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UNIVERSITY OF STAVANGER

Evaluation of the reorganization at GE Oil & Gas, Dusavik site, for the XT department

A Masters Thesis

By

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ABSTRACT

Cost increase has proven to become one of the main challenges for the oil and gas industry on the Norwegian Continental Shelf. Several Norwegian suppliers in the oil and gas industry have lost contracts because of this cost increase. This thesis addresses an evaluation to find the effect and trends (in the aspect of time) of a reorganization that took place February 2013 for the Xmas Tree department at GE Oil & Gas, Dusavik site. The purpose of this evaluation is to see if it is possible to see a trend on the total amount of hours spent on a project, if it is decreasing, the quotation of a Xmas Tree project can be lowered, and more contracts can be acquired.

In order to grasp the potential of effective project management and monitor, this paper have been made to understand what types of projects the Xmas Tree department executes, how these are managed, and how they can be monitored, controlled and managed in order to decrease the project time of a “Refurbishment and upgrade of a Xmas Tree” project.

To determine the trend we collected data from finished projects before and after the reorganization. We looked on the total amount of hours of each project at a high level to illustrate the trend. In order to see differences between hours spent on milestones, activities and functions we collected available data on two projects, and evaluated all of the functions, activities and milestones available.

The findings of the research suggest that further breakdown of the milestones is necessary to find the most contributing activities on a Xmas Tree project, in order to see which activities to adjust to offer a better quotation.

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Friends, colleagues and family should also be mentioned as great supporters and motivators.

ABBREVIATIONS

PDO – Plan for Development and Operation

NCS – Norwegian Continental Shelf

NDP – Norwegian Petroleum Directorate

E&P – Exploration and Production

PO – Purchase Order

RFQ – Request for Quotation

BOM – Bill of Materials

ITP – Inspection Test Plan

SNR – Serial Number Record

QCI – Quality Control Inspection

SCI – Strip, Clean and Inspect

RUR – Refurbishment, Upgrade and Repair

PMLC – Project Management Landscape

PMP – Project Management Process

DRB – Decision Review Board

TERMINOLOGY

Brownfield - An existing onshore or offshore installation.

Greenfield – A new field development, either onshore or offshore.

Decision Review Board – The DRB members is a group of people whom interact with the project team to build quality in the project.

Work Order Close Out Report – A document that describes the project in detail and requests for a completion certificate from the customer. It includes a detailed overview of the quality, finance, health, safety and environment aspects.

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Chapter 1 About the thesis

The petroleum industry has within five years become Norway's most important industry. It employs more than 250 000 people, stands for one quarter of the Gross Domestic Product (GDP), one third of the government's annual income and half of the national export. The Norwegian Continental Shelf (NCS) has produced oil and gas for more than 40 years, and the estimates of undiscovered resources are very promising. (Norwegian Oil and Gas Association, 2013).

A new era is about to begin on the NCS, new plans for development and operation (PDO) are being approved and several brownfields are facing modification and upgrades in order to maintain a sustainable production level. The Norwegian Petroleum Directorate (NDP) reports that the investment and exploration costs in 2013 were on NOK 210 billion were an all time high and the forecast for investment and exploration costs the next five years is estimated to be constant, as shown in Figure 1-1.

The industry is also facing demanding challenges, such as capital intensity and falling return. Nevertheless, the uncertain energy prices and the cost increase are the industry's main challenges (Norwegian Oil and Gas Association, 2013).

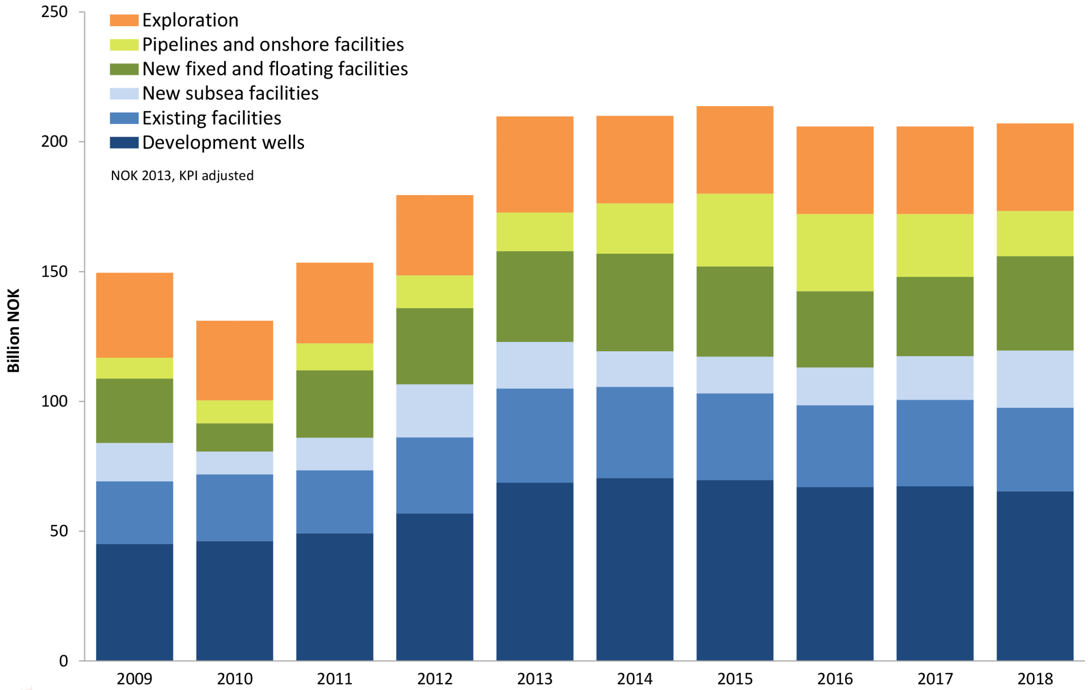

Figure 1-1 Investment and exploration costs on the NCS (source: NPD, 2014)

Statoil ASA as the biggest production and exploration (P&E) company on the NCS, responds to the challenges with a stricter project prioritization and a comprehensive efficiency program. 7th of February 2014, Statoil announced a plan for reducing its capital expenditure by more than USD 5 billion from 2014 to 2016, which will affect both suppliers (service and sub contractors companies) and Statoil employees.

The Norwegian Oil and Gas Association have put together an industry collaboration named the Norwegian Subsea Standardization after the Åm-report (Åm et al., 2010). Their objective is to raise quality, reduce cost and deliver times through increased subsea standardization on the NCS (Norwegian Oil and Gas Association, 2014).

GE Oil & Gas goes under the term supplier in this context, and the research topic for this thesis is an interesting and a very important factor of reducing costs in all types and parts of projects. Effective project management and well-planed projects that are delivered on time is a critical contributor to reducing cost in all industries.

1.1 Objectives

- Determine the trend of the re-organization of GE Oil & Gas for the XT-Department in aspect of time.

- o Suggest improvements to increase the efficiency of managing projects in the XT department.

1.2 Limitations

Variations are not considered as a part of the scope in this thesis, due to the fact that these variations are not known when receiving the first purchase order on a specific project.

Costs, margins and profits are excluded from the analysis, since it's classified as highly confidential information for GE and their customers.

1.3 Structure of thesis

The structure of this thesis is divided into five parts. Where as each of the parts focuses on capturing the essential information that is needed to establish a fundamental overview of the business being analyzed during the thesis.

Part I This part states the current situation of the activity level on the Norwegian Continental Shelf, it also provides information that covers the thesis objective, limitations, and a concise introduction of the company that this thesis is based upon on.

Part II A brief overview of how projects are supposed to be managed in a theoretical perfect world versus how they are managed at GE Oil & Gas. It will include sections that covers the academically, theoretical and practical perspectives of project management. In order to build up a fundamental background of the analysis that is to be performed during the thesis, the way of how projects are managed at the GE is described briefly in this part.

Part III This part covers the methodology and analysis used in the thesis. The methodology chapter in this section contains information of the data collected, how to read the results and tables that describes different abbreviations and meanings. The analysis chapter states the results of the analysis, these a briefly commented and presented in graphs and tables.

Part IV A discussions of the results found in the analysis are stated in this part. The discussions will contain theoretical aspects from Part II and combine these with the results in Part III. Potential future improvements and a short summary of potential milestone pitfalls are also listed here.

Part V Justification and the final conclusion of the thesis.

Chapter 2 General Electric

General Electric (GE) is a multinational conglomerate listed on the New York Stock Exchange, Dow Jones and S&P 500 Component. GE delivers products and services within different kinds of industries. GE was first established in 1892 after a merger of Edison General Electric Company of Schenectady, New York, and Thomas – Houston Electric Company of Lynn, Massachusetts. The merger was lead by Drexel, Morgan & Co (GE History, 2014).

As of 2014 GE has eight business divisions, GE Capital, GE Energy Management, GE Power & Water, GE Oil & Gas, GE Aviation, GE Healthcare, GE Transportation and GE Appliances & Lightning, present in over 100 countries with more than 315 000 employees. In 2013 GE had consolidated revenues on USD 146 billion from all of their businesses. The conglomerate also has one specific division dedicated to the global growth of the organization named, GE Global Growth Organization. All of the divisions is described in the organizational chart in Figure 2-1.

The organizational structure of this conglomerate is built upon a hierarchal system with Jeffery R. Immelt as the Chairman of the Board and Chief Executive Officer. All of the eight business divisions have one dedicated person as their president and CEO reporting directly to Immelt.

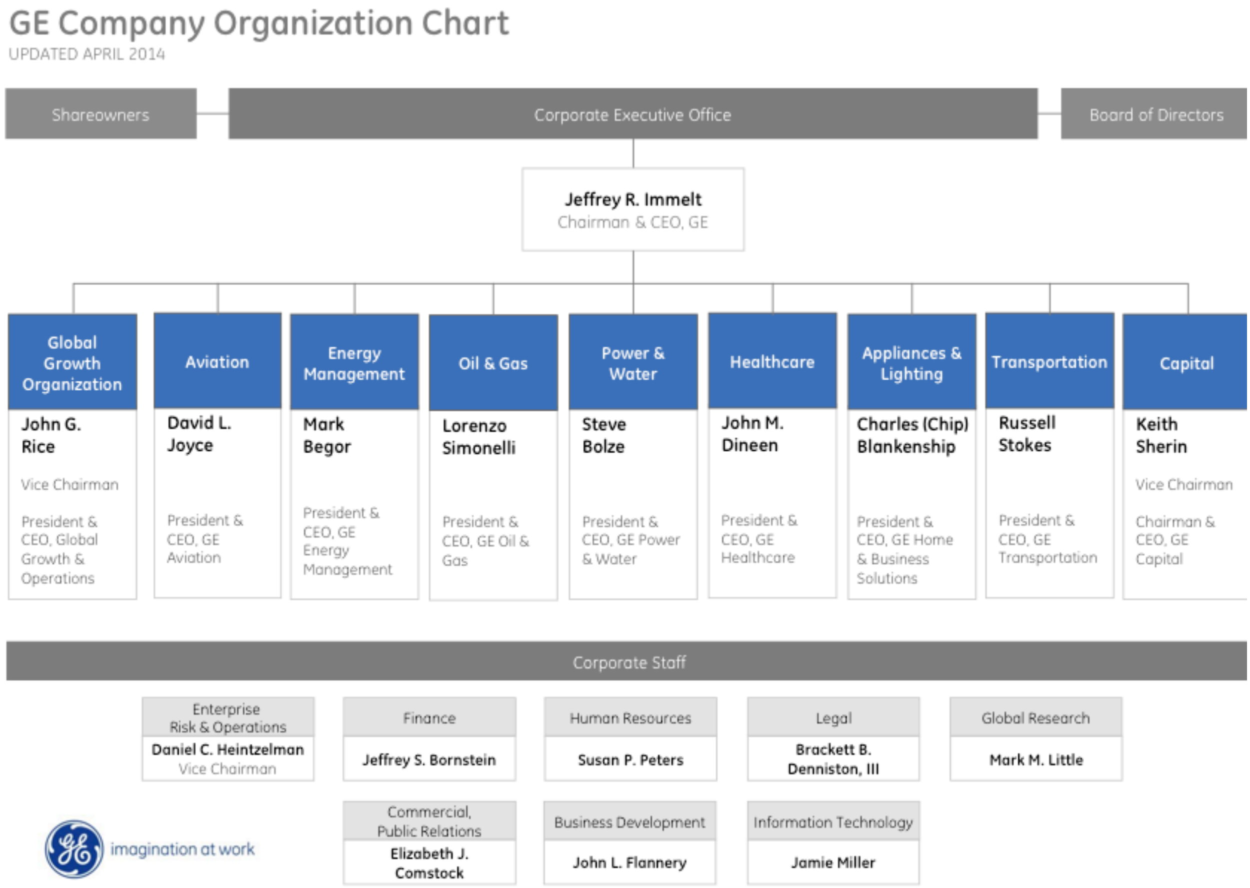

Figure 2-1: GE Company Organization Chart. The organization chart shows the eight business divisions and the global growth division of GE

