

MASTER STUDENT PROJECTS

CLUSTER ON INDUSTRIAL ASSET MANAGEMENT

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1. Title: Developing a dynamic risk simulator for rotating equipment integrity management

Author: Shyam Krishna Ramanan

Supervisor: Prof. Jayantha P. Liyanage

Abstract: Restricted

2. Title: Utvikling av et prestasjonsmålingsystem og prestasjonsmålingsverktøy for prosjektevaluering

Author: Jørn Kristian Flesland

Supervisors: Internal: Prof. Jayantha P. Liyanage; External: Kristian Eikemo

Abstract: Restricted

3. Title: Reconstruction of Roskrepp power plant to a reversible pumping plant - a feasibility study

Author: Marte Walmestad Tofteberg

Supervisors: Internal: Prof. Jayantha P. Liyanage; External: Bjarne Tufte (Sira-Kvina Kraftselskap)

Abstract: This project resulted from Sira-Kvina Power Company's desire to map the changing market conditions related to "balancing power" in their production facilities.

The recent focus on climate change goals has led to changes in market conditions. A strengthening of the grid that makes for more conversion into non-flexible power. There is a possibility that this in turn increases future demand for flexible production, thus "balancing power".

Sira-Kvina Power Company's production system could handle the implementation of an adjustable pumping power plant. However, market conditions are currently not favorable, as prices are low and there is high uncertainty. In this master thesis, a price forecast based on rising energy prices towards 2050 has been established. The current results show little margin and high risk. In able to carry on, a more detailed price forecast is required.

4. Title: A study of how a Lean approach can be used in dealing with challenges present at DeepOcean Offshore Base and their specialty within logistics-, warehouse- and workshop services

Author: Ingunn Tørresdal

Supervisors: Internal: Prof. Jayantha P. Liyanage; External: Hans Christian Håstø

Abstract: The recent drop in oil prices has forced the industry to become more efficient than ever. This has resulted in financial stress for many companies in able to stay afloat.

In order to survive in this context, one should strive for continuously improving the variables that can affect the business at all levels. This also includes a higher degree of supportive and inspiring management, a sense of personal empowerment and ownership by each individual.

This thesis attempts to use Lean as an approach to deal with the challenges the employees at DeepOcean Offshore Base are facing in their daily work. A qualitative mapping of work processes, interviews, observation and questionnaires have been applied in obtaining relevant information. This thesis encompasses identified challenges and improvement potentials. The results of the study revealed that the employees at DeepOcean Offshore Base are in a situation where they just spend time on 'keeping the business running', due to an arguable amount of inefficient work processes stealing valuable time. Changes are suggested within relevant variables that may affect the business, as well as specific Lean initiatives that can support the necessary changes, and more explicitly enhance flow efficiency.

5. Title: Development of integrated operations strategy to accelerate offshore operations capability

Author: Pipit Hendra Nurwinahyu

Supervisor: Prof. Jayantha P. Liyanage

Abstract: Integrated operations is a proven operating model to manage offshore assets smartly. BP with its Field of the Future program, Shell with its Smart Fields program, and Statoil with its Integrated Operations program have deployed it on their global assets since the early 2000's and successfully delivered value through better and faster decision-making. IO has been a global practice, consequently more and more companies initiate efforts to deploy on their assets.

Pertamina is the sole NOC and bears public obligations to fulfill oil and gas security of supply in Indonesia. This national obligation has exposed Pertamina to significant challenges since most of its onshore fields are in mature phase.

This thesis is an academic contribution to capture IO best practice from global players (BP, Shell, and Statoil), apply its key knowledge through literature review, and package them as an IO strategy. The main objective of such is to systematically configure a strategic plan to develop and deploy it as part of offshore operations in Pertamina. This is expected to be a high-level guideline that gradually transforms Pertamina into a top performing IO operator in Indonesia through the integration of people, process, and technology. This thesis offers a thorough IO strategy that is dedicated to accelerating offshore operation capability as Pertamina's competitive advantage in the future.

6. Title: Methodology for fact-based support in maintenance management decision-making

Author: Gilberto Cervantes

Supervisors: Internal: Prof. Jayantha P. Liyanage; External: Stian Bjerkenes

Abstract: Equipment maintenance is an essential part of any industrial plant. While fundamental, evaluating its impact quantitatively is a great challenge. Companies usually find it hard to obtain reliable financial support figures to justify the replacement of ageing equipment. Gassco AS identified this matter and provided the basis for this master thesis. This work's objective is to provide a methodology that supports decision-making for maintenance management in a factual manner. Such feature was done after an exhaustive survey of current methods.

Equipment reliability is an essential part of determining potential losses. A system's losses due to unreliability depend on subcomponent interdependencies and individual failure rates. A model combining two existing ones was developed: EVA (Economic Value Added) and CoUr (Cost of Unreliability). A real case concerning the potential replacement of UPS (Uninterruptible Power Supply) units was used to test the suggested method. A tool based in a spreadsheet software was developed in able to use the recommended model for analysis purposes. The results obtained deemed such investment as non-justifiable financially. The proposed tool is a cornerstone towards better decision-making support. Nonetheless, it still has room for added robustness.

7. Title: FDV-kostnadsberegning basert på produktspesifikk informasjon lagret i en BIM-modell

Author: Martin Gromsrud

Supervisors: Internal: Prof. Jayantha P. Liyanage; External: Erling Salicath (Utdanningsetaten, Oslo Kommune)

Abstract: Maintenance planning is not a strange word in the building sector. However, an increasing number of buildings deteriorate due to the increasing maintenance needs. To protect a building through its entire expected lifetime, it is essential for owners to consider all required future expenses before constructing; management, operation, maintenance and replacement.

Currently, this is done using general cost tables. For example, one of these indicates it costs 105 NOK per year per square meter to maintain a building in the Oslo region. However, these tools are not context specific. This project uses LCC (Lifecycle cost) analysis as a more effective alternative. Its task is to obtain product specific information directly from BIM (Building Information Modelling) models regarding cost calculation.

The "Munkerud" school has been used as an example. This work encountered that the information provided by suppliers was not detailed enough for an LCC analysis. It is therefore concluded that the attempted approach is not possible to be carried out now nor in the near future. In able to eventually make this happen, building constructors must inform on maintenance specifics and key numbers must actually be based on experiences.

