOBER 2013

Item	Minutes	Action	Due date
1	Schedule design review for 1” and 2” drums.	Engineer	15.10.13
2	Measure electrical contact on chain.	Engineer	15.10.13
3	Design review on drum	Engineer	
4	Decision to be taken regarding chain	Engineer	16.10.13
5	Schedule design review on the drive.	Engineer	11.10.13
6	Design interface brackets.	Engineer	18.10.13
7	Design parking for stab	Engineer	
8	Design review FLDR structure, drive and drum to be held.	Engineer	18.10.13
9	Where to place 1” receptacle	Engineer	25.10.13
10	Where to place 2” receptacle	Engineer	18.10.13
11	Decide how to fit the hose on the drum	Technical Lead	25.10.13
12	Electrical contact on chain = OK	Info	

23TH OF OCTOBER 2013

Item	Minutes	Action	Due date
1	Decide how the equipment is to be tested both internally and during yearly maintenance.	Technical lead	25.10.13
2	Design review FLDR structure, drive and drum to be held.	Engineer	continuous
3	Decide how to fit the hose on the drum	Technical lead	25.10.13

30TH OF OCTOBER 2013

Item	Minutes	Action	Due date
1	Pre read FLDR to be sent to customer	Technical lead	21.11.13
2	Design review FLDR structure, drive and drum to be held.	Engineer	continuous
3	Design ”hose guide”	Engineer	
4	Intern final design review to be held	Engineer	18.11.13
5	Design review med with customer (final)	All	25.11.13

6TH OF NOVEMBER 2013

Item	Minutes	Action	Due date
1	Check ROC hook and shackle	Technical lead	06.11.13
2	Design review	Engineer	Continuous
3	Reports to be sent to DNV	Structure department	08.11.13

13TH OF NOVEMBER 2013

Item	Minutes	Action	Due date
1	Change the date for final design review on FLDR?	Technical lead	13.11.13
2	Documents to be sent to DNV	Structure department	20.11.13
3	Need resource on the drawing department	Technical lead	13.11.13

27TH OF NOVEMBER 2013

Item	Minutes	Action	Due date
2	Establish drawings on various components.	Engineer	
3	Check weight on FLDR	Engineer	

11TH OF DECEMBER 2013

Item	Minutes	Action	Due date
1	Design review with client 13/12-13	Info	

18TH OF DECEMBER 2013

Item	Minutes	Action	Due date
1	General arrangement to be sent to customer.	Technical lead/Engineer	20.12.13
2	Decide how the equipment is going to be tested.	Technical lead	Week 3. 2014

8TH OF JANUARY 2014

Item	Minutes	Action	Due date
1	Update plan with more hours on detail design FLDR	Technical lead	
2	Some design work still remaining	Engineer	
3	Re-build FLDRs to make them easier to work with.	Engineer/ drawing department	
4	Update general arrangement	Engineer	
5	Establish documentation	Engineer	
6	Approve all drawings	Engineer	

15TH OF JANUARY 2014

Item	Minutes	Action	Due date
1	Need to update FLDR plan. More hours need to be added on detail design and checking of drawings. Estimated needed time: 225 hours.	Technical lead	16.01.14
2	Some design work still remaining	Engineer	
3	Update general arrangement	Engineer	
4	Establish documentation	Engineer	
5	Approve all drawings	Engineer	

21TH OF JANUARY 2014

Item	Minutes	Action	Due date
1	Some detail design still remains	Engineer	
2	Find out where to place anodes	Engineer	
3	Separate anode on gears?	Engineer	
4	Update GA with anode view	Engineer	
5	Documentation to be established	Engineer	
6	Check all drawings and components	Engineer	

12TH OF FEBRUARY 2014

Item	Minutes	Action	Due date
1	Overall orderlist to be completed ASAP	Engineer	13.02.14
2	Decide what parts to be made in Poland	Technical lead	14.02.14
3	Working on 2IN OMM	Engineer	