2.1 GE Oil & Gas

GE started its oil adventure in Florence, Italy, in 1994, acquiring Nuovo Pignone, a maker of turbines and compressors. GE Oil & Gas became its own division in 2013, when GE Energy was reorganized into GE Oil & Gas, GE Energy Management and GE Power and Water.

GE Oil & Gas delivers advanced technology equipment and services for all segments within the oil and gas industry. One of the benefits being a division in the GE conglomerate is the cross business innovation. This cross business innovation diversifies GE Oil & Gas from its competitors, taking breakthroughs in one business and applying them to others.

Since the acquisition of Vetco Gray in 2007, GE has spent over USD 14 billion acquiring companies, and it continues to invest heavily into the oil and gas segment. With its latest acquisition of Lufkin Industries Inc. on USD 3.3 billion, GE Oil & Gas made a statement that they want to take a part in the shale boom adventure in the US.

In 2013 GE Oil & Gas division increased its revenues with 11% and it now accounts for 10 % (USD 16,975 billions) of the total revenue of GE, making it the fastest growing business segment in the GE conglomerate (GE, 2014).

As of 2014, GE Oil & Gas has more than 43 000 employees in over 100 countries. Their head quarter is located in London and their Chief Executive Officer and President is Lorenzo Simonelli.

2.2 GE Oil & Gas – Order To Remittance, Dusavik site

Order to remittance (OTR) is the process within GE Oil & Gas that executes sales orders from order acceptance through final delivery. Throughout the process, control points are in place to verify and validate whether customer and regulatory requirements are met. The OTR process is divided into five following phases: (GE, 2010)

- Resource allocation that includes detailed technical definition as well as planning and scheduling of equipment, material and human resources
- Procurement of material resources to complete the order
- Product realization where in acquired resources are transformed into final product
- Fulfillment where in the product is delivered to the customer specified location and the terms of the contract are fulfilled
- Receipt of payment

The OTR organization at Dusavik site consists of seven different business segments and one contract department. Each of the segments represents one department (Complete OTR organization chart can be found in Figure 4-2). This includes services such as project management of smaller deliveries to major brownfield upgrades, new builds (Engineering, Procurement and Construction / EPC), onshore repair projects, exploration and offshore operations.

As Figure 2-2 illustrates GE Oil & Gas and OTR is categorized as a contractor on the NCS. OTR is currently delivering subsea services on frame agreements for several fields on the Norwegian Continental Shelf, including Balder, Draugen, Troll, Tordis/Vigdis, Snorre B, Snøhvit, Skarv, and Yme.

Figure 2-2 An overview of some of the operators, contractors and manufacturers on the NCS, adapted from NOG Subsea Standardization presentation

Dusavik site is located outside Stavanger, near the Dusavik harbor. It is 32 000 square meters facility with six workshops that are dedicated to their respective OTR department.

PART II: Background

Chapter 3 Theory

During the last centuries there's been several academic research papers about Project Management. To reduce misinterpretations of definitions related to the topic most of the basic project management theory in this chapter is taken from the curriculum used at courses in the University of Stavanger.

3.1 Projects

The word project has its origin from the latin word projicere, where pro means forward and "jicere" means "to throw", combined the project in latin means "throw forward".

A project is a sequence of unique, complex and connected activities that have one goal or purpose and that must be completed by a specific time, within budget and according to specification (Wysocki, 2009).

PMI 2000 defines a project as "A project is a temporary endeavor undertaken to create a unique product or service".

While Gido and Clements (2003) define a project as "A project is an endeavor to accomplish a specific objective through a unique set of interrelated tasks and effective utilization of resources."

All the definitions share some common key words, they are all goal oriented, they involve the coordinated undertaking of interrelated activities, they are of finite duration, with beginnings and ends and they are all, to a degree, unique (Davidson Frame, 1995).

3.1.1 Goal oriented

Projects are driven to achieve a specified result and all the planning and implementation efforts are undertaken so as to achieve them. A project must have one single goal, but it may also have sub goals or milestones, depending on the size and complexity of the project. Nevertheless it is important to establish clear and achievable goals, milestones or sub goals.

A milestone is used to measure progress in the project and to control that the sub goals are achieved. Milestones are a set of significant events that is defined as zero duration activities; it reflects that a certain amount of activities have been accomplished.
I.e. if a milestone is reached, the cost controllers may invoice the customer.

3.1.2 Activities

The activities in a project are a set of different unique activities that needs to be performed in a sequence in order to fulfill and finish the project according to plan. The output of one activity work as an input for the activity that is next in the sequence. The sequence of the activities is not based on management perspectives, but on the technical requirements for the given activity.

Each project has its own unique set of activities. With unique we refer to random variations. A project is never the same as previous, there will always be some changes, even though the scope may be the same, the conditions and boundaries of a project change.

3.1.3 Uniqueness

The uniqueness of a project may vary from one customer to another, according to their respective specific requirements for functionality and quality. New modifications on already existing equipment may also make the project difference than other similar projects.

To relate this to the oil and gas industry we can think of the different subsea structure of the oil fields on the NCS. They may have the same well head system(MS 700), but the proprietary characteristics are different, so the well head equipment used on Troll may not be used on Tordis or Vigdis.

Some companies also require sub-contractors to follow a special set of standards and procedures on their equipment. Take Statoil ASA as an example. Statoil has a welding procedure, Technical Requirement (TR) 2382, rev. 3, that have higher requirements than the ISO 15614-1/7 standard. This is unique, and thus the sub-contractors have to either buy the required equipment to perform the welding job or source it out to third party vendors.

3.1.4 Constraints

Each project has constraints and limits and it is important to control that these constraints stay within budget. The constraints are often referred to as limited duration and resources.

Projects have a limited duration and a specified completion date for when the project is supposed to start and finish. The project is over on the specified completion date or when the goal is accomplished. It is particular important to maintain the due date of projects that are temporarily or have a functionality in a system, in example: The building of BI Campus Nydalen, the building had to be completed and ready for educational use before semester start, in order for the students to start their education.

A temporary project consists of two criteria. It is crucial that the project is completed according to plan and that the project is actually terminated. (J.T Karlsen et al., 2005)

Projects have limited resources; we define resources as people, money and machines that are dedicated to a project. The project manager considers resources as fixed resources, but senior management can adjust the resources. It is important that the project initiators and owners can control the use of these resources, thus it is normal to set a maximum budget for the resources. This maximum can be adjusted if necessary, for example, if a variation occurs on an ongoing project.

3.2 The Iron Triangle

The well-known Iron Triangle is a direct result of the definition of a project and the way the project is being managed. The Iron Triangle in Figure 3-1 consists of five different parameters. Scope, quality, cost, time and resources, and it concludes that a project has one scope, one specified time (limit) and one budget. If you adjust one of the parameters, it will have a direct consequence on the four other parameters. The set of five parameters form a system that must balanced in order keep the project in balance.

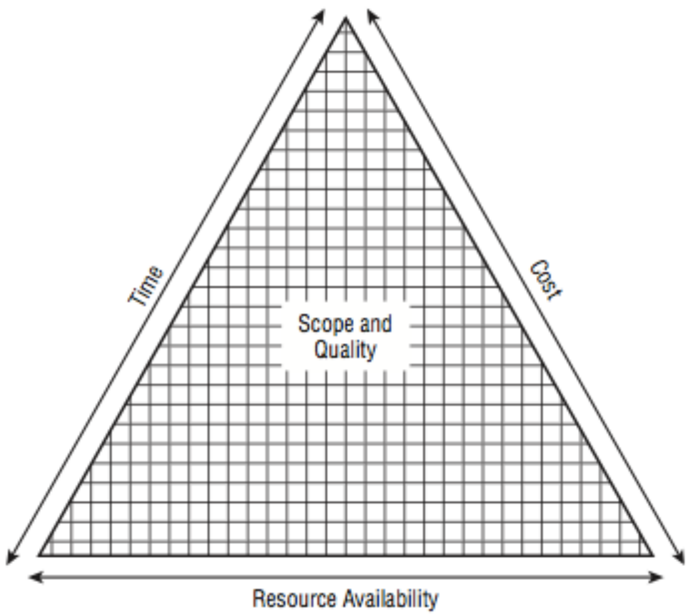

Figure 3-1 The Iron Triangle (Wysocki, 2009)

3.2.1 Scope

Scope is a statement that defines the boundaries of the project. It tells not only what to be done, but also what will not be done. The scope of a project may change during the project lifetime (Wysocki, 2009). The scope is often referred to as the scope of work to be performed, and is usually stated in the Request For Quotation (RFQ), Quotation and in the Purchase Order (PO).

3.2.2 Quality

Quality refers to meeting agreed requirements and not exceeding them. Every project consists of two types of quality, product quality and process quality. A good quality management program contributes to a good client satisfaction and helps organizations to use their resources more effective and efficient by reducing waste and revisions. The quality management program should focus on meeting product and process requirements. (Wysocki, 2009)

Product quality focus on the quality that the deliverable produced (of the project) is supposed to have. In order to be approved by a quality inspector the product has to verify the quality parameters to and fit for use and meet the customer requirements.

Process quality focuses on how well the project management process works and how it can be improved.

3.2.3 Cost

The cost is the budget that has been established for the project. Because of findings, variations and notifications of budget overrun the budgeted cost does not necessarily reflect the actual cost for the total project life cycle.

3.2.4 Time

The client specifies a time frame or due date within which all the project activities and the project must be completed. Time is a resource that cannot be inventoried, once the project is initiated it is consumed whether used or not.

A project with a good plan has a higher probability of delivering, than poorly planned projects. As Figure 3-2 illustrates, good planning consumes time in the planning process of the project, but it consumes less time than a poorly planned project in the end, and the benefits of good planning such as reduced cost and better quality goes on. “Pay me now or pay me later” is a quote made by Wysocki, the quote is illustrated in Figure 3-2.