8. Title: Modelling of spare part evaluation for offshore assets to support decision-making

Author: André Vike

Supervisors: Prof. Jayantha P. Liyanage

Abstract: Restricted

9. Title: The application of HSE management system in international petroleum geophysical field

Author: Yang Baojun

Supervisor: Prof. Jayantha P. Liyanage

Abstract: Restricted

10. Title: International development strategy of a Chinese offshore drilling contractor

Author: Xuecheng Zhang

Supervisor: Prof. Jayantha P. Liyanage

Abstract: Restricted

11. Title: An integrated approach for effective management of assets: a case study from steel industry in China

Author: Dawei Liang

Supervisor: Prof. Jayantha P. Liyanage

Abstract: Restricted

12. Title: Strategy for internationalization process of geophysical COSL

Author: Guiming Wen

Supervisor: Prof. Jayantha P. Liyanage

Abstract: Restricted

13. Title: Hose management system: complex source mapping

Authors: Daria Efimkina; Olga Kavaliova

Supervisor: Prof. Jan Frick

Abstract: Restricted

14. Title: How could the lean manufacturer make use of additive manufacturing?

Author: Henry V. Iversen

Supervisor: Prof. Jan Frick

Abstract: This thesis answers the following question: How can the industry make use of additive manufacturing (also called 3D printing) in the context of Lean?

3D printing has been around for a couple of decades, but it is not until recently that this manufacturing technique has become interesting for the manufacturing industry. In the early stages of the technology, only plastic substances could be used. Nowadays there are a number of techniques used and metal objects can now be made with good quality.

Lean is a management methodology deemed more effective than traditional ones. This work attempts to solve the balance between the constraints involved in 3D printing, like cost and time with its potential benefits in a lean context.

15. Title: An evaluation of the new product development process in the context of operational readiness

Author: Lyndall Jordaan

Supervisor: Prof. Jan Frick

Abstract: Restricted

16. Title: Lean design process in piping

Author: Devi Srinivasa Rao

Supervisor: Prof. Jan Frick

Abstract: Restricted

17. Title: Buy versus rent of cargo carrying units in the wireline segment at Schlumberger Norway

Author: Yulia Podlipaeva

Supervisor: Prof. Jan Frick

Abstract: Restricted

18. Title: The application of the internet of things and physical internet in Norwegian aquaculture supply chains

Authors: Andreas Ødegaard; Simon Dāvøy

Supervisor: Prof. Jan Frick

Abstract: The topic for this master thesis is Supply Chain Management within the Norwegian aquaculture industry. The thesis aims to examine how the industry can make use of aspects within the Internet of Things and Physical Internet in order to improve their supply chains. Moreover, the thesis identifies and defines three main factors affecting the customers purchasing decision; namely quality, time, and price. These factors are interconnected, and influenced by traceability and onshore transportation.

Due to increased focus relating to regularity and flexibility in deliveries, along with food safety, quality, and documentation, the need for innovative transportation- and traceability solutions has become imperative. As a solution to this, the thesis suggests that the Norwegian aquaculture industry can benefit from utilizing concepts from the Internet of Things and Physical Internet in their supply chains. Electronic traceability systems enable transparency and efficient communication throughout the supply chain. It provides key information about the products, which in turn facilitates better decision-making. Additionally, cost and time consumption reductions can be accomplished.

19. Title: [A smarter home, the smarter choice?](#)

Authors: Marie Berland Nesheim; Kine Sandanger Rosnes

Supervisor: Prof. Jan Frick

Abstract: In a world of expanding connected products, home automation has shown itself as one of the biggest trends to follow. Home automation is the automation of the home via highly advanced systems that control multiple functions of the home - more often called smart homes. The purpose of this thesis is to examine how smart home development affects consumers. It also tries to identify users, benefits and issues of smart homes.

The research is done with a theoretical approach, via literature reviews and indirect observations.

The findings showed multiple areas of development. The smart home industry is growing and taking its share of the smart market. Smart homes are for everyone, but we see it as highly beneficial for health purposes in a world where the elderly population is growing rapidly. This is an area of focus for the future. Three main issues were identified; privacy, security and standards. These areas have to be addressed in near future for the smart home to be fully adopted. Privacy needs to be addressed as best as possible, the more this concept grows, the more sensible data is collected.

20. Title: [A study of logistics in the supply chain of organic plant and animal products](#)

Author: Grete Clausen; Ane Thorvaldsen

Supervisor: Prof. Jan Frick

Abstract: This study shows the logistics in the supply chain of ecological animals and plant products considering the analysis of industry actors, positions, cash flow and food waste. The study takes into account the challenges and opportunities ranging from primary producers to consumers. The background of this project is the fact that there is a lack of correspondence between the parliament objectives in the subject and actual developments in the area.

This thesis is a contribution to further research in the sector accounting for the low availability of information on the subject. A combination of case studies and literature is used to resolve the issue at hand. The project concludes that ecological producers have no problem selling their products, something that shows the market and private consumers request these highly. The current low production makes it so that the offer lags behind the actual demand for eco-products.

21. Title: To what extent is it possible to use lean, to discover time thieves in the payroll department in the Norwegian government agency for financial management (DFØ)

Author: Geir Olav Byberg

Supervisor: Prof. Jan Frick

Abstract: This study has the objective to show the degree in which it is possible to use Lean principles to discover time loss activities ("time thieves") in the directorate for economy management (DFØ). The thesis is carried out in the form of a case study in the loan department at DFØ and is based primarily in the five Lean principles.

The data material gathered was obtained through interviews on three managers and six employees. They are anonymous and are used as analysis basis. The low population of interviewees and the short period to carry this project out can reduce the capacity to generalize and reproduce these results.

Results indicate that potential "time thieves" are connected to lacking skills amongst the workforce and tedious routines as well as communication issues. The department in study did not use Lean, but its testing indicates a rise in efficiency across it.

22. Title: Organizational bottlenecks in new technology implementation and utilization

Author: Mohammad Mohsin Salahuddin

Supervisor: Associate Prof. Knut Erik Bang

Abstract: The pace with which technology is currently developing is unparalleled in the history of humankind. Its development is continuously opening avenues through which tasks can be done in a more effective manner. It has therefore become the

key for the sustained growth for any organization. For, despite its utility and need, organizations are unable to implement new technology.

This master thesis will present organizational bottlenecks, which disable the implementation of new technology. The computerized maintenance management system of MEL has been used as a case study in this thesis. The current system in place is run primarily through a paper work order, which is issued when maintenance action is required. The data on the work order is typed into a Microsoft Excel based system through which maintenance reports are generated to enable management to make decisions.

The thesis highlights the bottlenecks related to management, tradition, costs and skill of the employees disabling the upgradation of the system to meet the organizational needs. The problems arising as a result and the overview of the limited reliability and functional capability of the current system is also presented. The thesis also discusses why an attempt to automate the system has failed. Finally, it establishes the causes of the existence of bottlenecks restricting technology implementation. It then presents a model solution based on Technology Acceptance Model and Kurt Lewin's theory of change, which can be applied to upgrade CMMS in line with new technology to minimize downtime and optimize asset performance.