26TH OF FEBRUARY 2014

Item	Minutes	Action	Due date
1	1IN and 2IN OMM ready for check	Engineer/ tech. Lead	
2	1IN and 2IN FAT ready for check	Engineer/ tech. Lead	
3	ASP 1IN and 2IN soon to be ready	Engineer	

5TH OF MARCH 2014

Item	Minutes	Action	Due date
1	Launching frame estimated finished design 21.03.14	Structure department	
2	Generic Mud Mat (against FLDR and CTTH) finished 11.04.14	Structure department	
3	MSC production start postponed due to HSE issues with supplier	Info	
4	Received updated documents from DNV	Technical lead	

APPENDIX C

Example of presentation for the chosen Service Company

RECOMMENDATIONS FOR IMPROVEMENTS

Based on the MEG project

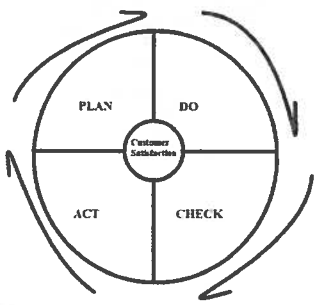
BACKGROUND

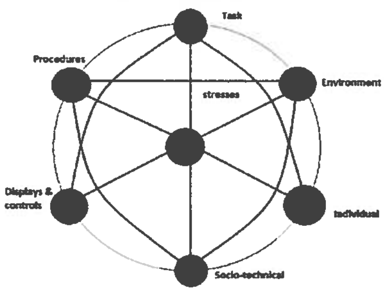
- Master Thesis
- Detailed study of large and complex project
- Find areas of improvements
- Find challenges
- Prepare the company for similar projects
- Improve project with reference to cost and time
- Improve motivation

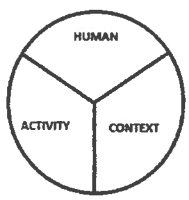
GENERAL

- Consists of general recommendations to improve project execution.

- Responsibility matrix
- To-Do lists
- PDCA
- Human Performance
- Performance influencing factors







TECHNICAL

- Recommendations based on improving the technical execution of large complex projects.

- Course the engineers in time- and cost effective modeling of heavy models.
- Workshop in the beginning of a project
- Better defined roles and responsibilities
- Define criteria for when pre-study is finished better
- Handovers

ORGANIZATIONAL

- Recommendations based on how to improve the organizational project execution in large complex projects.

- Workshop
- Place the project together
- Involve technical project manager
- Communication
- Delegation