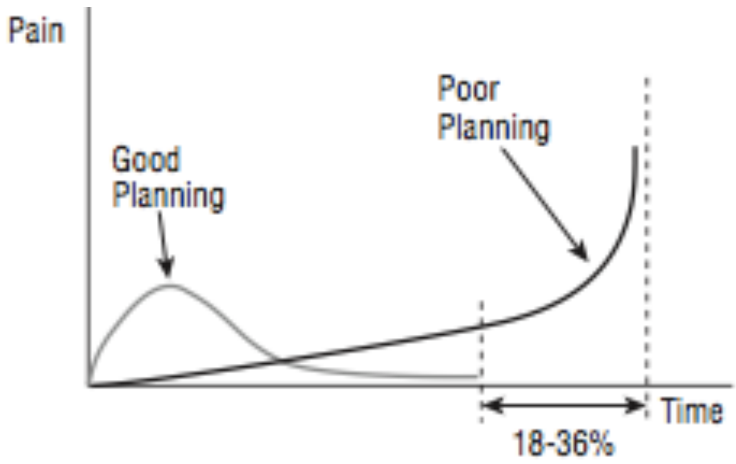

Figure 3-2: Project Planning "Pain curve". The curve illustrate that proper planning is painful but it pays off in less pain later on in the project (Wysocki, 2009)

If the project starts to float or the project owner dragging the due date, one may buy time by paying the contractors to work over-time to reduce the total time for the project, but the cost will then increase, thus time and cost is to a certain extent inversely related.

3.3 Resources

Resources are assets such as people, equipment, physical facilities, or inventory that have limited availabilities, can be scheduled, or can be leased from a third party. Some of these resources are fixed, and some are variable only in the long term. All of the resources are central to the scheduling of the project activities and the orderly completion of the project. (Wysocki, 2009)

For subsea services projects, available test equipment, workshop-, warehouse- and quality inspection personnel are the major resources.

3.4 Project Phases

Depending on the project organization, the overall main phases of a project relies the same. A project phase covers several milestones, activities and tasks that are to be performed by different types of functions. Table 3-1describes the main objectives of each phase.

All projects are divided into five different phases, and these process phases are the building blocks of every Project Management Life Cycle.

Table 3-1 Project process phases description (Adapted from Wysocki, 2009)

Process Phase:	Description:
Scoping	This phase describes what needs to be done and establishes the business success criteria.
Planning	This phase describes the project work, which explains how the contractor will perform the work that needs to be done. It also includes establishment of realistic time, cost and performance parameters. Linking activities to form a project network in order to show how the activities are linked together. No project actual project work is done in the phase.
Launching	This phase includes the recruitment of the project team and the establishment of team operating rules. It also includes all of the process to get the project work started.
Monitoring and Controlling	Includes processes related to on going work such as monitoring of project performance and risk, reporting project status, processing scope change requests, and discovering findings and solving them.
Closing	Includes all the processes related to the completion of the project and gaining client approval of having met the acceptance criteria. Deliver the deliverables or services and administrative closedown of the project.

3.5 Work Breakdown Structure

Gardiner**Feil! Bokmerke er ikke definert.** describes a work breakdown structure (WBS) as a top down, deliverable-oriented representation of all areas of work involved in a project (Gardiner, 2005).

WBS is a useful tool for communicating in early project phases, controlling and visualizing the project work and deliverables that are to be performed. Each project has a has its own unique WBS code that represent a level and position in the project. These codes can be used to monitor and control of costs, materials, allocation of parts and hours spent on each level.

A more detailed description of work breakdown structures will be given and illustrated in Chapter 4.3.1.

3.6 Stage Gate Process

Robert Cooper developed the Stage gate model in the early 1990s, since then the Stage gate project management process (PMP) has been adopted by several industries to manage different types of projects. The amount of phases and content may vary from industries, but the purpose is the same. Stage gate PMP is a model that is primarily used for new project development and is meant to create a better shareholder value. Its structure is built upon decision-making between the phases and gates, each phase has a specific goal, and ends with a decision to either continue with the project or drop out of it, except for the last phase, which has no alternative options than to continue.

As Figure 3-3 shows, the first three phases and gates focuses on value identification, while the two last phases is consuming the value realization. The information of the different phases is a brief summary adapted from G.W Walkup Jr. et al 2006.

During phase one a typical feasibility study is performed. Is the idea worth spending resources on? Is the idea feasible at all? Technical and non-technical concerns should be raised. If the project team finds the project feasible, a PMP road map of how to continue moving forward should be handed to the decision review board (DRB). The DRB is the ones taking the decision whether to continue to the next phase or not.

Phase two is where the DRB select the best-suited development plan for the project. This is the phase where companies conduct business-, development- and project plans and quality reviews to map out the project quality aspects. External personnel with broad experience within the subject being analyzed make these reviews and plans. The selection phase ends when the DRB decides which of the alternatives is the best-suited development plan. The project team has to conduct an updated PMP road map if the DRB decides to continue with the project.

The third phase is the last phase of the front end loading (FED), the definition phase. In phase three the goal is to provide enough details into the development plan (chosen in phase 2) so that procurement and construction may start (execution phase). The details provided should be sufficient enough for the DRB to make the final investment decision.

Value realization starts in phase four (execution phase), the sourcing departments starts to procure materials and services according to the defined planed (from phase three) and the construction of the project deliverable starts.

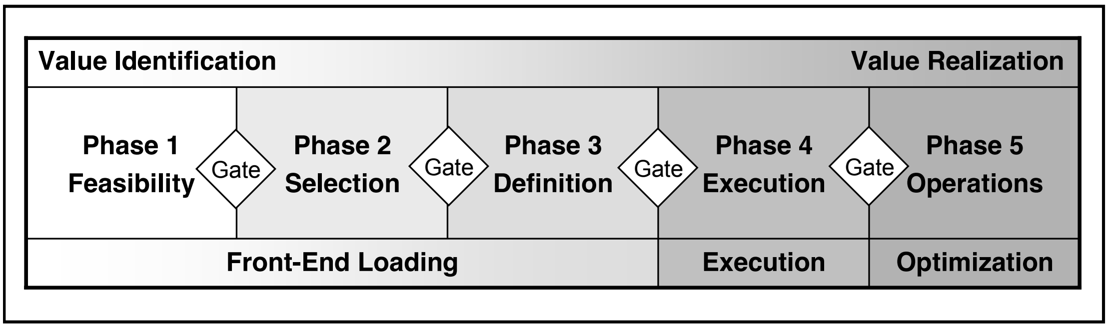

Figure 3-3 Stage Gate Project Management Process (G.W. Walkup et al. 2006)

At the end of the stage gate PMP comes the optimization phase, this phase is introduced to capture the lesson learned and project reviews from the project in order to improve future projects.

Stage gate PMP can be built within project networks. The project shown in Figure 3-4 is from WBS 908083 in SAP. Each gate includes a set of milestones that needs to be executed and finished to meet the gate deliverable (i.e Gate 0 Bidding Hold point).

Project Structure: Description	Identification
Template project structure Service	908083
Refurbish X-Mas tree No:XYZ	%00000000001
Gate 0 Bidding	%00000000001 0010
1. Approved SOW	1428
2. Approved BCTR's in SAP	1429
3. Approved Quote	1430
4. Approved PO	1431
Gate 0 Bidding Hold point	%00000000001 0010 0...
Gate 1 Prepare for workshop	%00000000001 0020
1. Completed WOP (ITP/SNR/QCI/PROC/DW)	1432
2. Spares Reqd. for Teardown RFP	1433
3. Tools & Equipment available	1434
4. MRB Data Available	1435
5. Customer Equipment at site	1436
Gate 1 Prepare for workshop Hold Point	%00000000001 0020 0...
Gate 2 Strip / Clean / Inspect	%00000000001 0030
1. All Parts ready for Test & Assembly.	1437
2. Test Equipment OK for Test & Assembly	1438
Gate 2 Strip/Clean/Inspect Hold Point	%00000000001 0030 0...
Gate 3 Repair Management	%00000000001 0040
1. All Parts ready for Test & Assembly.	1439

Figure 3-4 Gated process adapted from WBS 908083, a GE Oil & Gas project

Gated process is a useful tool to use to monitor and control that all project work is completed in each phase.

3.7 Gantt chart

A Gantt chart is a tool used for planning and monitoring projects. It is easy to interpret and clearly shows the project timeline and milestones. The timeline is built upon the hours and resources that are estimated and allocated in the quotation (Gardiner, 2005: 253).

Some companies have to different set of Gantt charts, one for internal use, which contains a more detailed plan of all the activities for each milestone, and one to the customer that only provides the milestones in the project.

Figure 3-5 shows a Gantt char for a Tubing Hanger, belonging to WBS network 908480. This specific project timeline is estimated to start the 18th of January 2016 and finish the 28th of September 2016. It includes several milestones that cover a set of activities. Variations (VOR) is also estimated, but since this is just an estimated time on a typical variation it is not set to be the correct timeline for this milestone.

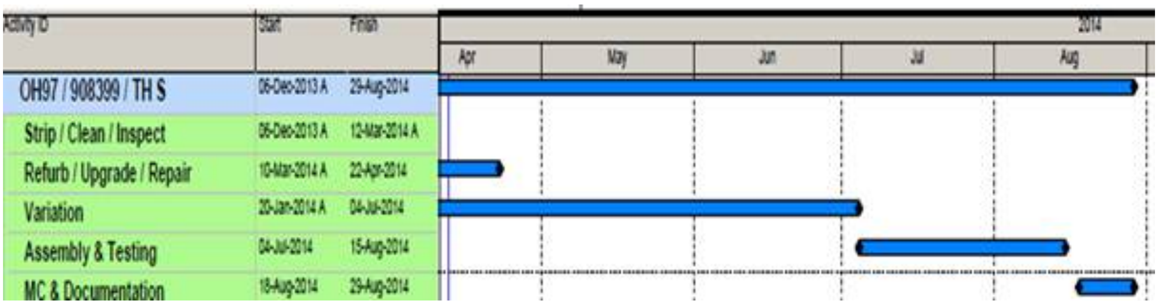

Figure 3-5 Example Gantt chart of WBS network 908399

Some of its disadvantages are that it does not clearly show activities that are dependent of each other and it is not possible to perform project crashing.

3.8 Critical path

The critical path is often referred to as the most important part in the project plan. The path is a set of critical activities that have no flexibility and float. These activities must start precisely and finish on or before the schedule date. In a project there are some activities that have float, free float and negative float. The total float is the total amount of days an activity can be delayed without interfering the delivery date on the project.

Some activities have the possibility to start later than their earliest start date in the plan because of the float. Free float is the amount of time the early start of an activity can be delayed without interfering and delaying the early start of the successor (Trond Bendiksen et al., 2005).

Negative float occurs when the total float days have ran out, and the finish date of the activity now sets the delivery date. It is required to monitor the critical path as often as possible to be sure that the project can deliver according to schedule.

3.9 Communication

Communication within projects is important to reduce uncertainty and ambiguity within projects. Uncertainty is a direct result of lack of information, while ambiguity can be described as a cause of existent multiply and conflicting interpretations.

It exists two different types of communication, lean and rich media. Lean is communication that comes in forms such as numeric based data and formal text. Rich communication is categorized as visual signs, speeches, phone conversations and face to face conversations. Rich communication is more direct and precise, and it reduces uncertainty and ambiguity. Lean communication is used to get data and answers on specific topics or questions.

