Faculty of Science and Technology

MASTER'S THESIS

Study program/Specialisation: Industrial Economics	Spring semester, 2016 Open / ~~Restricted access~~
Writer: **Thomas R. Skutle**	…… (Writer's signature)
Faculty supervisor: **Frank Asche** External supervisor(s): **Edward McBarnet**	
Thesis title: **Risk Culture and Processes: An Analysis of OneSubsea M&MS**	
Credits (ECTS): **30**	
Key words: Risk Risk Culture Risk Management Risk Management Process Risk Maturity	Pages: **48** + enclosure: **51** Stavanger: **15.06.2016** Date/year

“The first step in the risk management process is to acknowledge the reality of risk. Denial is a common tactic that substitutes deliberate ignorance for thoughtful planning”

Charles Tremper

Project Risk Management

Risk Culture and Processes: An Analysis of OneSubsea M&MS

By

Thomas Skutle
Master Thesis in Industrial Economics
Stavanger 2016

Faculty of Science and Technology
Institute for Industrial Economics, Risk Management and Planning
Thesis Supervisor: Frank Asche

“Risk Management is about people and processes not about models and technology”

Trevor Levine

EXECUTIVE SUMMARY

This paper set out to identify and evaluate the risk management tools and processes currently being used by M&MS and if possible obtain an understanding of the overall risk culture in the organization. The research method consisted mainly of document review and a questionnaire, but also enquiries directly to key personnel within OneSubsea pr. email and live chat.
The findings indicate that the culture of risk management in M&MS is somewhat underdeveloped. There is no broad use of the risk management tools and the knowledge regarding them and the risk management process is not sufficient.
There is no clearly defined risk management policy. For any risk management initiative to succeed it is important that the objectives, and what they aim to achieve, are clearly identified and understood by the entire organization.

The survey revealed that as little as 22% of the organization incorporates the operations manual for risk management, OM-0011, in risk management activities during projects. The use of risk management tools, Risk Register and Risk Heat Map is also fairly low, not as low as the utilization of the process but still too low. Almost 40% of the respondents have never used any of the RM tools, and as little as 16% stated that they were familiar with both tools. The overall the knowledge level of the organization on the subject of risk management is not sufficient. It is prudent to ask if the training of risk management has not had a high enough priority through the history of the M&MS department. The demographic of the survey indicates that the M&MS is an organization with many experienced individuals with almost 50% of them having been with the department for more than 6 years. As little as 13% had only been around for 2 years or less. Despite being a very experienced organization almost 60% stated that they had never received any form of risk management training. Only 3% had completed both e-learning and classroom training. Interestingly there is significantly higher risk awareness amongst the group that have completed the classroom course compared to the group that only have completed the e-learning.

Areas M&MS need to improve were identified. There is a need to achieve a common understanding of risks and raise the collective risk awareness. This will improve the risk culture in the organization and enable M&MS to gain the full benefits of risk management. They have to develop or adopt a risk management policy. The OneSubsea risk management team is currently reviewing the OM-0011 process. This revision will also have to include the process for lower category projects for it to be useful to M&MS. The use of the current RM tools should also be reviewed to ensure that they provide the intended results.

The overall impression is that M&MS have implemented many of the principles for good risk management. There are however several weaknesses and the potential for improvements are substantial.

“Risk management should be an enterprise-wide exercise and engrained in the business culture of the organization.”

Julie Dickson

PREFACE

This report represents the end of my two-year master´s program in Industrial Economics at the University of Stavanger, Faculty of Science and Technology, where I have had a specialization towards contract strategy and risk analysis -and management.
The report was written during the final semester in the months between February and June 2016.

In parallel with my studies at the University of Stavanger I have been working full time as a field engineer for OneSubsea. The juggling of a demanding master's program and a full time job that entail several assignments both onshore and offshore around the world have been challenging at times, but it has also provided me with valuable knowledge of the oil and gas industry and different cultures around the world.

I would like to express my gratitude to all the people who have supported me and provided input throughout this process. Their thoughts and deliberations have helped a great deal in my writing. Special recognition goes to my brother Anders who has assisted in proofreading and to my supervisor at UiS Frank Asche who has helped guiding me in the right direction and provided valuable feedback.