APPENDIX D

WBS / Plan Progress

From the following dates: 13.03.14, 06.05.14, 13.05.14, 06.06.14, 16.06.14

Master Kristin

WBS / Activity	Activity ID	Activity % Complete	Duration %	Start	Finish	Planned Labor Units	Actual Labor Units	Remaining Labor Units
Master Kristin			**39.9%**	**13.Jan.14 08:00 A**	**17.Jun.14 10:30**	**458.00h**	**184.00h**	**271.00h**
Del 1			**100%**	**13.Jan.14 08:00 A**	**21.Jan.14 10:30 A**	**43.00h**	**43.00h**	**0.00h**
Lese spec nr.1	A1000	100%	100%	13.Jan.14 08:00 A	13.Jan.14 16:00 A	6.00h	6.00h	0.00h
Lese spec nr.1	A1010	100%	100%	14.Jan.14 08:00 A	14.Jan.14 10:30 A	6.00h	6.00h	0.00h
Lese spec nr.1	A1020	100%	100%	15.Jan.14 08:00 A	15.Jan.14 10:30 A	6.00h	6.00h	0.00h
Lese spec nr.1	A1030	100%	100%	16.Jan.14 08:00 A	16.Jan.14 10:30 A	6.00h	6.00h	0.00h
Lese spec nr.1	A1040	100%	100%	17.Jan.14 08:00 A	17.Jan.14 10:30 A	6.00h	6.00h	0.00h
samle oppsummering av spec nr.1-5	A1050	100%	100%	18.Jan.14 08:00 A	19.Jan.14 10:30 A	12.00h	12.00h	0.00h
skrive kontrakt for oppgave	A1060	100%	100%	21.Jan.14 08:00 A	21.Jan.14 10:30 A	1.00h	1.00h	0.00h
Del 2			**33.6%**	**24.Jan.14 08:00 A**	**17.Jun.14 10:30**	**25.00h**	**23.00h**	**2.00h**
skrive bakgrunn	A1070	100%	100%	24.Jan.14 08:00 A	11.Feb.14 10:30 A	12.00h	12.00h	0.00h
skrive mål med oppgaven	A1080	100%	100%	25.Jan.14 08:00 A	25.Jan.14 10:30 A	2.00h	2.00h	0.00h
oprette dokumenter (selve oppgave dokument)	A1100	100%	100%	25.Jan.14 08:00 A	25.Jan.14 10:30 A	1.00h	1.00h	0.00h
skrive om specs	A1110	80%	32.1%	28.Jan.14 08:00 A	17.Jun.14 10:30	10.00h	8.00h	2.00h
Del 3			**32.9%**	**28.Jan.14 08:00 A**	**17.Jun.14 10:30**	**135.00h**	**67.00h**	**66.00h**
FLDR pre-study	A1120	100%	32.1%	28.Jan.14 08:00 A	17.Jun.14 10:30	20.00h	20.00h	0.00h
FLDR MOM	A1130	100%	23.1%	12.Feb.14 08:00 A	17.Jun.14 10:30	10.00h	10.00h	0.00h
CDA/CTTH kort forklart	A1190	50%	23.1%	12.Feb.14 08:00 A	17.Jun.14 10:30	10.00h	5.00h	5.00h
FLDR endringer underveis	A1140	25%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	10.00h	2.00h	6.00h
FLDR enigneering (juni-desember 2013)	A1150	50%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	40.00h	20.00h	20.00h
FLDR etter design review des 2013	A1160	40%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	15.00h	6.00h	9.00h
FLDR utfordringer under bygging, sammenstillin...	A1170	0%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	15.00h	0.00h	15.00h
FLDR oppsummert	A1180	26.7%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	15.00h	4.00h	11.00h
Del 4			**24%**	**12.Feb.14 08:00 A**	**17.Jun.14 10:30**	**45.00h**	**15.00h**	**30.00h**
Organisasjonsendring i OAS	A1200	60%	23.1%	12.Feb.14 08:00 A	17.Jun.14 10:30	5.00h	3.00h	2.00h
Prosjekt organisasjon	A1210	0%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	5.00h	0.00h	5.00h
Ressurser	A1220	50%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	10.00h	5.00h	5.00h
Prosjektkrav vs organisasjon	A1230	0%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	5.00h	0.00h	5.00h

Master Kristin

WBS / Activity	Activity ID	Activity % Complete	Duration %	Start	Finish	Planned Labor Units	Actual Labor Units	Remaining Labor Units
"prosjektet er større enn organisasjonen"	A1240	20%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	5.00h	1.00h	4.00h
hva er erfaringen?	A1250	40%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	15.00h	6.00h	9.00h
Del 5			**0%**	**12.Mar.14 08:00 A**	**17.Jun.14 10:30**	**140.00h**	**8.00h**	**131.00h**
tek. Kva gjorde me bra/dårleg	A1270	10%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	20.00h	2.00h	18.00h
tek. Kva kunne vore unngått	A1280	10%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	20.00h	2.00h	18.00h
tek. Kva har me lært til neste gong	A1290	0%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	20.00h	0.00h	20.00h
org. Korleis har org. Takla prosjektet	A1300	0%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	20.00h	0.00h	20.00h
org. Kor jekk me feil	A1310	5%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	20.00h	1.00h	19.00h
org. Kva var bra	A1320	5.3%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	20.00h	1.00h	18.00h
org. Kva bør me hugse til neste gong	A1330	10%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	20.00h	2.00h	18.00h
Del 6			**0%**	**12.Mar.14 08:00 A**	**17.Jun.14 10:30**	**70.00h**	**28.00h**	**42.00h**
møter med veileder	A1340	10%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	10.00h	1.00h	9.00h
møte ang. bakgrunn av prosjekt	A1350	35%	0%	12.Mar.14 08:00 A	17.Jun.14 10:30	20.00h	7.00h	13.00h
møtereferat/info	A1360	50%	0%	12.Mar.14 08:00 A	19.Mar.14 10:30	40.00h	20.00h	20.00h