In 1986 Daft and Lengel created Figure 3-6, it illustrates the differences between lean and rich media.

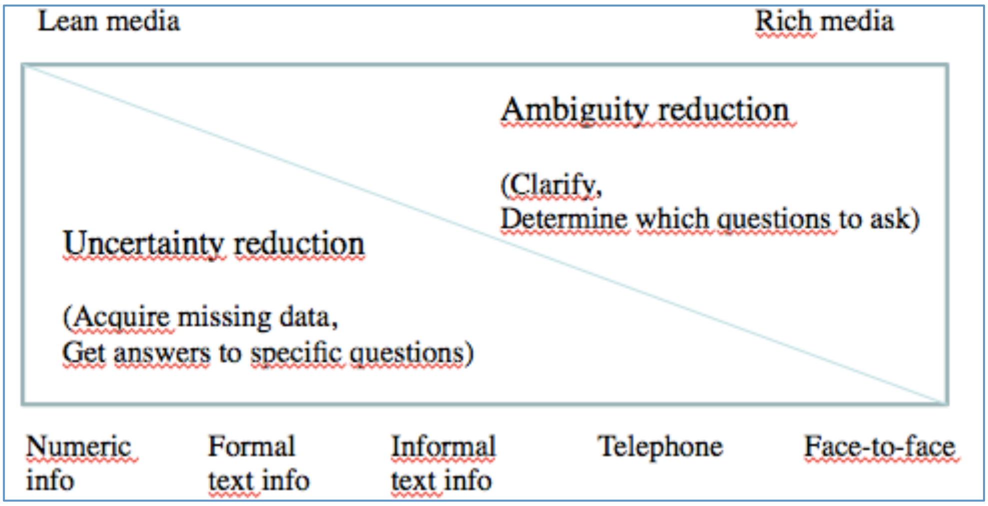

Figure 3-6 Lean media vs Rich media (Daft et al., 1986)

I.e. a meeting can be informative, but it can also be inefficient, depending on the media used in the meeting. If sufficient data have been sent to the attending people before the meeting begins, the result and value of a face-to-face meeting can be much higher than the opposite. Arranging meetings with to much numbers without preparation data can have the opposite effect if the attendances do not have enough background knowledge of the subject for the meeting.

Chapter 4 XT Theory

The Xmas Tree (XT) department at GE Oil & Gas Dusavik, recently started to manage their projects with a local made project model(located in Appendix A1). It was developed in 2013 by the department managers from tools and XT, with inputs from the project coordinators from XT and Tools department at Dusavik. The objectives of model is to clarify and map the responsibilities and roles of all people working in a project, to improve and establish a fundamental model that the project coordinators can use to manage their projects more efficient.

4.1 Subsea Services Projects – XT

As a part of the Order to Remittance (OTR) a typical project in the XT department is a refurbishment and upgrade of a subsea component from a subsea installation belonging to a MS-700 wellhead system from a producing oil field on the NCS.

The complexity of the projects varies as it depends on the component, but the activities and actions to be performed are most likely to be repetitive. The more complex the component is, the more resources is given to the project.

Figure 4-1describes the flow of general activities that an accepted project is determined to follow. A customer requests the company for quotation by sending out a request for quotation. After that the designated department collects data from all involved personnel in order to prepare and create a quotation, this known as the bidding phase. If the customer accepts the quote, company will receive a purchase order (PO) and the project starts.

Projects Coordinators creates the work order packages (WOP) prior to the deliverance on the subsea equipment. A WOP can be explained as a typical work instruction for the all involved personnel, it follows the project from start to end, and all work performed on the equipment have to be documented in the WOP. It includes a set of activities, inspection test plans (ITP), bill of materials (BOM), RE.IC procedures, technical drawings, serial number record (SNR) and quality control inspection (QCI) lists. Depending on the size and complexity of the project, the amount of WOPs varies.

Strip, clean and inspect (SCI) is the first milestone in the project. To check out this milestone the project equipment have to be striped, cleaned and inspected. An internal QCI-review meeting is held, if there are any deviations found during the QCI, the project may have to involve engineers to find a solution for the finding, depending on the part that the deviation is on. In order to continue the project, an external QCI-review meeting is necessary to get approval from customer on the original documentation of the parts recorded in the SNR list, and a variation order (VO) for the deviations. A customer has the possibility to reject a solution on the deviation.

Deviations are registered with a number in a Global Rejection Network (GRN) , etc. GRN143912. The disposition is the solution from one engineer, and it has to be reviewed and accepted by another engineer. Dispositions have to meet customer technical requirements.

After checking out the SCI milestone, the project starts on the activities related to the next project milestone, refurbishment, repair and upgrade. Standard replacement parts (soft seals etc.) are being replaced, internal and external repairs of parts and if any modifications on the equipment are hereunder performed. After each repair a new quality control inspection is performed to check if everything is acceptable. A third party vendor creates a Global Rejection Vendor (GRV) if a deviation occurs from their repair on the part. Solving the repairs are often very time consuming for the project.

The next milestone after refurbishment and repair are done is to assembly and then test the product. Depending on the product, this is often the most time consuming milestone due to several parameters such as parts on stock, warehouse capacity, available test equipment and slot prioritization.

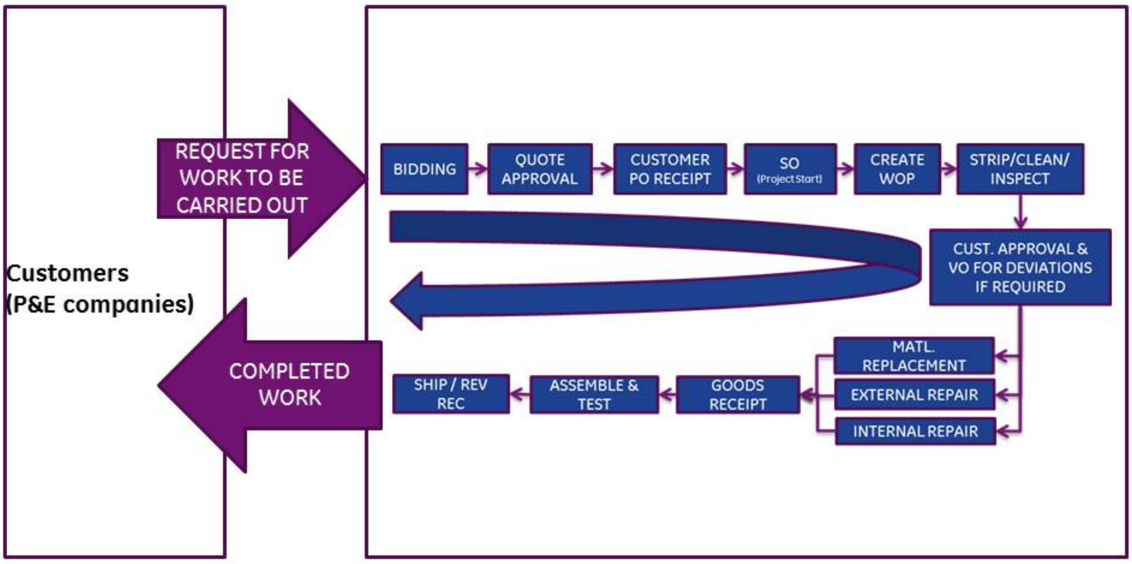

Figure 4-1 GE Oil & Gas general project milestones

After assembling the product, several tests are to be performed and approved on the product before it can be prepared for shipment.

The responsibility of the product changes from GE Oil & Gas to the customer once the goods are shipped. Before closing a project a customer meeting is arranged where the agenda is to go through the Material Record Book (MRB) and sign the Mechanical Completion Check Record (MCCR). After everything is signed a work order close out report (a request for completion certificate) is sent to customer. A project is formally closed when the completion certificate is received.

4.2 New and old organization structure

In February 2013 GE Oil & Gas changed its organizational structure. The old structure was field (or license) based while the new is a product-based structure. Some of the disadvantages with the old structure were that it required a much higher competence and experience level from the project coordinators, coordinating all of the tools and xmas trees on the license.

Figure 4-2 displays the new organization structure that OTR now operates by. It is divided into different product segments, XT department can be found under Subsea Onshore Services. The new structure provides more focus on each product and emphasizes a more efficient and structured way of managing projects.

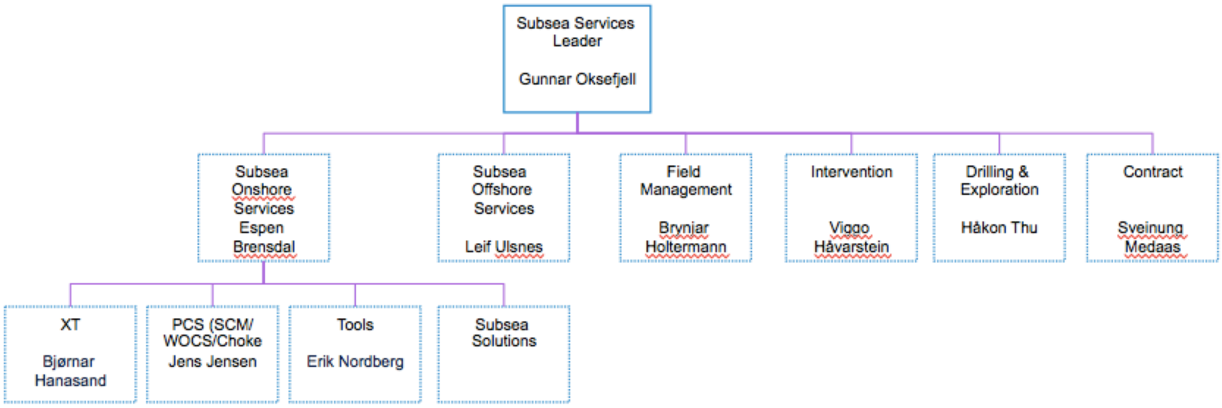

Figure 4-2 OTR organization chart 2014

As mentioned, a typical project for the XT department is subsea components belonging to a XT system and the department quotes on all requests for quotations that are categorized as a XT system, independent of field or license. The project coordinators are now operating as a "domain expert" representing OTR. Support functions are represented with the document controller, cost controller and the project planner.

4.3 Monitor and control – Tools

GE Oil & Gas uses several tools for monitoring and controlling their projects. These tools are listed and described below.

4.3.1 Work Breakdown Structure - SAP

GE Oil & Gas uses SAP as a tool for managing major parts of their projects. The transaction CJ20N, also known as the Project Builder is used for the work breakdown structure (WBS) on each project.

Previous projects were managed without a designated work breakdown structure in the project builder. As a consequence of this, the monitor and control of hours used on an activity was hard to manage, and thus, hard to budget and quote as well. Support functions booked their hours on cost centers instead of the project WBS.

All new projects in the XT department has a common designed WBS that covers all the milestones and activities that are to be performed in order to complete the project. And all involved personnel (functions) have it´s own level in the structure to book their hours according to their work instructions. The designed WBS has its origins from the stage gate process.

A projects WBS structure is first based on the milestones as illustrated in Figure 4-3. “Strip, Clean and Inspect” is located on WBS level 909175-01.