23. Title: An analysis of asset availability performance: a practical determination of well system reliability and maintainability.

Author: Kai Petter Vika

Supervisors: Internal: Associate Prof. Knut Erik Bang; External: Shawn Le Maitre and Shaun O'Brien

Abstract: With decreasing oil prices, optimizing existing production is essential to generate as much revenue as possible. When the product sold decreases in value, more volume is required to maintain the revenue levels. Therefore, when oil prices are low, well availability is an important contributor to reaching revenue targets. A major international oil and gas company, with assets in NCS and UKCS, had a goal to better understand which failures impact their asset's well production availability. The goal of this thesis was to determine Company's assets' availability through practical system reliability and maintainability.

This was achieved by reviewing historic production performance data. When commencing this thesis, the goal was to obtain knowledge of how the offshore assets were managed to achieve well availability. It was believed that simple manipulations in excel would provide sufficient information to gain an understanding of how the wells are operated. However, as the thesis progressed, new discoveries were made which required further analysis, and most importantly it has been necessary to consider and recommend how to apply this historic insights to improve future performance.

24. Title: Application of the "maintenance loop" for land-based manufacturing

Author: Geir Østensen

Supervisors: Internal: Associate Prof. Knut Erik Bang; External: Stein N. Jørgensen

Abstract: The maintenance function is an important part of any organization that possesses tangible assets. Whether it is machinery, buildings, equipment, or others, maintenance of these assets are vital to enable them to deliver as intended. In this thesis, the focus is on maintenance of industrial production machinery and equipment. The literature on the topic of industrial maintenance is extensive, and there are lots of different frameworks and strategies proposed to enhance the performance of the maintenance function.

In this thesis the model of the Maintenance Loop, developed by the Norwegian Oil Directorate in the late 90s, are used to assess the performance of the maintenance function at Benteler Automotive Farsund. The model divide the maintenance function into 11 elements. For these 11 elements, the current status, problems and challenges, and finally, improvement potentials and future goals were identified. The results show that a thorough review of the maintenance function like the one performed in this thesis will reveal much information and several minor improvement potentials not visible by the naked eye. From the results of this thesis, it can also be seen clearly how important it is to have a properly functioning Computerized Maintenance Management System (CMMS) at hand, and how important good communication is to be able to work efficiently.

25. Title: Methodology for project evaluation

Author: Ashok Devanaboyina

Supervisors: Internal: Associate Prof. Knut Erik Bang; External: Andrew Kilmartin

Abstract: Recent studies reveal that the offshore projects undertaken on the Norwegian Continental Shelf failed consistently to deliver on time and budget. The study performed by Norwegian Petroleum Directorate (NPD) confirms major cost & schedule overruns.

It was identified that numerous International oil and gas projects faced similar challenges in meeting the budgets and schedule. In spite of having various project management techniques, the oil companies (operators) still experience challenges to track the project deliverables.

With the current lower oil prices, executing projects on time (OTD-On Time Delivery) according to the agreed budget is the need of the hour for the Norwegian oil and gas industry. This thesis looks into developing a methodology to track the projects and handles various project issues early to manage effective project deliveries. The study identifies various key issues that have promoted project failures in different project phases on an EPCIC project model. This thesis shows how to effectively capture the project issues and enhance overall project performance.

26. Title: An assessment of Kvaerner's supply chain surveillance function

Author: Thomas Sætre

Supervisors: Internal: Associate Prof. Knut Erik Bang; External: Odd Ingvar Ur, SCS Manager at Kvaerner (K2JV)

Abstract: Restricted

27. Title: Evaluation of local power generation concepts for subsea application

Author: Rodrigo Vicente Mello Lima

Supervisor: Associate Prof. Knut Erik Bang

Abstract: The demand for oil & gas resources is forecasted to continue increasing in the next decades. Most new discoveries will be made offshore. By reviewing the available power generation technologies for powering subsea production equipment, ranking them according to a set of parameters, selecting the most feasible concepts and evaluating the cost of these concepts in different subsea cases; this thesis identifies the power generation technologies most suitable for the subsea application. Energy storage technologies are also briefly screened for the subsea application and recommendation is done on the use of a specific one.

The Levelised Cost of Electricity (LCOE) is used to define the most cost effective technology for four different subsea cases (operation of a SSIV, operation of a single subsea well, operation of 8 subsea wells and operation of a subsea boosting station). It is observed that there is technology available, with high readiness level, which can power subsea equipment, as an alternative to powering from the topside facilities of the platform or from onshore facilities, with considerable cost saving, also solving some other technical challenges faced in long tiebacks and in platform space management.

28. Title: Development concepts for Sakhalin's offshore field development

Author: Andrei Beltcoy

Supervisors: Internal: Prof. Ove Tobias Gudmestad; External: Prof. Anatoly Borisovich Zolotukhin (Gubkin University)

Abstract: The concept phase of developing an oilfield includes screening of concepts, selection of concept and its development. The use of engineering data that represents a feasibility study of offshore oil and gas fields is essentially the screening of concepts.

The selection consists of finding a solution that would meet technical, environmental and safety demands. Despite the fact that the Sakhalin Island shelf contains enormous hydrocarbon reserves, it is also a very environmentally sensitive region. This puts a significant burden of responsibility on the project team during development.

Selecting the optimum Sakhalin Shelf development concept is the aim of this thesis. The significance in the concept selection chain affects selection of various

parameters affecting the optimum development concept and subsequent prioritization. Special attention is paid to challenges and peculiarities that can be faced at the Sakhalin Region. The paper analysis addresses concept screening and engineering solutions. The main driving factors of concept selection are touched upon. The final model – step by step approach to concept phase execution, is concluded to be applicable to Sakhalin oil and gas development projects.

29. Title: Development of a wave-driven pump for energy production

Author: Lars Alexander Eikeland

Supervisor: Prof. Ove Tobias Gudmestad

Abstract: Restricted

30. Title: Validation of heat transfer coefficients in pipes and deck elements without ice glazing

Author: Jino Peechanatt

Supervisor: Prof. Ove Tobias Gudmestad

Abstract: In recent years, there has been unprecedented interest shown in the Arctic region by the industry as it has become increasingly accessible for exploration. Engineering research in heat transfer studies and design of material suitable for low ambient temperature has progressed in the right direction to instill confidence in operators that energy loss can be minimized. This thesis tries to answer some of these queries by undertaking comprehensive study of the heat transfer phenomenon in pipes and deck elements.