WBS / Activity	Activity ID	Planned Labor Units	Actual Labor Units	Remaining Labor Units
Master Kristin		**803.00h**	**325.00h**	**476.00h**
Del 1		**343.00h**	**168.00h**	**175.00h**
Bakgrunnsarbeid	A1370	200.00h	105.00h	95.00h
Innhenting av fagstoff	A1380	100.00h	20.00h	80.00h
Lese spec nr.1	A1000	6.00h	6.00h	0.00h
Lese spec nr.1	A1010	6.00h	6.00h	0.00h
Lese spec nr.1	A1020	6.00h	6.00h	0.00h
Lese spec nr.1	A1030	6.00h	6.00h	0.00h
Lese spec nr.1	A1040	6.00h	6.00h	0.00h
samle oppsummering av spec nr.1-5	A1050	12.00h	12.00h	0.00h
skrive kontrakt for oppgave	A1060	1.00h	1.00h	0.00h
Del 2		**25.00h**	**23.00h**	**2.00h**
oprette dokumenter (selve oppgave dokument)	A1100	1.00h	1.00h	0.00h
skrive bakgrunn	A1070	12.00h	12.00h	0.00h
skrive mål med oppgaven	A1080	2.00h	2.00h	0.00h
skrive om specs	A1110	10.00h	8.00h	2.00h
Del 3		**175.00h**	**72.50h**	**100.50h**
Bid phase	A1390	20.00h	2.00h	18.00h
CDA/CTTH	A1190	10.00h	6.00h	4.00h
Changes	A1140	10.00h	2.00h	6.00h
Consept design	A1120	20.00h	20.00h	0.00h
Design review	A1160	15.00h	6.00h	9.00h

WBS / Activity	Activity ID	Planned Labor Units	Actual Labor Units	Remaining Labor Units
Detail design	A1150	40.00h	21.50h	18.50h
Eng.meetings	A1130	10.00h	10.00h	0.00h
General info	A1400	20.00h	0.00h	20.00h
Manufacturing(Testing	A1170	15.00h	1.00h	14.00h
Summary	A1180	15.00h	4.00h	11.00h
Del 4		**50.00h**	**15.50h**	**34.50h**
"prosjektet er større enn organisasjonen"	A1240	5.00h	1.00h	4.00h
Experiences	A1250	15.00h	6.00h	9.00h
Project Organisation	A1210	10.00h	0.50h	9.50h
Re-organisation	A1200	5.00h	3.00h	2.00h
Resources	A1220	10.00h	5.00h	5.00h
Theories	A1230	5.00h	0.00h	5.00h
Del 5		**140.00h**	**14.50h**	**125.50h**
Challenges	A1310	20.00h	3.00h	17.00h
Good experiences	A1320	20.00h	2.50h	17.50h
Lessons learned	A1330	20.00h	4.50h	15.50h
org. Korleis har org. Takla prosjektet	A1300	20.00h	0.00h	20.00h
tek. Kva gjorde me bra/dårleg	A1270	20.00h	2.00h	18.00h
tek. Kva har me lært til neste gong	A1290	20.00h	0.50h	19.50h
tek. Kva kunne vore unngått	A1280	20.00h	2.00h	18.00h
Del 6		**70.00h**	**31.50h**	**38.50h**
møte ang. bakgrunn av prosjekt	A1350	20.00h	8.00h	12.00h

WBS / Activity	Activity ID	Planned Labor Units	Actual Labor Units	Remaining Labor Units
møter med veileder	A1340	10.00h	2.50h	7.50h
møtereferat/info	A1360	40.00h	21.00h	19.00h