Project Structure: Description	Identification
T/V OH087 TH B-2	909175
T/V OH087 TH B-2	909175
Template Bidding	909175-99
Strip, Clean & Inspect	909175-01
Refurbishment & upgrade	909175-02
Assembly/Test	909175-03
MC/Documentation	909175-04
Spareparts	909175-05

Figure 4-3 Milestone Work Breakdown Structure for WBS 909175

There are different types of functions working on delivering the deliverables for a specific milestone. As shown in Figure 4-4 all functions involved in the “Refurbishment and upgrade” milestone have a specific WBS level to use. This structure is repeated on all of the milestones for a project.

Refurbishment & upgrade	909175-02
Engineering	909175-02.01
Workshop	909175-02.02
QC	909175-02.03
Sub-contractor	909175-02.04
Admin	909175-02.05

Figure 4-4 Function Work Breakdown Structure for WBS 909175

As a measure to increase the control of the costs on a project and to monitor how much time each function uses on an activity, a project coordinator is allowed to design an activity level for a function and for a sub-contractor (vendor). For the project illustrated in Figure 4-5 one of the activities for the workshop personnel in the

"Refurbishment and upgrade" milestone is to pack the parts for coating and for the sub-contractor it is to coat the parts. This simplifies the billing of the sub-contractor, and it also makes it possible to schedule a more precise cost and time estimate for a similar activity in the future.

Refurbishment & upgrade	909175-02
Engineering	909175-02.01
Workshop	909175-02.02
Packing for coating	909175-02.02.01
909175-02.02.02	909175-02.02.02
QC	909175-02.03
Sub-contractor	909175-02.04
Coating	909175-02.04.01
909175-02.04.02	909175-02.04.02
909175-02.04.03	909175-02.04.03
Admin	909175-02.05
Planning	909175-02.05.92
Finance	909175-02.05.93
Warehouse/logistics/MA	909175-02.05.94
Sourcing	909175-02.05.95
Documentation	909175-02.05.96
QA	909175-02.05.97
OTR	909175-02.05.98
NR	909175-02.05.99

Figure 4-5 Activity Work Breakdown Structure for WBS 909175

The project coordinator is in charge of approving booked hours on any of hers / his projects. If any functions (included support functions) book hours on a wrong WBS level it is the project coordinators responsibility to reject the hours in SAP.

Materials and equipment has its own WBS level on each project, all the standard spare parts that are to be replaced during the project is located in this WBS level. In Figure 4-3 standard spare parts has the WBS level 909175-05.

4.3.2 Planning – Primavera

Primavera is the tool that the project planer in the department uses to schedule the activities. It has its origins from Gantt charts, showing float envelopes, critical activities and noncritical activities. Based on a baseline for all of the activities the time of each activity is planned, and updated regularly during an ongoing project.

The project planner calls in for a planning meeting weekly, to update the plan according to the progress of the project. An activity may have three different statuses in Primavera, "Not started", "In progress" and "Completed", all respectively describing the status of the current activity. Linked activities is marked with an "*", it indicates that activity Y can only be started after completing activity X.

4.4 Milestones and functions

A quotation given to the customer is a quote based on milestones. All refurbishment and upgrade projects has four bill able milestones, executed in the following order

- "Strip, Clean and Inspect"
- "Refurbishment, Upgrade and Repair"
- "Assembly and test"
- "MC – Documentation"

Participation of each function depends on the milestone. This section provides an overview of the main objectives for each function in a milestone, based on the project model made by the XT and tools department (Appendix A1). Note that a milestone does not necessarily include work for all functions.

4.4.1 Strip, Clean and Inspect functions

Table 4-1 describes some of the main objectivities for each function performing work during "Strip, clean and Inspect" on a refurbishment and upgrade project.

Table 4-1 Functions and their main objectives for Strip, Clean and Inspect

Function	Main objectives – Strip, Clean and Inspect
Workshop Apprentice	Participating in stripping, cleaning and preparing the parts for quality control inspection. Fill in S/N in the serial record list to the WOP.
Cost Controller	Bill completed activities.
Project Coordinator	Project responsible person. Finalize and deliver the work order package (WOP) to the workshop. Participate in internal and external QC meeting. Create purchase requisitions if necessary.
Document Controller	Collect documentation on parts according to the serial number record list. Attend external QC meeting to show the documentation.
Engineering	None (Only if included in scope of work)
Workshop Foreman	Managing the workshop technicians, order non-destructive testing on the equipment. Attend internal and external QC meeting.
Project Planner	Keep track of the project and update plans

Quality Controller	Inspect parts according to the quality inspection list and procedures attached in the WOP, send to coordinator. Attend internal QC meeting.
Sourcing	None
Workshop Technician	Stripping, cleaning and preparing the parts for quality control inspection. Fill in S/N in the serial record list to the WOP.
Warehouse	None
Welding	None

The purpose of this milestone is to disassembly the product, clean all of the parts to be able to record serial numbers (for traceability) and prepare the parts for quality inspection. Warehouse and welding personnel are usually inactive functions during this milestone.

The cost controller is allowed to bill each milestone as long as the milestones are checked out. A cost controller needs to get the progress report from the project coordinator in order to know when the milestone is completed and ready for billing.

Engineers are used if any deviations are detected under the quality control inspection to solve the variation registered by the quality controller in the Global Rejection Network. A deviation is as stated a variation, which is not included or considered as an active function in this thesis.

4.4.2 Refurbishment, Upgrade and Repair functions

Table 4-2 describes some of the main objectivities for each function performing work during "Refurbishment, Upgrade and Repair" on a refurbishment and upgrade project.

Table 4-2 Functions and their main objectives for "Refurbishment, Upgrade and Repair"

Function	Main objectives - Refurbishment, Upgrade and Repair
Workshop Apprentice	Prepare parts for coating
Cost Controller	Bill completed activities.
Project Coordinator	Creating third party services requisitions for coating of parts, modifications of parts (machining), following up on these requisitions and attending kick-off meetings at vendors. Ensure that all standard parts are available before the next milestone.
Document Controller	Put new coating (and other) documentation into the material record book (MRB).
Engineering	If needed prepare/select welding procedures for welding personnel.

Workshop Foreman	Managing the workshop technicians, ensure that correct parts are sent on the different requisitions. Communicate with project coordinator and project planner on the progress.
Project Planner	Keep track of the project status and update plans.
Quality Controller	Inspect new purchased parts and parts that return from third party vendors.
Sourcing	Collect quotes on purchase requisitions for the project coordinator.
Workshop Technician	The involvement of the technicians is usually to prepare the parts for shipping and also receiving them back from third party services after QC has inspected the parts.
Warehouse	None
Welding	Weld to modify a part (upgrade of part)

The main objective of this milestone is to get all the parts that are not standard replacement parts refurbished and coated. Parts that need to be upgraded are being modified to the correct revision. A lot of the activities in this milestone are performed at third party vendors.

Engineers can be used to prepare or select a suitable welding procedure for a modification (upgrade of a part).

4.4.3 Assembly and Test functions

Table 4-3 describes some of the main objectivities for each function performing work during "Assembly and Test".

Table 4-3 Functions and their main objectives for "Assembly and Test"

Function	Main objectives - Assembly and Test
Workshop Apprentice	Assembly parts and test. Finalize and prepare for shipping. Clean the workshop for surplus material.
Cost Controller	Bill completed activities.
Project Coordinator	Give warehouse instructions of picking parts and send these to the workshop according to the assembly plan. Coordinate with the project planner and foreman of the assembly progress. Participates on several tests that he or she has to witness according to inspection and test plan of the project, this to ensure that the quality of the project meets the company and customer quality and technical requirements.
Document Controller	Put documentation of standard replacement parts into material record book (MRB).
Engineering	None

Workshop Foreman	Managing the workshop technicians, ensure that correct parts are assembled according to the plan. Communicate with project coordinator and project planner on the progress. Ensure assembling and testing is performed according to the procedures in the WOP.
Project Planner	Keep track of the project status and update plans. Coordinate with project coordinator and foreman for assembling plan.
Quality Controller	None
Sourcing	Push sub-suppliers if standard spares are not yet delivered.
Workshop Technician	Assembly parts and test according to instructions given by the foreman. Finalize and prepare for shipping. Clean the workshop for surplus material.
Warehouse	Pick and deliver parts according to the instructions given by the project coordinator.
Welding	None

During "assembly and test" the main purpose is to assemble all old and new parts before they are tested. Various tests are performed to see if everything meets the technical and quality requirements. All tests have to be documented and aligned into the material record book (MRB). Workshop personnel prepare the equipment for shipping after the tests are successfully completed.

4.4.4 MC – Documentation functions

Table 4-4 describes some of the main objectivities for each function performing work during "MC – Documentation".

Table 4-4 Functions and their main objectives for "MC-Documentation"

Function	Main objectives - MC - Documentation
Workshop Apprentice	Clean the workshop for surplus material
Cost Controller	Ensure that all activities and milestones are billed. Close the project.
Project Coordinator	Call in customer for a project review meeting. Go through the Material Record Book (MRB) and get the Mechanical Completion Check Record (MCCR) signed. Solve an eventually punch list. Clean up the WBS of surplus material. Send a work order close out report(WOCOR). Receive completion certificate and report to cost controller to close the project when all committed costs are sorted out.

Document Controller	Prepare the MRB, request customer for the required MCCR of the equipment being delivered. Attend on MRB/MCCR meeting to go through original documentation with customer.
Engineering	None
Workshop Foreman	Deliver a list of surplus material to project coordinator. Attend MRB/MCCR meeting (if necessary). Ensure that the equipment is shipped according to the given instructions by the project coordinator.
Project Planner	Mark as completed in planning tools and remove from weekly status plans.
Quality Controller	None
Sourcing	None
Workshop Technician	None
Warehouse	Allocate surplus material (if there is any)
Welding	None

The main objective of this milestone is to go through the Material Record Book (MRB) and Mechanical Completion Check Record (MCCR) with the customer before shipping and closing the project.

PART III: Methodology and Analysis

Chapter 5 Methodology

In order to establish a clear performance evaluation picture, the assessment part of the project management process is predominately focused on conducting an evaluation of the actual work completed and actual expenditure of time.

5.1 Research approach

The research approach used in this thesis is a top down approach on finished projects xmas tree project belonging to the Troll field. Starting at the highest level (milestones) then breaking it further down to all monitored activities for each function. This gives us a clear overview of how many hours a function use on one specific activity in each milestone.

“Limitations” in chapter 1.2, no margins or cost numbers will be presented in the thesis, due to the degree of highly confidentiality. Thus the only numbers presented will be from actual time spent on each milestone. Keep in mind that time and cost is to a certain extent inversely related as presented under “Time” in chapter 3.2.4.

Evaluating and showing the actual time differences between projects and their milestones is crucial to validate if there are room for further improvements, and to inform project personnel of how they are performing from project to project.

5.1.1 Quantitative data

All actual data used in this thesis is taken from different transactions in SAP when the project is delivered and closed. These numbers are hours that are recorded and approved for all functions on each of the four milestones of a project.

The different data of the milestones evaluated can be seen on the level of the project WBS. Table 5-1 explains the milestone for each WBS level.

Table 5-1 WBS level and milestone description (WBS level in bold)

WBS level	Milestone	Abbreviation
907992-**01**	Strip, clean and inspect	SCI
907992-**02**	Refurbishment, upgrade and repair	RUR
907992-**03**	Assembly and test	A&T
907992-**04**	MC - Documentation	MC&D

I.e. 907992-02 represents the milestone and all its belonging activities for refurbishment, upgrade and repair on the project 907992.