A thorough comparison of the heat transfer coefficients determined experimentally and through theoretical methods using existing heat transfer correlations such as Hilpert, Fand and Keswani, Morgan, Žukauskas, Whitaker and Churchill-Bernstein for horizontal pipes under cross-flow wind condition showed that the values were in good agreement for the insulated pipes with the deviation in the range 0.5 - 2.82 % for diameter 50 mm insulated pipe and 12 -14 % for diameter 25 mm insulated pipe. Comparison of diameter 50 mm uninsulated and insulated pipe showed that the reduction in heat transfer coefficient is in the range of 400 - 4000 % with the usage of insulation material having low thermal conductivity.

However, in the case of uninsulated pipe and deck element, the values were substantially higher for experimental heat transfer coefficient values compared to theoretical results. The values were in the range 72 - 88 % and 17- 90 % respectively. Time to freeze results for diameter 25 mm and diameter 50 mm uninsulated and insulated pipes showed increase in time to freeze by 27 % and by 52 % with the usage of 10 mm and 25 mm insulation respectively, in the case of diameter 25 mm pipe. For diameter 50 mm pipe, the time to freeze increased by 22 % and 47 % respectively for similar increase in insulation thickness. Based on the governing criteria

and experimental findings, the Churchill-Bernstein correlation was suggested as the best method for use by the industry.

31. Title: Rectification of free spans on subsea pipelines

Author: Anders Haga

Supervisors: Internal: Prof. Ove Tobias Gudmestad; External: Jarle Kvåle Kolbeinsen (DeepOcean AS)

Abstract: Restricted

32. Title: Analysis of an offshore lifting operation according to DNV - How to find the characteristic load by repeated dynamic simulations in the time domain

Author: Anders Aasen

Supervisors: Internal: Prof. Ove Tobias Gudmestad; External: Dag Abel Sveen (DeepOcean Group)

Abstract: In order to analyze a lift offshore performed from a vessel, focus is often put on preparing a good model of the main lifted object, the vessel motions (RAOs), the crane characteristics plus the sea state characteristics. However, something that is not so often put into focus is how to find the correct characteristic load that is affecting the object based on statistical data.

Usually, an irregular sea state is used when analyzing lifts at sea. In this thesis, a consideration of an object launch through the splash zone in a defined sea state has been analyzed. The resulting hydrodynamic forces in such a case are highly dependent on the timing with the incoming wave and the vessel motions.

After running simulations, the calculated results reveal that given repeated dynamic simulations for lifting operations offshore in a short term sea state does:

1. The most extreme loads experienced not always follow a Gumbel distribution and that the tail region given the use of probability papers should be considered;
2. The given characteristic loads may have a large statistical scatter depending on the simulation size, and;
3. Given the DNV standard regulations where a probability of structural failure should be less than 1 per 10000 lifting operations (DNV-OS-H101, 2011, Section 1, A201), large sample/simulation sizes are required in order to get a high level of confidence. A second criterion has therefore been proposed for implementation.

33. Title: Use of submarines as field development facilities

Author: Aleksei Gorodishenin

Supervisors: Internal: Prof. Ove Tobias Gudmestad; External: Prof. Anatoly Borisovich Zolotukhin (Gubkin University)

Abstract: Today, it becomes clearer that the era of easy to extract oil is almost gone. Thus, the oil and gas industry starts to face the development of complex deposits located in deep and ultra-deep waters or in the Arctic region, often under the ice. This thesis has focused on the second type. Therefore, it is necessary to find the most effective solutions for the field development in the ice infested waters where the ice-free is short. One of the possible answers can be the transfer of different technologies from other industries.

Such kind of technology may be taken from the military industry. Of course, we are talking about submarines. This thesis considers submarines and their possibilities as solutions for challenges in the Arctic environment. Nowadays, diesel-Stirling-electric submarines do their job in a way with minimum risks to the operator, the environment, and the crew.

The main idea of this paper is to show that submarines can be used as a mothership or, in simple words, a carrier for ROVs, which application is very versatile, but the core purpose is to maintain the field operations during the production phase. To show that it is possible, the design of submarines will be considered with an accent on special room for ROVs and the compartment for its running in the water. Nevertheless, submarines can perform simple tasks like installation, inspection, maintenance, and repair by itself with a help of an on-board gantry crane.

34. Title: Cluster development of the Barents and Kara Seas oil and gas fields from the archipelago Novaya Zemlya

Author: Andrei Starodubtcev

Supervisors: Internal: Prof. Ove Tobias Gudmestad; External: Prof. Anatoly Borisovich Zolotukhin (Gubkin University)

Abstract: Starting with a comparison of sea-state parameters and metocean conditions of the Barents and Kara Seas, this thesis will discuss the challenges for development of potential hydrocarbon fields in the Barents-Kara Area. The main accent of this master's thesis will be placed on possibilities of the technological challenges for choice of platform and construction of common infrastructure on the base of archipelago.

Part I (Introduction) provides the general information about the exist projects in the Barents-Kara region. Mainly these projects are owned by Russian majors – Gazprom and Rosneft. Except of that, the first part considers an ore project on the archipelago.

Part II (Metocean Parameters and Conditions) provides the environmental data with metocean and ice conditions. Such conditions that require a consideration are topography, winds, waves, temperatures, ice duration, iceberg's occurrence, environmental concern.

Part III (Offshore Field Development) considers a short description of development of different areas in the region.

Part IV (Pipeline Route Selection) provides a calculation in the specialized program. It is guaranteed a successful offshore pipeline laying from the fields to the center located on the archipelago. All data are gathered in the one map – cost distance map/surface.

Part V (Economical Aspects of the Project) considers a short economic conclusions of the project. It discusses the main advantages.

Part VI (Conclusions) provides final remarks that sum up all material assembled in this project.

35. Title: Validation of heat transfer coefficients; single pipes with different surface treatments and heated deck element.

Author: Bjarte Odin Kvamme

Supervisors: Internal: Prof. Ove Tobias Gudmestad; External: Oddbjørn Hølland, GMC Maritime AS

Abstract: Interest in the polar regions is rising. Further research is required to evaluate the adequacy of equipment and appliances used on vessels traversing polar waters. This thesis investigates the adequacy of different theoretical method of calculating the heat loss from cylinders and deck elements when exposed to a cross-wind scenario. Experiments were conducted at GMC Maritime AS's climate lab on Buøy, Stavanger.

Correlations for convective heat transfer over cylinders are evaluated and compared. Based on findings, the best correlation for use by the industry was determined to be the Churchill-Bernstein. The deviation of the correlation with respect to experimental measurements was found to be between 0.40% and 1.6% for a 50mm insulated pipe and from -3.86% to -2.79% for a 25mm one.