WBS / Activity	Activity ID	Units % Complete	Duration %	Start	Finish	Planned Labor Units	Actual Labor Units	Remaining Labor Units
Master Kristin		**21%**	**82.1%**	**09.Dec.13 08:00 A**	**16.Jun.14 10:30**	**984.00h**	**218.00h**	**820.00h**
Del 1		**53.9%**	**82.1%**	**09.Dec.13 08:00 A**	**16.Jun.14 10:30**	**239.00h**	**158.00h**	**135.00h**
Bakgrunnsarbeid	A1370	52.5%	82.2%	09.Dec.13 08:00 A	16.Jun.14 10:30	150.00h	105.00h	95.00h
oppsummering av spec nr.1-5	A1050	100%	100%	18.Jan.14 08:00 A	19.Jan.14 10:30 A	22.00h	22.00h	0.00h
kontrakt	A1060	100%	100%	21.Jan.14 08:00 A	21.Jan.14 10:30 A	1.00h	1.00h	0.00h
opprette doc	A1410	100%	100%	22.Jan.14 08:00 A	22.Jan.14 10:30 A	1.00h	0.00h	0.00h
Background	A1420	100%	100%	22.Jan.14 08:00 A	22.Jan.14 10:30 A	15.00h	15.00h	0.00h
Purpose of scope	A1380	75%	0%	23.Jan.14 10:30 A	16.Jun.14 10:30	15.00h	15.00h	5.00h
Methodology	A1430	0%	0%	13.May.14 08:00	20.May.14 10:30	10.00h	0.00h	10.00h
Limitation	A1440	0%	0%	13.May.14 08:00	20.May.14 10:30	10.00h	0.00h	10.00h
Thesis structure	A1450	0%	0%	13.May.14 08:00	20.May.14 10:30	15.00h	0.00h	15.00h
Del 2		**0%**	**0%**	**13.May.14 08:00**	**20.May.14 10:30**	**150.00h**	**0.00h**	**150.00h**
Innhenting av fagstoff	A1460	0%	0%	13.May.14 08:00	20.May.14 10:30	50.00h	0.00h	50.00h
status quo tek.	A1470	0%	0%	13.May.14 08:00	20.May.14 10:30	50.00h	0.00h	50.00h
status quo, org.	A1480	0%	0%	13.May.14 08:00	20.May.14 10:30	50.00h	0.00h	50.00h
Del 3		**0%**	**0%**	**13.May.14 08:00**	**20.May.14 10:30**	**175.00h**	**0.00h**	**175.00h**
MEG backgeround	A1490	0%	0%	13.May.14 08:00	20.May.14 10:30	30.00h	0.00h	30.00h
Project Processes	A1500	0%	0%	13.May.14 08:00	20.May.14 10:30	10.00h	0.00h	10.00h
Pre-Stundy	A1510	0%	0%	13.May.14 08:00	20.May.14 10:30	55.00h	0.00h	55.00h
Changes	A1520	0%	0%	13.May.14 08:00	20.May.14 10:30	10.00h	0.00h	10.00h
Engineering	A1530	0%	0%	13.May.14 08:00	20.May.14 10:30	60.00h	0.00h	60.00h
CDA/CTTH	A1540	0%	0%	13.May.14 08:00	20.May.14 10:30	10.00h	0.00h	10.00h
Del 4		**100%**	**72.7%**	**12.Feb.14 08:00 A**	**16.Jun.14 10:30**	**60.00h**	**60.00h**	**0.00h**
Re-organisation	A1200	100%	72.9%	12.Feb.14 08:00 A	16.Jun.14 10:30	30.00h	30.00h	0.00h
Project Organisation	A1210	100%	64.2%	12.Mar.14 08:00 A	16.Jun.14 10:30	15.00h	15.00h	0.00h
Resources	A1220	100%	64.2%	12.Mar.14 08:00 A	16.Jun.14 10:30	10.00h	10.00h	0.00h
"project is bigger than....."	A1240	100%	64.2%	12.Mar.14 08:00 A	16.Jun.14 10:30	5.00h	5.00h	0.00h
Del 5		**0%**	**0%**	**13.May.14 08:00**	**20.May.14 10:30**	**160.00h**	**0.00h**	**160.00h**
Technical	A1550	0%	0%	13.May.14 08:00	20.May.14 10:30	80.00h	0.00h	80.00h
Organizational	A1560	0%	0%	13.May.14 08:00	20.May.14 10:30	80.00h	0.00h	80.00h
Del 6		**0%**	**63.9%**	**12.Mar.14 08:00 A**	**16.Jun.14 10:30**	**50.00h**	**0.00h**	**50.00h**
recommendation	A1340	0%	64.2%	12.Mar.14 08:00 A	16.Jun.14 10:30	50.00h	0.00h	50.00h
Del 7		**0%**	**0%**	**13.May.14 08:00**	**20.May.14 10:30**	**80.00h**	**0.00h**	**80.00h**
Discussions	A1570	0%	0%	13.May.14 08:00	20.May.14 10:30	20.00h	0.00h	20.00h
Conclusions	A1580	0%	0%	13.May.14 08:00	20.May.14 10:30	20.00h	0.00h	20.00h