Chapter 6 Results

In this evaluation the overall project time is weighted as the target. The data behind the evaluation can be found in Appendix A2. Each project has been given a dedicated name to reduce ambiguity when presenting the results. The evaluation is presented in tables and graphs, and the results are briefly commented under each section. Causes for the results are discussed in chapter 7.

6.1 Total project time (2011-2014)

The first objective of the thesis is to see the value of the re-organization of the OTR have created a positive efficiency value on the total project time spent on one xmas tree. The data presented and used in this section is based on xmas trees from the Troll field, all with the same scope, “Refurbishment and upgrade of XT”.

The data collected from all of the Troll Xmas Trees is shown in Table 6-1 and illustrated in Figure 6-1.

Table 6-1 Actual hours spent on a Troll XT Project (2011-2014)

Old Troll projects				**Mixed and new Troll projects**		
Name	**WBS**	**Hours [h]**		**Name**	**WBS**	**Hours [h]**
1	906880	4359,52		6	907265	3939,75
2	906881	4100,50		7	907620	4072,60
3	906882	4275,50		8	907923	3247,53
4	907247	4118,75		9	907921	2919,94
5	907262	3715,50				
Average		4113,95		Average		3544,96

The actual hours spent on all of the projects in Table 6-1 is collected from all hours booked on all WBS levels in SAP, variations are as stated excluded from this table.

Project 1 (WBS: 906880) is registered with most booked hours on the same scope, while the project 9 (WBS: 907921) has the lowest amount of booked hours registered. Project 9 was delivered to customer the 21st of June 2014. Only minor amount of hours are missing on the "MC – documentation" milestone (estimated to be ± 60 hours).

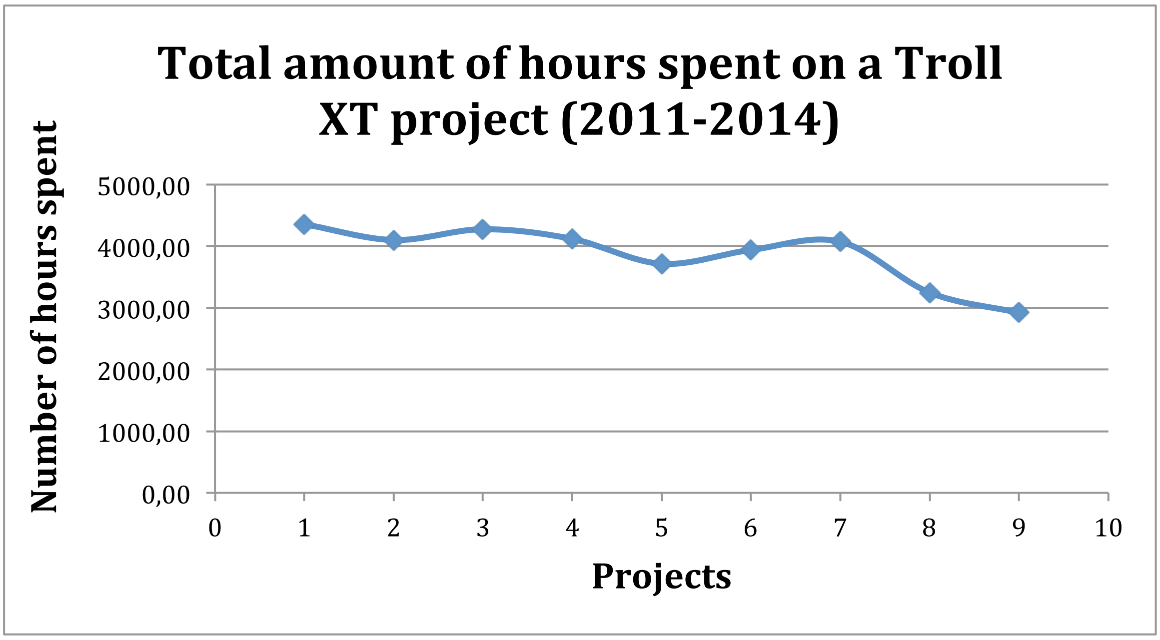

Figure 6-1 Total amount of hours spent on a Troll XT project (2011 - 2014)

Nevertheless the results of the reorganization in 2013 are positive and the total amount of actual hours spent on each Troll project in the period from 2011 to 2014 is decreasing.

Looking into the results of project 7 and 8 and comparing these we found several differences and improvements. These are stated in the following sections.

6.2 Post Project Results of Project 7

Table 6-2 shows all functions involved in each different milestone, and the hours registered on the "active" functions for project 7 (WBS: 907620) from Table 6-1. This provides us with information of the total amount of hours used to accomplish the main objectivities (ref 4.4) of a milestone by each function.

Table 6-2 Project 7 functions and milestones WBS 907620

Field	Type	Description	Function	SCI [h]	RUR [h]	A&T [h]	MC&D [h]	Sum [h]
Troll Olje	XT	907620	**Apprentice**	13	0	165	0	178
Troll Olje	XT	907620	**Cost Controller**	0	0	60	0	60
Troll Olje	XT	907620	**Project Coordinator**	136	239	163	0	538
Troll Olje	XT	907620	**Document Controller**	0	32	138	0	170
Troll Olje	XT	907620	**Engineering**	0	0	0	0	0
Troll Olje	XT	907620	**Foreman**	111	34	231	0	376
Troll Olje	XT	907620	**Planner**	0	0	55	0	55
Troll Olje	XT	907620	**QC**	97	106	0	0	203
Troll Olje	XT	907620	**Sourcing**	0	74	0	0	74
Troll Olje	XT	907620	**Technician**	713	32	1 451	0	2 196
Troll Olje	XT	907620	**Total amount**	1 070	517	2 263	0	3 850

From table 6-2 we see that "Assembly and test" is the most time consuming milestone with a total amount of hours on 2263 hours, followed up by "strip clean and inspect" with 1070 booked hours and the "refurbishment, upgrade and repair" on 517 hours. There are no booked hours under the "MC – Documentation milestone".

Engineers consumed zero hours on all four milestones. This is due to the scope of work did not include any particular engineering work.

Project 7 does not reflect any use of the cost controller on the first two milestones and has no booked hours on the MC and documentation milestone.

All of the activities in There were only three activities in the "assembly and test" milestone that did not have a budget overrun of hours.

Table 6-3 are workshop activities belonging to the most time consuming milestone of project 7, it shows real hours spent on the workshop floor on the different activities. It also shows the budgeted labor hours on each of the activities, and the difference between budgeted labor hours and actual labor hours in percentage.

There were only three activities in the “assembly and test” milestone that did not have a budget overrun of hours.

Table 6-3 Project 7 workshop activities for "assembly and test" milestone. Numbers marked with red indicates the percentage of overrun on the activity. Negative numbers indicates that the activity is within the budgeted time.

Activity	Assembly / Test	Budgeted labor [h]	Actual performance [h]	Difference [%]
Guide Frame	Assembly	37,5	47	25 %
WH connector	Assembly	75	90	20 %
FL connector	Assembly	75	77	3 %
POD / VPI / Sealsubs	Assembly	45	64	42 %
Annulus Wing Block	Assembly	75	42	-44 %
Master Valve Block	Assembly	150	246	64 %
Actuator [average of 5 actuators]	Assembly	26,5	33	25 %
Sub-assy unitization	Assembly	75	104	39 %
Mounting to Guide Frame	Assembly	75	81	8 %
Assy unitization	Assembly	150	161	7 %
Flushing/testing tubing & actuators	Testing	150	200	33 %
Testing needle valves	Testing	75	88	17 %
Testing bore, cavities, gas test	Testing	135	45	-67 %
POD interface test	Testing	30	46	53 %
Final assy, wrap-up	Assembly	180	137	-24 %
Total		**1354**	**1461**	**8 %**

Table 6-3 does not include finalizing, yet the activities performed in the workshop had a budget overrun (in the matter of time) of 8%.

Note that there is an average time on the assembling of the actuators. This is due to the amount of five actuators being assembled. This average causes the deviation on 10 hours in the total amount of hours for the “assembly and test” milestone in table 6-2 and 6-3.

6.3 Post Project Results of Project 8

Table 6-4 shows all functions involved in each different milestone, and the hours registered on the "active" functions and milestones for project 8 (WBS: 907623) from Table 6-1. This provides us with information of the total amount of hours used to accomplish the main objectivities (ref 4.4) of a milestone by each function.

Table 6-4 Project 8 functions and milestones WBS 907923

Field	Type	Description	Function	SCI [h]	RUR [h]	A&T [h]	MC&D [h]	Sum [h]
Troll Olje	XT	907923	**Apprentice**	24	1	348	0	373
Troll Olje	XT	907923	**Cost Controller**	0	0	26	0	26
Troll Olje	XT	907923	**Project Coordinator**	173	276	175	3	627
Troll Olje	XT	907923	**Document Controller**	0	0	0	36	36
Troll Olje	XT	907923	**Engineering**	0	0	0	0	0
Troll Olje	XT	907923	**Foreman**	87	34	258	0	379
Troll Olje	XT	907923	**Planner**	1	1	59	0	60
Troll Olje	XT	907923	**QC**	232	64	23	0	318
Troll Olje	XT	907923	**Sourcing**	0	90	0	0	90
Troll Olje	XT	907923	**Technician**	317	6	1 024	0	1 346
Troll Olje	XT	907923	**Warehouse**	0	0	50	0	50
Troll Olje	XT	907923	**Welding**	0	23	0	0	23
Troll Olje	XT	907923	**Total amount**	833	494	1 961	39	3 326

As for project 8 "Assembly and test" is also the most time consuming milestone with a total amount of hours on 1961 hours, followed up by the "strip, clean and inspect" with 833 booked hours, "refurbishment, upgrade and repair " on 494 hours and "MC – Documentation" with 39 hours.

Even thought the project coordinator spent more hours on managing, the overall project time decreased. Another significant reduction occurred with the document controller. The hours on project 7 were 170 hours while on project 8 it was reduced to 36 hours.

Technicians significantly reduced the amount of hours on the "strip clean and inspect" milestone, as for "assembly and test" table 6-5 shows that there are 10 activities within budget, and only four activities that exceeded the budgeted hours. In total the "assembly and test" milestone came under budget by 11%.

Table 6-5 Project 8 workshop activities for "assembly and test" milestone. Numbers marked with red indicates the percentage of overrun on the activity. Negative numbers indicates that the activity is within the budgeted time.

Activity	Assembly / Test	Budgeted labor [h]	Actual perforamnce [h]	Difference [%]
Guide Frame	Assembly	37,5	23	-39 %
WH connector	Assembly	75	21	-72 %
FL connector	Assembly	75	30	-60 %
POD / VPI / Sealsubs	Assembly	45	20	-56 %
Annulus Wing Block	Assembly	75	57	-24 %
Master Valve Block	Assembly	150	240	60 %
Actuator [average of 3 actuators]	Assembly	41,25	50	21 %
Sub-assy unitization *	Assembly	150	190	27 %
Mounting to Guide Frame *	Assembly	-	-	-
Assy unitization	Assembly	150	195	30 %
Flushing/testing tubing & actuators	Testing	150	108	-28 %
Testing needle valves	Testing	75	58	-23 %
Testing bore, cavities, gas test	Testing	135	105	-22 %
POD interface test	Testing	90	84	-7 %
Final assy, wrap-up	Assembly	180	91	-49 %
Total		**1428,75**	**1272**	**-11 %**

* Mounting to guide frame and sub-assy unitization is planned as one activity. Same total amount of hours was budgeted on the post as it was on project 7.