Deviations are significant enough to warrant further studies. Key elements for an optimal design of deck elements are suggested. Experiences from testing in the laboratory and in the field are presented and discussed.

36. Title: Safe and efficient approach for planning of offshore heavy lift operation

Author: Ida Gaviola-Intes

Supervisors: Internal: Prof. Ove Tobias Gudmestad; External: Alan Clifton & Kevin Sirski (LOC Stavanger)

Abstract: Mechanical lifting is one of the more important operations regarding offshore installation. This typically involves topside lifting from a barge or transport vessel. In the last years, lifting activity has increased, along with significant boosts in the dimensions and weights of the structures to be lifted. Furthermore, some of the areas with highest lifting activity increase involve tough environments such as the arctic regions, which poses additional challenges.

In this report, the marine lifting procedure used for the lifting operation of the Valemon Topsides developed by Saipem will be presented as a general overview of occurrences in typical marine lifting operations. The study outlines and addresses the main challenges that may or may not be encountered during the aforementioned operation. This thesis also includes a comparison study of existing marine lifting guidelines to gain consensus on the subject of handling criteria and limitations for rigging arrangement. This thesis pursues the optimization of current practices and discusses the ability to categorize risks in heavy lifting planning to potentially update LOC Group guidelines.

37. Title: Structural modelling of offshore module for loadout, transportation and installation

Author: Ivan Azad Ali

Supervisor: Prof. Ove Tobias Gudmestad

Abstract: The increasingly harsh offshore environments that the oil and gas industry has to deal with result in the need for more accurate modelling. This thesis focuses on the modelling of an offshore module. The main focus is to stress the many important considerations and conditions during loadout, transportation, lifting and installation phases.

This work is performed at the University of Stavanger. The report presents an introduction to the selection of design factors in the different operational phases and presents a comparison of these factors as given in NORSOK, ISO and DNV-GL standards. Subjective risk analysis has also been performed and suitable risk reducing measures proposed. Discussions on the main findings challenges and recommendations based on results and experiences are provided.

38. Title: Risks associated with geohazards

Author: Roshana Raut

Supervisor: Prof. Ove Tobias Gudmestad

Abstract: Geohazards are ones caused by various geological processes and conditions that lead to the damage of existing environment. These pose a threat to about 1.4 billion world inhabitants. It is therefore imperative to address them.

The primary objective of this thesis is to broaden the knowledge of geohazard risks by understanding their potential causes, the likelihood of occurrence and their possible consequences. A concept of geohazard risk is built on the basis of vulnerability, exposure and elements in danger.

In this work, some significant geohazards in Norway are discussed along with the factors leading to the future risk. As specifics of geohazards, the landslide issue of Nepal is taken into account. With the identification of triggering factors of landslides and their potential consequences, mitigation measures are suggested. It is

concluded that there is a need or broader thinking to adopt new measures of risk management and design for the prevention and mitigation of geohazard risks.

39. Title: DP system reliability for offshore operations

Author: Shaobo Xin

Supervisor: Prof. Ove Tobias Gudmestad

Abstract: With the development of the offshore oil and gas industry, more and more activities are operated far away from shore and are moved into deep-water areas. The complexity of the deep-water missions and unpredictable ocean environment leads to manual operations that could not satisfy a vessel's positioning requirements. Keeping the vessel's position accurately for a long time during operation is crucial. Thus, the dynamic positioning system used nowadays is an indispensable tool.

A DP system can control a vessel's position and heading automatically and can ensure position precision for a long time. However, sometimes it may fail to keep the position and an incident might occur. Therefore, the reliability of such system is a key factor in an offshore safety operation. This thesis firstly introduces the development of DP and their components. It later focusing on discussing the risks of a DPsystem in offshore operations, analyzing possible barriers which could reduce or eliminate them. The FMEA method to improve their reliability is used. A real case is studied at last to provide lessons on DP operations.

40. Title: Risk management and reduction (mitigation) measures in seismic exploration

Author: Yang Yanhao

Supervisors: Prof. Ove Tobias Gudmestad

Abstract: The main safety management procedures used for Geophysical-COSL (China Oilfield Services Limited) during work are QHSE & SMS. These show how the work's risks are assessed and the related risks are identified, directed and managed accordingly. From this aspect, this work discusses how the reduction measures are used in practice. Although these risks reductions are useful during work, there are still aspects that can be improved on the assessment.

The main target of this thesis is to use the project's risk assessment (mainly use a Barents Sea Project) to show how Geophysical-COSL's reduction procedure through QHSE and SMS works. Its usefulness is evaluated. Furthermore, new methods are discussed and how they could potentially contribute to the current ones. Finally, it is shown that while there is room for improvement, the tools in place are of essential value.

41. Title: Method for flowback handling after well interventions using acid for the Valhall field

Author: Guro Vaagan

Supervisor: Prof. Ove Tobias Gudmestad

Abstract: Restricted

42. Title: Waste and fluid return handling on the Valhall complex

Author: Arnfinn Grøtte

Supervisor: Prof. Ove Tobias Gudmestad

Abstract: Restricted

43. Title: Apparent negative damping; an original approach to the oscillations of offshore structures

Author: Baptiste Reyne (Nantes University Exchange Student)

Supervisors: Prof. Ove Tobias Gudmestad; Prof Franck Schoefs

Abstract: The structural design of offshore constructions is a complex process subject to various difficulties. The interaction with seawater flow is one of the more important ones. By the natural periodic nature of this motion, it tends to make submerged structures oscillate in different ways.

The most obvious resultant behavior is the rather slow oscillations caused directly by fluid pressure. A second level of concern is the assessment of vortex induced vibrations; a crossflow motion due to the alternative shedding of water particles.

The present work deals with related non-linearities and unexpected short-term behaviors. The experimental reference that is used is the Draugen platform. A monopile structure located in the Norwegian Sea for which data and testimonies were made available. The investigations detailed in this report consist in the proposal and analysis of original models inspired from literature and applied to an equivalent one degree of freedom oscillator.

The first part of this project deals with inflow non-linearities. The second part discusses crossflow behaviors such as galloping or stall flutter with examples of different approaches that can be brought by the apparent negative damping point of view.

44. Title: Geological settings, data evaluation and identification of criteria for drilling solutions in the Dreki offshore exploration area, Iceland

Author: Augusta Maren Jonsdottir (DTU exchange student)

Supervisors: Luise Joseffine Belmonte; Prof. Ove Tobias Gudmestad

Abstract: The goal of this thesis is to gather and evaluate existing data from the Icelandic offshore exploration area Dreki and to identify criteria for selecting an arctic drilling system concept. The functionality of the anchor drilling solution will be compared to the dynamic positioning (DP) one.