WBS / Activity	Activity ID	Units % Complete	Duration %	Start	Finish	Planned Labor Units	Actual Labor Units	Remaining Labor Units
References	A1590	0%	0%	13.May.14 08:00	20.May.14 10:30	20.00h	0.00h	20.00h
Appendix	A1600	0%	0%	13.May.14 08:00	20.May.14 10:30	20.00h	0.00h	20.00h
Del 8		**0%**	**0%**	**13.May.14 08:00**	**20.May.14 10:30**	**70.00h**	**0.00h**	**70.00h**
møte med veileder	A1610	0%	0%	13.May.14 08:00	20.May.14 10:30	10.00h	0.00h	10.00h
møte ang prosjekt	A1620	0%	0%	13.May.14 08:00	20.May.14 10:30	20.00h	0.00h	20.00h
møtereferat	A1630	0%	0%	13.May.14 08:00	20.May.14 10:30	40.00h	0.00h	40.00h

WBS / Activity	Planned Duration	Start	Finish	Planned Labor Units	Actual Labor Units	Remaining Labor Units
Master Kristin	**124.9d**	**09.Dec.13 08:00 A**	**23.Oct.14 15:00**	**1,014.00h**	**827.00h**	**201.00h**
Del 1	**124.9d**	**09.Dec.13 08:00 A**	**16.Jun.14 10:30**	**269.00h**	**283.00h**	**0.00h**
Background work	125.4d	09.Dec.13 08:00 A	16.Jun.14 10:30	150.00h	164.00h	0.00h
Summery of spec nr.1-5	68.9d	18.Jan.14 08:00 A	30.Apr.14 10:30 A	22.00h	22.00h	0.00h
Read spec 1-5	66.9d	18.Jan.14 08:00 A	30.Apr.14 10:30 A	30.00h	30.00h	0.00h
Contract	0.3d	21.Jan.14 08:00 A	21.Jan.14 10:30 A	1.00h	1.00h	0.00h
Create documents	0.3d	22.Jan.14 08:00 A	22.Jan.14 10:30 A	1.00h	1.00h	0.00h
Background	0.3d	22.Jan.14 08:00 A	22.Jan.14 10:30 A	15.00h	15.00h	0.00h
Purpose of scope	65.5d	22.Jan.14 10:30 A	30.Apr.14 10:30 A	15.00h	15.00h	0.00h
Methodology	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
Limitations	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
Thesis structure	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	15.00h	15.00h	0.00h
Del 2	**95.9d**	**23.Jan.14 08:00 A**	**16.Jun.14 10:30**	**150.00h**	**90.00h**	**60.00h**
Litterature review	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30	50.00h	50.00h	0.00h
status quo tek.	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30	50.00h	20.00h	30.00h
status quo, org.	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30	50.00h	20.00h	30.00h
Del 3	**96.9d**	**22.Jan.14 08:00 A**	**16.Jun.14 10:30**	**175.00h**	**175.00h**	**0.00h**
MEG backgeround	66.9d	22.Jan.14 08:00 A	30.Apr.14 10:30 A	30.00h	30.00h	0.00h
Pre-Stundy	96.9d	22.Jan.14 08:00 A	16.Jun.14 10:30	55.00h	55.00h	0.00h
Project Processes	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
Changes	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
Engineering	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	60.00h	60.00h	0.00h
CDA/CTTH	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
Del 4	**51.9d**	**12.Feb.14 08:00 A**	**30.Apr.14 10:30 A**	**60.00h**	**60.00h**	**0.00h**
Re-organisation	51.9d	12.Feb.14 08:00 A	30.Apr.14 10:30 A	30.00h	30.00h	0.00h
Project Organisation	31.9d	12.Mar.14 08:00 A	30.Apr.14 10:30 A	15.00h	15.00h	0.00h