6.4 Summary of the results

Due to the amount of data presented, main results and findings will be summarized in this section before they are discussed in chapter 7.

6.4.1 Results of the presented data

- The results of the reorganization in 2013 are positive and the total amount of actual hours spent on each Troll project in the period from 2011 to 2014 is decreasing.
- "Assembly and test" was the milestone that consumed most hours on project 7, with a budgeted overrun of 8%. Project 8 did it more efficiently by finishing under budget by 11%.
- Only three out of fifteen activities performed by the workshop personnel did not have a budget overrun of hours on the "Assembly and test" milestone on

project 7. This was changed to 10 out of 14 activities below budget on project 8.

- No engineering hours were booked on both of the projects because of the scope of work.

- There were no booked hours on activities in the "MC and documentation" milestones, even thought the project is completed on project 7. Project 8 had registered hours.

- The project coordinator spent more hours managing project 8 than project 7, yet the total amount of hours on project 8 was reduced.

PART IV: Discussion

Chapter 7 The bigger picture

As for the results stated in chapter 6 the causes can be several. There are no clear indications of what the budget overruns was caused by in the data presented, thus, a discussion of possible reasons is addressed below.

7.1 Total project time discussion

Determine the trend of the reorganization of GE Oil & Gas for the XT Department in aspect of time.

According to our findings the total amount of hours for each project has decreased after the reorganization and that there is a positive ongoing trend in the XT department. There were some indications of increase during the change, but the result of the top down approach of project 7 and 8 clearly shows progression on the biggest milestone, assembly and test.

Table 7-1 Comparison of project 6, 7 and 8

Old and new comparison		
Name	**WBS**	**Hours [h]**
5 (old)	907262	3715,50
6 (mixed)	907265	3939,75
7 (mixed)	907620	4072,60

Project 6 and 7 had an increased amount of hours, compared with project 5. Because of the way the work breakdown structure were managed before the reorganization it is hard to point out which activity that caused the increase on project 6 and 7.

During the reorganization all personnel had to adapt to the changes in the organization, and it is a common knowledge that changes takes time. Change of focus area for the project coordinators is also a valid cause. Instead of operating with several tools and products, the project coordinator now only had to focus on specific products, which naturally enhance a higher quality on each project. Higher quality equals to more time on the deliverables.

Another reason for the high amount of hours on project 6 and 7 was that during the reorganization new personnel were exposed for new projects. New employees usually spend more time on their first projects as a part of the learning curve. After the reorganization the workshop operates with field-based technicians, the effect of this can be seen in the improvements on several activities in the “Assembly and test” for project 8.

There are no available data collected on the delivery of standard spare parts, so this is an assumption based on conversations in the workshop and experience. Late deliveries of standard spare parts are often resulting in periodic working. Periodic working is usually a massive contributor to high amount of hours on projects, waiting on a part and working simultaneously on several projects instead of finishing the current milestone on the project, can result in unnecessarily high amount of hours on the “assembly and test” milestone.

Changes take time and the hours spent on the projects are moving in the right direction after the reorganization. To put it into perspective, a normal labor day for employees in Norway are 7,5 hours / day, from the peak to the lowest amount of hours spent on a XT project there is a gap (Project 1 and Project 9) of 1439,58 hours, which is equivalent to 38,4 weeks of work for one person.

7.1.1 Workshop slots consideration

If the trend continues, and the workshop continues to improve their time on activities, it will result in a bigger flow of projects. If this occurs, a strict line between periodic working should be assessed. More projects can cause less control, if booking of hours are not done properly, wrong numbers are collected and analyzed for further projects. And thus, new projects will be based on wrong data, and several projects might experience an increase of the total amount of hours on different activities.

7.1.2 Planning

The project coordinator is responsible for managing projects, and as the results states the function had an increasing amount of hours on project 8 versus project 7, but the overall project time was significantly reduced. This result can be related to Wysockis "Pain curve" Figure 3-2), good planning pays off in the longer run. Several more functions are active on different milestones on project 8, and hours are used on the MC-documentation milestone, which indicates that the planning and control was better.

There is still room for improving the project plans, as the assembly and test milestone (project 8) had several activities that went under the budgeted time. Wrong adjustment would backfire GE, as they would have to send out a notification of budget overrun, if they exceeds the adjusted timeframe stated in the quotation.

7.1.3 Monitoring and control

Chapter 4.3 presented tools used for monitoring and controls at GE Oil & Gas and in chapter 4.4 we explained the main objectives (deliverables) for each function on the four different milestones.

The choice of monitoring an activity should be weighted against the cost of resources implementing and monitoring it. Using a work breakdown structure template with a top down approach as the XT department does, creates a system of control. It gives a precise overview of the time each function use on a milestone, and the activities under "assembly and test" are also covered, as this is the most time consuming milestone. This information is important when creating the schedules for new projects. A more exact schedule defines the budgeted cost of hours in the quotation when the department bid on new projects.

The monitoring of the assembling activities (project 8) tells us that these need to be adjusted if the technicians continue to improve their efficiency. Further work could be to evaluate project 8 and 9 (when the project is formally closed), to see the trend and differences of the activities, before making any adjustment decisions for new quotations.

7.1.4 Improvements

Standardized work instructions (procedures) for all project functions should be implemented to reduce uncertainty and ambiguity for a newly employees. A similar sheet as the project model in appendix A1 for all functions involved could increase insight of the progress on ongoing projects if the sheet was located in an open database for all the involved personnel. This can also improve

Rather than analyzing each individual activity with a top down approach. Further work would be to break it down another step to find the contribution of each activity to that milestone evaluated, and then see if it is possible to improve their time.

Project review meetings should be implemented after each project, with a lesson learned from each function, and stored in one open database for all functions participating on a project.

PART V: Conclusion

Chapter 8 Conclusion and Recommendations

The overall trend of xmas tress delivered from the XT department shows that the total amount of hours used on a project are decreasing, it also indicates that the re-organization works as a measure for facing one of the industries main challenges, cost increase.

Monitoring and controlling the projects helps in creating a more correct cost picture. By adjusting activities based on previous projects a more correct budget can be made for new projects. Quotations with lower budgeted hours can be sent to the customer if the effectiveness of the projects continues to improve and the correct activities and milestones are adjusted accordingly.

Some improvements can be made to improve, such as:

- Establishing a project model, that all project personnel (functions) can use as a checklist for their work on ongoing projects.
- Better communication between the functions, to communicate problems and transfer knowledge of the project.
- Analyze each milestone to find the activities that contribute the most on the total amount of hours.

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Appendix A

Project name: SNO/BB05/HXT-5

WBS: 909999

#	Major Tasks	Status	Date confirmed	TEAM MEMBERS – OTR: Department Manager	OTR: Bidding lead	OTR: Project Coord	OTR: Planner	WS: Plant Leader	WS: Supervisor	Controller	Buyer	Engineering: Eng. Manager	Engineering: Lead Eng.	QA: PQE	QA: QC	Doc controller	Warehouse/Transport	ITO	Customer	Deliverable	Template	To be saved where	Input	Output
0	STEP 0: Bidding Stage																							
0.1	Establish Project reg WF																	R						
0.2	Complete Project reg WF			R																				
0.3	Create WBS structure					R																		
0.4	Establish WBS									R														
0.5	Create project file					R																		
0.6	Create action list for project					I															Action List Template			
0.7	Kick Off SoW					R								I						Prepare package				
0.8	Create SoW (use wbs structure)					R														Standard SoW for refurbishment				
0.9	Create SoW description for quotation					R																		
0.10	Establish Procurement strategy (make or buy)					R																		
0.11	Business CTRs																	R						
0.12	Establish SNRL					R														Template to be revised/template				
0.13	Create REQ for spare parts replacements					R														According to procedure no xx				
0.14	Create REQ for 3 part services					R														According to procedure no xx	Refurbishments			
0.15	Release REQs in 01																	R						
0.16	Get 3 part prices of replacement spares										R							A						
0.17	Get 3 part prices of services										R							A						
0.18	Inform planner of lead time spares/services										R									Delivery date in SAP	ZMATSTATWBS			
0.19	Implement CPI and test equipment plan					R																		
0.20	Establish Project schedule					A	R													Hours from SAP				
0.21	Establish Quality Plan													R										
0.22	Establish communication plan (stakeholders)					R																		
0.23	Establish SMDL															R				Statoil document				
0.24	Establish MCCR															R								
0.25	Establish quotation (cost estimation)																	R						
0.26	Sign quotation																	R						
0.27	Create quotation doc no in ePic															R								
0.28	Upload quotation doc in ePic															R								
0.29	Submit quotation																	R						
0.30	Receive PO from customer																	R						
0.31	Review and accept PO from customer																	R						
0.32	Sign out Gated Process					R																		
0.33	Handover from ITO to OTR																	R		MoM / QP-DUS-OTR-010				
0.34	ITO handover signed			A	R															Signed handover form				
1	STEP 1 Before work starts in workshop																							
1.1	Review Bidding documents					R														Fullkost, quote and PO			ITO	
1.2	Verify that PB and PO corresponds			A	R															Updated PB				
1.3	Update SO									R										Updated SO with correct dates from PO				
1.4	Kick off with support functions					R														MoM				
1.5	Actions from OTR handover meeting follow up					R														MoM action plan				
1.6	Update planner					A	R													Project from ITO to production plan				
1.7	Verify PRs for all standard refurbishment					R														PRs for refurb	in the making		Demands from Customer PO	
1.8	Create Coating overview					R														Coating overview in WOP				
1.9	Update PR with new date					R														PR with correct date	MEMASSRQ			
1.10	Update need dates according to plan in SAP					R														All PR to show correct need date/ ZMATSTATWE	ZMATSTATWBS			
1.11	Release PR			A		R														All PR released 02	ME55			
1.12	Check original documentation from archives															R				Documentation uploaded in project folder			P/N & S/N on equipment	Action list for PMI if not present on time
1.13	ENS/Document numbers from Statoil															R				More information needed				
1.14	Perform Risk review					A								R						Risk register				
1.15	Initiate WOP					R														Doc number in Epic		Project folder		
1.16	Create ITP					R														Doc number in Epic, PQE to approve ITP	Stig Andre folder	Project folder		
1.17	Review ITP													R						Approved ITP uploaded in Epic		Epic		
1.18	Submit ITP to customer					R														Reviewed ITP by tech rep for customer				
1.19	ITP approved by customer																		R	Signed ITP plan updated in Epic		Epic		
1.20	Final ITP transmitted to customer															R				Signed ITP transmitted to customer(transmittal)		Epic		
1.21	Update CPI/Test equipment plan						R													All CPI/Test equipment to show in plan				
1.22	Create SNR list with standard replacement parts					R														SNR/QC list uploaded in Epic	Here	Project folder		
1.23	Create QC list with RE.IC/WS inspection, coating overview					R														SNR/QC list uploaded in Epic	Here	Project folder		
1.24	Finalize WOP					R														WOP uploaded in Epic	PRO-VGS-EN-08	Epic		
1.25	Verify PRs into POs					R					A									ZMATSTATWBS run/ Sourcing feedback after m	ZMATSTATWBS			
1.26	Verify delivery of equipment from customer					R														Shipping of equipment/RGN filled out correctly	RGN			Updated plan
1.27	Lesson learned					R														Lesson learned		Project folder		
1.28	Ready for production			A		R														Check list				
1.29	Close gate					R														Gate closed				
2	STEP 2 Strip Clean inspect																							
2.1	Kick-off WS					R														MoM Inform plan/BCTR target				
2.2	Execute work according to plan/CTR					R														All resources/equipment need for SCI ready				
2.2	Execute work according to plan/CTR								R											Weekly updates to planner/ updated plan				
2.3	update SNR lists								R											Updated QCI list sent QC team leader				
2.4	Strip/Clean complete								R											Signed WOP/ITP/QC/SNR list filled out				
2.5	Kick-off inspection					R														Updated QCI list sent QC team leader				
2.6	Inspection report rev 0 (QC report)														R					Uploaded in Epic and sent Coordinator				
2.7	Review inspection report					R														Minor damages to be defined				
2.8	Clear out minor damages from review QC report								R											Minor damages to be cleared				
2.9	NDT inspection								R											NDT request				
2.10	NDT reports								R											NDT reports approved/findings identified				
2.11	Internal QC review meeting					R														MoM -> dress/GRN/Scrap proposal/actions			QC reports	
2.12	Clear out minor damages								R											Updated QC report				
2.13	Create GRNs														R									
2.14	Create VOR workflow					R																		
2.15	Inspection report rev 1														R					Uploaded in Epic and sent Coordinator				
2.16	External QC review meeting					R														MoM -> dress/GRN/Scrap proposal				
2.17	Send VOR																							
2.18	Verify billing of milestone			A						R										Signed invoice				
2.19	Close down WBS for hours and other cost									R										Closed WBS				
2.20	Lesson learned					R														Lesson learned				
2.21	Close gate					R														Gate closed				
3.1	STEP 3.1: Variation work																							
3.1.1	Create VOR workflow			A		R														New VOR WF made				
3.1.2	Create VOR WBS and description					A				R										VOR WBS as needed				
3.1.3	Create GRNs														R					GRN created				
3.1.4	Review GRNs					R														Correct WBS, planner, send to GRR XT Disp				
3.1.5	Solve GRNs											A	R							GRNs released with clear scope				
3.1.6	Inspection report rev 2														R					Report with updated information on GRNs				
3.1.7	Create PRs needed for corrective work and spares					R														PRs going into VOR				
3.1.8	Verify quality of manual PRs/lead time MRP PRs										R									Ready for vendor quoting				
3.1.9	Collect prices and delivery for variation																	R		Input for VOR ready				
3.1.10	Update plan with affected activities			A			R													VOR plan/total impact for activities				
3.1.11	Pricing of VOR																	R		VOR created				
3.1.12	Sign off VOR			A		R														Signed VOR				
3.1.13	Send VOR																	R		Transmittal to customer				
3.1.14	VO received and verified																	R		Approved PO				
3.1.15	ITO handover meeting																	A		Signed handover form				
3.1.16	Update SO with new VO			A						R										Updated SO in SAP				
3.1.17	Kick off functions					R														PRs in 02, WS work -> updated WOP				
3.1.18	Expedite external repairs										R									Service to be delivered within need date				
3.1.19	Expedite internal repairs					R														Service to be delivered within need date				
3.1.20	Verify VO SoW completion					R														Completed VO				
3.1.21	Verify billing of milestone			A						R										Signed invoice				
3.1.22	Close down WBS for hours and other cost									R										Closed WBS				
3.1.23	Lesson learned					R														Lesson learned				
3.2	STEP 3.2:Planned repair, Refurbishment & Upgrade																							
3.2.1	Create PR for standard refurbishment (1.7)					R														PRs for refurb			1.7	
3.2.2	Verify PRs										R									PO to vendor				
3.2.3	Review ITP													R						Approved ITP from vendor				
3.2.4	Prepare items in shop for transport					A			R															
3.2.5	Call off transport					A											R			Transport booked in PB, parts shipped				
3.2.6	Inform lead time/ verify finish										R									Within need date				
3.2.7	Quality surveillance according to ITP													R										
3.2.8	Arrange transport back to Dusavik					R														Delivered to shop				
3.2.9	Verify all refurbishment work is done					R														Use "Full Cost sheet" to verify				
3.2.10	Verify billing of milestone			A						R										Signed invoice				