The thesis consists of two parts. The first one covers the tectonic history of the Jan Mayen micro continent (JMMC) and geology including the rifting history of the North Atlantic Ocean (NAO) and identification of potential sedimentary layers in the Dreki area. The close by basins of the JMMC are Haltenbanken basin (mid-West Norway), Vikingarben basin (Northern North Sea) and the Jameson Land basin (JLB) (East Greenland). There are well-known petroleum systems in the Haltenbanken basin and the Vikingarben where currently producing reservoirs exist. There are no producing wells in East Greenland. Therefore, the current knowledge of the Jameson Land basin will be covered to obtain knowledge on both sides of the JMMC. The logical question is if there are the same or similar geological data from the JLB that correlates to offshore Norway, why should it not be the same in between, in the JMMC including the Dreki area?

In the second part, the evaluation of the existing data from the Dreki area will be covered. The main question posed is, is there potential for oil and gas to be found in the Dreki area?

45. Title: Decision making and project management in a well overhaul program

Author: Yunfeng Fu

Supervisor: Prof. Ove Tobias Gudmestad

Abstract: When wells enter the ageing process they suffer several problems; sand production, tube corrosion, etc. At this point in time, work-overs are commonplace. In able to do so, a holistic project management method would be needed to ensure a solution. It would integrate time, budget and risk control. Meanwhile, decisions made by top managers play a big role. This paper discusses such decisions through the use of an example from a well overhaul in the Bohai Bay.

Firstly, costs and benefits must be analyzed. Secondly, an integral project management should be activated. Lastly, the paper would propose some advantageous strategies regarding project management for the effective implementation from the organizational structure, communication management, human resources disposition, safety and risk analysis and so on. In addition, the differences of management style between China and Western countries are discussed.

46. Title: Eastern-Mediterranean metocean design basis

Author: Rami Zughayar

Supervisors: Internal: Prof. Ove Tobias Gudmestad; Sverre Kristian Haver

Abstract: The Eastern Mediterranean has an enormous potential, it is estimated that there are 122 trillion cubic feet of undiscovered, technically recoverable natural gas volumes, as assessed by the USGS (2010). The area has seen increased activity recently and will continue to be an attractive option for drilling and pipe laying activities in years to come.

Therefore, this thesis attempts to capture the most important aspects of this phenomenon. The metocean design basis topic was selected due to it touching on both design and operation concepts in the offshore industry. It requires a special bundle of skills such as programming and application of statistical methods. It is a widely applicable topic, relevant knowledge and skills are required in the shipping industry, offshore wind turbine projects, coastal engineering and structural reliability studies.

47. Title: Assessment of technical building blocks for the development of Leningradskoe field in the Kara Sea

Author: Vadim E. Razhev

Supervisors: Internal: Prof. Ove Tobias Gudmestad; Prof. Muk Chen Ong; External Prof. Anatoly B. Zolotukhin (Gubkin University)

Abstract: The artic shelf is becoming more important as existing fields are depleting and the oil and gas industry is searching for new prospects of reserves. Meanwhile, it is supposed that Artic is a big pie for future development. The Leningradskoe field is located in the south-west of the Kara Sea. Thus, it is necessary to develop new technologies and concepts for artic offshore fields including this one.

There is no technical assessment of the development of Leningradskoe in the scientific literature. However, the expansion of operations in the artic region requires the development of new technologies and solutions that can cope with harsh physical conditions. Nowadays, some technologies are sufficiently proven to have high reliability and be ready to use in freezing waters. Nevertheless, there are still difficulties regarding the adaptation of such to artic waters.

This thesis focuses on the technology assessment of five major areas that are all crucial to the development of Leningradskoe. Drilling technical block, reservoir engineering, pipeline technical block, production technical block and technical block of logistics. An evaluation of the most important risks is performed in the Master thesis in the form of a "Bow Tie" analysis. The results are synthesized by organizing the R&D roadmap for the development of Leningradskoe.

48. Title: Udfordringer ved snøkrabbefangst med hensyn på risiko ved operasjoner på sjøen

Author: Andreas Jørgensen

Supervisors: Prof. Ove Tobias Gudmestad

Abstract: Central organs in the Norwegian fishing industry have mapped out the spreading of snow crabs in Norwegian waters. These come from Russian waters and make their way west across the border line. The Norwegian Marine Institute determined that they will settle in Svalbard in the following years.

Even if this species proves to be resilient to catching, they are a luxury item that is worthy of pursuing. Under current law, their hunting is regulated. It is estimated that these limitations will decrease in the next years.

This thesis has the objective of giving an overview of the risk picture pertaining snow crab catching. It also has the task to provide with measures to limit such risk. The results show large challenges regarding icing, communication, training and lack of search and rescue resources. At the same time, several feasible risk-reducing measures were clearly identified.

49. Title: Identification of challenges and hazards associated with cruise traffic and evacuation in the artic

Authors: Tord Nese; Raymond Dalsand

Supervisor: Prof. Ove Tobias Gudmestad

Abstract: Artic cruise tourism is gaining popularity. There is a need to better understand hazards that are connected with cruise traffic and evacuation in the Artic. The polar code tries to enhance the safety of persons travelling in polar waters by giving functional requirements to life-saving appliances. However, it is unclear what is needed to achieve the required functionality, and how existing life-saving appliances perform compared to the requirements in the Polar Code.

This thesis looks to present the challenges associated with cruise traffic in the artic. The main hazards related to evacuation in an artic environment and what the possible gaps are between the current life-saving appliances and the level of safety the polar code tries to ensure.

50. Title: The application of unmanned aerial vehicles for snow avalanche search and rescue

Author: Andreas Albrigtsen

Supervisor: Prof. Ove Tobias Gudmestad

Abstract: Snow avalanches claim in excess of 200 lives annually worldwide. Humans as a means of rescue are deemed as ineffective and can experience secondary avalanches, making such practice life threatening. Thus, the small-unmanned aerial vehicle (UAV) concepts has gained importance in recent years. It presents a simple and non-expensive approach to this problem.

The main challenges identified and discussed in this thesis are under categories of adverse meteorological conditions and technological challenges. The UAV platform was identified to be a sufficient carrier for electronic search devices. Some hazards

were identified due to UAV implementation but none is believed to pose an excessive risk.

51. Title: Assessment of the potential for condition monitoring at Jøssang Power Plant

Author: Ronny Steine

Supervisors: Internal: Prof. Tore Markeset; External: Arve Jakobsen, Lyse Produksjon AS

Abstract: Developments in maintenance have been significant in the last 100 years. Good maintenance can be distinguished by positive and negative financial results. This work is based on a case study of Jøssang Kraftverk with the objective to identify parameters that through monitoring will provide value in the form of reduced risk, costs and rise in employee satisfaction.