WBS / Activity	Planned Duration	Start	Finish	Planned Labor Units	Actual Labor Units	Remaining Labor Units
Resources	31.9d	12.Mar.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
"project is bigger than....."	31.9d	12.Mar.14 08:00 A	30.Apr.14 10:30 A	5.00h	5.00h	0.00h
Del 5	**95.9d**	**23.Jan.14 08:00 A**	**16.Jun.14 10:30**	**160.00h**	**80.00h**	**80.00h**
Technical	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30	80.00h	40.00h	40.00h
Organizational	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30	80.00h	40.00h	40.00h
Del 6	**61.9d**	**12.Mar.14 08:00 A**	**16.Jun.14 10:30**	**50.00h**	**35.00h**	**15.00h**
recommendation	62.3d	12.Mar.14 08:00 A	16.Jun.14 10:30	50.00h	35.00h	15.00h
Del 7	**95.9d**	**23.Jan.14 08:00 A**	**16.Jun.14 10:30**	**80.00h**	**55.00h**	**25.00h**
Discussions	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30	20.00h	20.00h	0.00h
References	2.3d	02.Jun.14 08:00 A	04.Jun.14 10:30	20.00h	10.00h	10.00h
Appendix	2.3d	02.Jun.14 08:00 A	04.Jun.14 10:30	20.00h	15.00h	5.00h
Conclusions	2.3d	09.Jun.14 08:00 A	12.Jun.14 10:30	20.00h	10.00h	10.00h
Del 8	**95.9d**	**23.Jan.14 08:00 A**	**23.Oct.14 15:00**	**70.00h**	**49.00h**	**21.00h**
møte med veileder	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30	10.00h	10.00h	0.00h
møte ang prosjekt	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30	20.00h	13.00h	7.00h
møtereferat	95.9d	23.Jan.14 08:00 A	23.Oct.14 15:00	40.00h	26.00h	14.00h