3.2.11	Close down WBS for hours and other cost									R										Closed WBS				
3.2.12	Lesson learned					R														Lesson learned				
3.2.13	Close gate					R														Gate closed				
4	STEP 4 :Assembly/test/MC/ Documentation																							
4.1	Verify all parts on stock/delivered in time for activity										R									Spare Parts Status report (2 weeks prior assy)	Spare Parts Status Report		WBS	SAP latest delivery date
4.2	Verify all CPI/test equipment on stock/delivered in time for activity					R														Shipping of equipment/RGN filled out correctly	RGN			
4.3	Verify all needed parts for 1 activity is available for picking					R														QCI list = SAP need =Picking list				
4.4	Allocate all parts in VO WBS into main network					R														Leave cost as-is, to ease the material handling in shop				
4.5	Issue picking note to MA					R														Release network, inform MA by e-mail				
4.6	Parts delivered WS																R			DN executed and delivered to WS				
4.7	Parts signed off and stored, all parts on site, ready for assembly								R											Signed complete DN		VLN03		
4.8	Traceability review with customer					R														Complete SNRL	SNRL	Project Folder		
4.9	Perform work according to WOP								R											WS Signed WOP	WOP	Project Folder	Proj signed WOP	WS signed WOP
4.10	WOP handover from WS to OTR								R											Invoice/MRB input	WOP	Project Folder		
4.11	Verify billing of milestone			A						R										Signed invoice				
4.12	Close down WBS for hours and other cost									R										Closed WBS				
4.13	Close gate					R														Gate closed				
4.14	Lessons learned capture					R														Lessons Learned	Doc no:			
5.2	Step 5.1: MC/documentation																							
5.1.1	Submit WOP to Document Controller					R														Upload to Epic or input to MRB	WOP	Project Folder	Completed WOP	rev rec doc/MRB
5.1.2	Create and sign CoC, if applicable					R														CoC for input in MRB	CoC	Project Folder	Proj specific info	Final CoC
5.1.3	Finalize MRB															R				Org doc, WOP, CoC	MRB Index	Project Folder		Complete MRB
5.1.4	Perform MC of equipment														R					Signed MC report	MC report			
5.1.5	Sign MC report														R					Signed MC report				
5.1.6	Sign MCCR for Contractor					R														MCCR				
5.1.7	Call for MRB meeting with customer					R														Scheduled MRB review				
5.1.8	Attend MRB meeting with customer					R														Signed MRB				
5.1.9	Customer sign MCCR																							
5.1.10	Prepare for transport					R																		
5.1.11	Ship equipment																R			DN executed and delivered to Customer				
5.1.12	Collect signed DN from SAP					R														Rev rec documentation	VL03N			
5.1.13	Transmittal of MRB to customer															R				Transmittal (no customer cc) e-mail receipt		EPIC		Rev Rec doc
5.1.14	Verify billing of milestone			A						R										Signed invoice				
5.1.15	Close down WBS for hours and other cost									R										Closed WBS				
5.1.16	Close gate					R														Gate closed				
5.1.17	Lessons learned capture					R														Lessons Learned	Doc no:			
5.3	Step 5.2:Project close																							
5.2.1	Verify all spares have been transferred out of WBS					R														No parts on stock	ZLX02			
5.2.2	Register Notification in Customers SAP (if applicable)					R																		
5.2.3	Scan documentation/upload in EPIC					A										R								
5.2.4	Issue WOCOR					R														WOCOR issued and approved	Epic	Epic		
5.2.5	Receive CC			A															R	Completion certificate	N/A	Epic		
5.2.6	Final invoice									R														
5.2.7	Financial analysis									R										Financial analysis, actual vs. forecast				
5.2.8	Lesson learned					R														Lesson learned report				
5.2.9	Close down WBS									R										Project in CLSD				
9	Recurring events	Recurrence																						
9.1	Update planner on progress/completed activities	Weekly				R														Weekly plan				
9.2	Verify progress vs. hours	Weekly					R													report out if over budget or low output				
9.3	Updated delivery dates from functions	Weekly					R																	
9.4	Update weekly report to customer	Weekly				R														Weekly report				
9.5	Updated delivery dates sub-contractor items	Monthly									R									Updated dd in PO/SAP				
9.6	Update risk register	Monthly				R														Risk register				

R
Y
G

R		Responsible = Actively drives for results. " Doer"
A		Accountable = Ensures results. Only one 'A' per row
C		Consulted = Provides input
I		Informed= Receives status and updates

Field	Description	Function	SCI	RUR	A&T	Guide Frame	WH connector	FL connector	POD / VPI / Sealsubs	AWB	MVB	Actuator [average]	Sub-assy unitization	Mounting to Guide Frame	Assy unitization	Flashing / testing tubing & actuators	Testing needle valves	Testing bore, cavities, gas test	POD interface test	Final assy, wrap-up	MC&D	Other	Σ
Troll Olje	OH53 / 907620 / XT E	**Apprentice**	13	0	165																0	0	**178**
Troll Olje	OH53 / 907620 / XT E	**Controller**	0	0	60																0	0	**60**
Troll Olje	OH53 / 907620 / XT E	**Coordinator**	136	239	163																0	69	**606**
Troll Olje	OH53 / 907620 / XT E	**DC**	0	32	138																0	0	**170**
Troll Olje	OH53 / 907620 / XT E	**Engineering**	0	0	0																0	997	**997**
Troll Olje	OH53 / 907620 / XT E	**Foreman**	111	34	231																0	0	**375**
Troll Olje	OH53 / 907620 / XT E	**Planner**	0	0	55																0	0	**55**
Troll Olje	OH53 / 907620 / XT E	**QC**	97	106	0																0	5	**208**
Troll Olje	OH53 / 907620 / XT E	**Sourcing**	0	74	0																0	0	**74**
Troll Olje	OH53 / 907620 / XT E	**Technician**	713	32	1 451	47	90	77	64	42	246	33	104	81	161	200	88	45	46	137	0	228	**2 423**
Troll Olje	OH53 / 907620 / XT E	**Warehouse**	0	2	11																0	0	**13**
Troll Olje	OH61 / 907923 / XT T	**Apprentice**	24	1	348																0	0	**373**
Troll Olje	OH61 / 907923 / XT T	**Controller**	0	0	26																0	0	**26**
Troll Olje	OH61 / 907923 / XT T	**Coordinator**	173	276	175																3	25	**652**
Troll Olje	OH61 / 907923 / XT T	**DC**	0	0	0																36	0	**36**
Troll Olje	OH61 / 907923 / XT T	**Engineering**	0	0	0																0	284	**284**
Troll Olje	OH61 / 907923 / XT T	**Foreman**	87	34	258																0	0	**379**
Troll Olje	OH61 / 907923 / XT T	**Planner**	1	1	59																0	0	**60**
Troll Olje	OH61 / 907923 / XT T	**QC**	232	64	23																0	58	**376**
Troll Olje	OH61 / 907923 / XT T	**Sourcing**	0	90	0																0	0	**90**
Troll Olje	OH61 / 907923 / XT T	**Technician**	317	6	1 024	23	21	30	20	57	240	50	190	-	195	108	58	105	84	91	0	242	**1 588**
Troll Olje	OH61 / 907923 / XT T	**Warehouse**	0	0	50																0	0	**50**
Troll Olje	OH61 / 907923 / XT T	**Welding**	0	23	0																0	0	**23**