This thesis carried out several surveys by conducting interviews and polls. Hard data from literature was also utilized. The analysis shows that workers have good experience and are positive about learning more on these maintenance techniques. Several parameters including their most critical aspects are enlisted and suggested to be tracked to better the performance of the company.

52. Title: Drilling and completion challenges in the deepwater South China Sea – a case study of the Lufeng 22-1 oilfield

Author: Wangjun Hu

Supervisor: Prof. Tore Markeset

Abstract: The thesis provides background and basic information of the Deepwater operations both in the world and in the South China Sea. It gives the reader a comprehensive understanding of Deepwater operations. It then fully identifies its main challenges and problems within three aspects: environment conditions, facilities, and technologies.

The solutions and advice provided for some of the problems are enlisted as well as other study areas. At last, a case study of the successful development of the first Deepwater oilfield in the South China Sea (Lufeng 22-1 oilfield) is discussed. Inspirations and experiences are summarized in the and used as suggestions for other Deepwater operations in South China Sea.

53. Title: Criticality of service innovation in COSL's oil and gas business

Author: Gang Li

Supervisor: Prof. Tore Markeset

Abstract: The study focused on the major challenges that were making it impossible for COSL to achieve most of its goals and streamline its operations. Innovation in

services with a focus on COSL is another area of interest. Such innovation practices can play a major role towards supporting the performance of oil companies.

The obtained findings were critical towards ensuring the company refocused and realigned its commitment to clients through clearly defined and practiced service innovation practices. Such approaches will present quality findings that can be embraced to improve the major oil and gas operations.

54. Title: Failure analysis and inspection research of drill stem in oil and gas industry

Author: Hai Wen

Supervisor: Prof. Tore Markeset

Abstract: With the demand for oil and gas increased, and the development of oil and gas drilling technology so fast, the development of global oil and gas exploration has entered a deep well, ultra deep well and offshore deep water exploration and development era. Land and shallow sea oil and gas exploration degree now is high, oil and gas production has been close to the peak, therefore many country and big oil and gas multinational companies have turned to deep water search for oil and gas resources, and have got a series of major discovery and development. Due to the restriction and impact of the ocean drilling platform arrangement and cost, Offshore drilling widely used cluster well, directional well, horizontal well and large displacement technology, all these lead to drill stem under cyclic loading, and the working condition of drill stem become more and more bad. Due to the high cost of offshore drilling industry, the failure accident of drill stem will cause huge economic losses. Oil drill stems is the main tool for exploration and development of oil and gas, the failure accident of drill stem in oil and gas exploration will not only hindered the drilling speed and production, but also caused huge economic loss. The failure type of drill stem is given priority to fatigue failure, according to the research of the drilling contractor, there are about 50-60% fatigue failure in the total failure of drill stem. Therefore, the research of tool fatigue prediction will bring great significance for enhance drill stem management standards, establish a whole life cycle of drill stem, monitoring, evaluation and query, ensure the safety of drill stem quality and drill string, and reduce drilling cost.

55. Title: Appliace of dynamic positioning in offshore industry: The problems and feasible solutions

Author: Pengfei Zhou

Supervisor: Prof. Tore Markeset

Abstract: Dynamic positioning systems (DP) applied offshore increase the safety of operations; and make many critical operations possible. Thanks to DP, offshore supply vessels could continuously be alongside rigs for days even weeks; subsea operations like trenching and BOP installing could reach accurate track and position; drilling and pipe laying could be implemented in the water depth deep to three

thousand meters. But the reliability of DP system depends on other subsystems (the DP control systems, position reference system, power system, propulsion system, etc.); and the safety of DP operations relies on the reliability of DP system, engine and power systems, external environment and the operator. So many elements affect the safety of DP operation, which makes the appliance of DP vulnerable. Risks always associates with DP operation and accident happens. In this thesis, we are going to discuss the problems existing with the DP application and the control measures taken in practice.

The discussions in this thesis are based on working experience and study on the relative articles, publications; and aimed to give readers an overview on DP system and the problems with the use of this system in practice; as well as some solutions to these problems.

56. Title: Waste heat recovery potential evaluation of a combined cycle and organic rankine cycle by integrating desalination process

Author: Ha Jaechul

Supervisor: Prof. Mohsen Assadi

Abstract: Restricted

57. Title: Risikobasert tilsyn i Oslo- brann og redningsetat: En studie av utfordringene i implementeringen av risikobasert tilsyn med særskilte brannobjekter

Authors: Øyvind Flengsli Pedersen; Ruben Roaldsø

Supervisor: Prof. Preben H. Lindøe

Abstract: The requirements that fire fighters have to use as a reference in fire sensitive objects change constantly due to new regulations. Demands regarding fix supervision intervals have stopped and been replaced with risk-based ones.

This means that fire departments must evaluate the risk and prioritize their activities themselves. In this work, the development of the praxis is researched, particularly in the Oslo fire department.

58. Title: En studie av læring mellom petroleumsvirksomheten og offentlig sektor når det gjelder risikoutsatte grupper (RUG)

Author: Kari Gro Haakestad

Supervisor: Prof. Preben H. Lindøe

Abstract: The objective of the thesis is to take a further look into the learning between the petroleum industry and the public sector regarding vulnerable groups.

The background for the selection is that the petroleum safety authority has had vulnerable groups since 2007 as a priority. Therefore, this organism has developed relevant experiences in the improvement of vulnerable group management.

A case study with a qualitative approach is used to obtain answers for this work's issue at hand. The Stavanger region has been used as a case with a comparative perspective. Data gathering has been possible due to document studies regarding vulnerable groups.

59. Title: Optimal design for projectile and blast protection during pressure testing

Author: Eirik Storhaug

Supervisors: Internal: Prof. Hirpa G. Lemu; External: Arne B. Nysæther

Abstract: The thesis identifies the main hazards in hydrostatic pressure testing as pressure wave, water jet, burst of water hose, fragment and projectile discharge as well as ejection of plug or end section.

A test, where a pressurized vessel ejected a projectile, was conducted as part of the thesis. The aim of this test was to find the relationship between potential energy inside pressure vessel and kinetic energy in a discharged projectile. The results showed that the Baker formula together with the elastic energy of the expanded pipe, gave a good representation of the kinetic energy.

Based on the results from the test, a risk analysis concerning pressure testing at TDW is made. The analysis involves hazards assessment through calculations. Existing safety walls are analyzed and mediating measures to lower the risk to an acceptable level are proposed.