WBS / Activity	Planned Duration	Start	Finish	Planned Labor Units	Actual Labor Units	Remaining Labor Units
Master Kristin	**125.5d**	**09.Dec.13 08:00 A**	**16.Jun.14 15:00**	**923.00h**	**937.00h**	**7.00h**
Del 1	**125.4d**	**09.Dec.13 08:00 A**	**16.Jun.14 10:30 A**	**269.00h**	**283.00h**	**0.00h**
Background work	125.4d	09.Dec.13 08:00 A	16.Jun.14 10:30 A	150.00h	164.00h	0.00h
Summery of spec nr.1-5	68.9d	18.Jan.14 08:00 A	30.Apr.14 10:30 A	22.00h	22.00h	0.00h
Read spec 1-5	66.9d	18.Jan.14 08:00 A	30.Apr.14 10:30 A	30.00h	30.00h	0.00h
Contract	0.3d	21.Jan.14 08:00 A	21.Jan.14 10:30 A	1.00h	1.00h	0.00h
Create documents	0.3d	22.Jan.14 08:00 A	22.Jan.14 10:30 A	1.00h	1.00h	0.00h
Background	0.3d	22.Jan.14 08:00 A	22.Jan.14 10:30 A	15.00h	15.00h	0.00h
Purpose of scope	65.5d	22.Jan.14 10:30 A	30.Apr.14 10:30 A	15.00h	15.00h	0.00h
Methodology	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
Limitations	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
Thesis structure	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	15.00h	15.00h	0.00h
Del 2	**96.2d**	**23.Jan.14 08:00 A**	**16.Jun.14 13:30 A**	**90.00h**	**90.00h**	**0.00h**
Litterature review	96.2d	23.Jan.14 08:00 A	16.Jun.14 13:30 A	50.00h	50.00h	0.00h
status quo tek.	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30 A	20.00h	20.00h	0.00h
status quo, org.	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30 A	20.00h	20.00h	0.00h
Del 3	**96.9d**	**22.Jan.14 08:00 A**	**16.Jun.14 10:30 A**	**175.00h**	**175.00h**	**0.00h**
MEG backgeround	66.9d	22.Jan.14 08:00 A	30.Apr.14 10:30 A	30.00h	30.00h	0.00h
Pre-Stundy	96.9d	22.Jan.14 08:00 A	16.Jun.14 10:30 A	55.00h	55.00h	0.00h
Project Processes	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
Changes	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
Engineering	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	60.00h	60.00h	0.00h
CDA/CTTH	65.9d	23.Jan.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
Del 4	**51.9d**	**12.Feb.14 08:00 A**	**30.Apr.14 10:30 A**	**60.00h**	**60.00h**	**0.00h**
Re-organisation	51.9d	12.Feb.14 08:00 A	30.Apr.14 10:30 A	30.00h	30.00h	0.00h
Project Organisation	31.9d	12.Mar.14 08:00 A	30.Apr.14 10:30 A	15.00h	15.00h	0.00h

WBS / Activity	Planned Duration	Start	Finish	Planned Labor Units	Actual Labor Units	Remaining Labor Units
Resources	31.9d	12.Mar.14 08:00 A	30.Apr.14 10:30 A	10.00h	10.00h	0.00h
"project is bigger than....."	31.9d	12.Mar.14 08:00 A	30.Apr.14 10:30 A	5.00h	5.00h	0.00h
Del 5	**95.9d**	**23.Jan.14 08:00 A**	**16.Jun.14 10:30 A**	**160.00h**	**160.00h**	**0.00h**
Technical	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30 A	80.00h	80.00h	0.00h
Organizational	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30 A	80.00h	80.00h	0.00h
Del 6	**62.3d**	**12.Mar.14 08:00 A**	**16.Jun.14 10:30 A**	**50.00h**	**50.00h**	**0.00h**
recommendation	62.3d	12.Mar.14 08:00 A	16.Jun.14 10:30 A	50.00h	50.00h	0.00h
Del 7	**95.9d**	**23.Jan.14 08:00 A**	**16.Jun.14 10:30 A**	**70.00h**	**70.00h**	**0.00h**
Discussions	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30 A	20.00h	20.00h	0.00h
References	9.3d	02.Jun.14 08:00 A	16.Jun.14 10:30 A	10.00h	10.00h	0.00h
Appendix	9.3d	02.Jun.14 08:00 A	16.Jun.14 10:30 A	20.00h	20.00h	0.00h
Conclusions	4.3d	09.Jun.14 08:00 A	16.Jun.14 10:30 A	20.00h	20.00h	0.00h
Del 8	**96.4d**	**23.Jan.14 08:00 A**	**16.Jun.14 15:00**	**49.00h**	**49.00h**	**7.00h**
møte med veileder	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30 A	10.00h	10.00h	0.00h
møte ang prosjekt	95.9d	23.Jan.14 08:00 A	16.Jun.14 10:30	13.00h	13.00h	7.00h
møtereferat	96.4d	23.Jan.14 08:00 A	16.Jun.14 15:00 A	26.00h	26.00h	0.00h