60. Title: Structural health monitoring of offshore jackets

Author: Herman Vestli

Supervisors: Internal: Prof. Hirpa G. Lemu; External: Bjørn Thomas Svendsen and Ole Gabrielsen

Abstract: The aim of what is reported is to explore how developments within SHM can be applied as a tool for assessing the structural integrity of offshore jackets. More specifically develop a proposal for monitoring an existing jacket in a cost-effective manner. New research has been evaluated concerning both local and global damage detection methods. The suitability of combining those two methods is investigated. The work done in this thesis was primarily based on available articles and conference papers. This thesis covers a literature survey of SHM in general and for jacket structures, including a proposed methodology describing how to set up a monitoring system on an offshore jacket structure. This methodology is thereafter implemented and used to design a monitoring system for a fictional platform on the Norwegian Continental Shelf (NCS).

It is concluded that due to increased research there is possible to make more cost effective and more robust SHM systems in the near future. However, even though

there is an increased research effort in SHM of offshore jacket structures, real experiments have to be done to verify their applicability. In addition, it should be focused on further development and tests regarding measurement methods and sensor technologies.

61. Title: [Functionality risks associated with dimensional, geometrical and strength deviations in 3D printed parts.](#)

Author: Adugna D. Akessa

Supervisor: Prof. Hirpa G. Lemu

Abstract: Restricted

62. Title: [Contact stress and temperature variation analysis of Bondura bolts, numerical and experimental study.](#)

Author: Imad Berkani

Supervisors: Internal: Prof. Hirpa G. Lemu; External: Øyvind Karlsen

Abstract: Restricted

63. Title: [Evaluation of fatigue in single sided x – joint welds on Oseberg UWP](#)

Author: Breivik, Simon Palviainen

Supervisor: Prof. Dimitrios Pavlou; External: Bjørn Melhus, Kværner Jacket Technology

Abstract: This report assesses the challenges regarding fatigue calculations on the inside of a single sided weld on the Oseberg UWP. SN – fatigue and FM – fatigue calculations are performed on two different models to establish a foundation/basis for evaluation of the inside.

Model one is a beam model used to identify the most critical joint on the Oseberg UWP. Model two is a FE – model of the critical joint identified. A comparison of the fatigue results from the two models provided a good foundation/basis for evaluating the inside of the single sided weld.

The calculated fatigue life on the outside of the single sided weld is 447 years using FE - fatigue. With a DFF of 3,0 this correspond to a design life of 149 years. For the inside of the single sided weld with a DFF of 10,0 to have the same safety level as the outside, the inside fatigue life is calculated to be 1490 years which correspond to a design life of 149 years.

Following the procedure described in standard DNVGL – RP – C203 using a W3 – curve the calculated fatigue life is only 263 years, which differ significant from the FM – fatigue results. Therefore there is a belief that the procedure is too conservative and a parameter study based on the approach in this report is recommended for further work.

64. Title: Water Hammer Induced Vibration of Steel Pipelines Repaired with FRP Composites

Author: Rege, Kristen

Supervisor: Prof. Dimitrios Pavlou

Abstract: Since the 1990s, there has been an increasing trend to repair corroded or eroded pipelines, conveying oil, gas or water, by using fibre-reinforced polymer (FRP) composites. This relatively new repair technique involves wrapping the corroded part of the pipeline with a so-called FRP overwrap. FRP materials are lightweight, have high relative strength and do not corrode, which makes them an effective repair solution.

The viability of this repair technique has been proved by the numerous research programs performed. However, most of the literature regarding the design of FRP overwraps does only consider a static internal pressure. In this thesis, the behavior of steel pipelines, repaired with FRP overwraps, subjected to water hammer conditions, has been investigated. An approximate dynamic model, describing the radial vibration of steel pipes with a FRP overwrap, due to water hammer conditions, has been derived.

65. Title: Transforming a Norwegian Landscape into an Iconic Tourist Attraction: The Trolltunga Experience

Author: Anouk Evers

Supervisor/s: Jens Kristian Steen Jacobsen; Øystein Jensen; Prof. Reidar Mykletun

Abstract: Trolltunga; one of Norway's iconic tourist attractions, has experienced an exponential increase in visitation from only a few, to thousands of visitors. Famous for its viewpoint cliff, reaching the cliff, however, is coupled to a total nine-hour hiking journey. It has been argued a person depicted on the edge of a dangerous cliff confronted with his mortality, is not regarded unique to our time. Such images do seem to generate a rather strong interest to today's traveler. Trolltunga not only appeals to experienced hikers but also draws in large groups of "first time" and less experienced visitors. Tourist attractions as Trolltunga are of key importance to tourist destinations as they attract high tourist flows. Sustaining positive experiences at such sites and developing a better understanding of the tourist experience is imperative for destinations. This study has aimed to develop a better understanding by means of exploring the tourist experience at Trolltunga. From a dynamic perspective, the visual experience by means of sightseeing and the physical experience of hiking have been analyzed. This paper presents unique insights of 139 tourists' experiences and viewpoints. On-site data sources include in-person interviews, observations, and photographic collections. Results have shown hiking was mainly experienced negative in terms of challenging and too long with feelings of fear and frustration. Sightseeing however, was experienced as sublime. This paper argues it is not the physical, but the visual as the central and positive aspect of the experience, and main driver of visitation. Results of this study agree with previous works in the

literature, arguing for the “centrality of the visual” in tourism. This paper provides practical managerial implications based on study results and discussions.

66. Title: A Reduced Order Model for Fast Production Prediction from an Oil Reservoir with a Gas Cap

Author: Yichen Yang

Supervisor: Prof. Reidar B. Bratvold

Abstract: Economic evaluations are essential inputs for oil and gas field development decisions. These evaluations are critically dependent on the unbiased assessment of uncertainty in the future oil and gas production from wells. However, many production prediction techniques come at significant computational costs, as they often require a very large number of highly detailed grid based reservoir simulations.

In this study, we present an alternative compelling and efficient approach to assess the impact of reserves uncertainty on the oil and gas production from an oil reservoir with a gas cap. The justification for using the reduced order (less detailed) model to assess possible future production is that, for many decisions, it is more important to capture the uncertainties in the production than the production impact of the detailed characteristics of the reservoir in question. The computational costs of the reduced order model presented in this work is small relative to a typical grid based simulator which makes it possible to assess production uncertainties by using Monte Carlo simulation with a large number of iterations.

The approach in this study is developed in MATLAB and easy to modify and extend, so it can be applied to other gas cap fields and combined with cash flow model to help the decision maker design specific development and production plans and maximize the overall value of the field.