Stavanger 15th of June 2016

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

CAPEX	–	Capital Expenditure
CAM	–	Cameron
CRITER	–	Cameron Risk Tracker
E&P	–	Exploration & Production
FE	–	Framo Engineering AS
FEL	–	Front End Loading
FMECA	–	Failure Mode, Effect and Criticality Analysis
HAZID	–	Hazard Identification
HAZOP	–	Hazard & Operability Study
HSE	–	Health, Safety & Environment
ISO	–	International Organization for Standardization
M&MS	–	Multiphase Meters & Measurement Systems
MPFM	–	Multiphase Flow Meter
NYSE	–	New York Stock Exchange
OM	–	Operation Manual
OSS	–	OneSubsea
P&SP	–	Pumps & Subsea Processing
PRM	–	Project Risk Management
RHM	–	Risk Heat Map
RMF	–	Risk Management Framework
RMM	–	Risk Maturity Model
RR	–	Risk Register
SLB	–	Schlumberger
SPLC	–	Subsea Project Life Cycle

1. INTRODUCTION

Since the end of 2014 the oil price has plummeted to a level not seen since the early 2000´s as can be seen in figure 1.1. As a consequence of the recent market turndown, service providers to the oil and gas industry are experiencing an increasingly challenging business environment as the E&P companies are restricting their investments and put new developments on hold. Global E&P CAPEX fell by 23% in 2015 and is by Barclay´s[1] expected to decline a further 15-20% in 2016, for the first time since 1986-1987 we have a negative growth in the annual spending for two consecutive years. To comparison, after the global financial crisis of 2008 E&P CAPEX spending fell by 14% for the year 2009.

Competition for new contracts is fiercer than ever and margins are under pressure. Several third party suppliers have had to reduce their workforce due to the lack of new assignments and contracts. This necessitates a closer look at the production chain as control of all aspects of the various deliveries become increasingly important in such a competitive environment. Being able to deliver a successful project, on schedule and cost with the agreed upon quality, requires good project management and a high level of control. In this respect having a well-functioning and efficient risk management system in place is crucial as it enables you to identify potential risks and introduce the necessary measures in time. It also needs to be done properly with the correct amount of commitment and structure.

Figure 1.1 - Brent Spot (Source: Tradingeconomics.com)

In light of these market conditions this thesis aims to identify and document the current risk management system and the risk culture within a department of a contractor company. The goal is to identify a set of distinct areas of improvement that can contribute to enhancing the risk management system and the efficiency of the department. This may in turn contribute to maintaining and even improving the profitability of contracts awarded. The thesis will be limited to reviewing one department and will not evaluate the company as a whole.

2. THE COMPANY

2.1 OneSubsea

OneSubsea is a subsea contractor that delivers integrated solutions, products, systems and services for the oil and gas market.
OneSubsea was created in 2013 as a joint venture between Schlumberger (NYSE: SLB) and Cameron (NYSE: CAM). This joint venture enables OneSubsea to leverage Cameron's flow control expertise, process technologies and world-class manufacturing and aftermarket capabilities, along with Schlumberger's petro-technical leadership, reservoir and production technology, and R&D capabilities.

OneSubsea currently has more than 6,000 employees in over 23 countries operating in six divisions - Integrated Solutions, Production Systems, Processing Systems, Control Systems, Swivel and Marine Systems, and Subsea Services – that provide products and services to oil and gas operators around the world. (Source: www.cameron.slb.com/onesubsea/)

During the process of writing this thesis the acquisition of Cameron by Schlumberger was finalized, Cameron (and thereunder OneSubsea) is now a sub-division of Schlumberger.

2.2 Processing Systems

The Processing System division of OneSubsea is located in Bergen, Norway. This division is a former Schlumberger company, Framo Engineering AS, acquired by Schlumberger in 2012. Framo Engineering AS and now the Processing Systems division consist of two main business areas, Pumps and Subsea Processing Systems (P&SP) and Multiphase Meters and Measurements Systems (M&MS). Swivel and marine systems a former Framo Engineering division is now a separate division within OneSubsea, Swivel and Marine Systems. The P&SP and M&MS organizations operated as two separate business units when within FE. P&SP deliver subsea boosting infrastructure for increased oil recovery, these projects represent a high CAPEX for the clients due to their complexity and scope. M&MS on the other hand deliver a more standardized product that is usually part of a larger system, for instance a P&SP delivery may include MPFMs delivered by M&MS.

2.2.1 M&MS

The history of M&MS dates back to 1988 when Framo Engineering AS conducted testing of a flow mixer in combination with a dual energy gamma spectrometer. The results from these

tests were satisfactory and a joint industry program with several different oil companies was launched. Early in the nineties further tests using a mixer, venturi and gamma spectrometer using a Barium 133 source yielded promising results and the development of a commercial multiphase meter continued. The first topside multiphase flow meter was delivered in 1995, a subsea application was delivered a few years later. This meter was known as the Framo Multiphase Flow Meter.

In 1997 Schlumberger reached out to FE as they were developing their own multiphase flow meter on a similar concept. SLB planned to use their MPFM for portable topside well testing, they intended to replace the current practice of portable test separators. In 1998 FE and SLB came together to create a company, 3-Phase Measurements AS (3PM). 3PM should produce and further develop the multiphase technology for three markets, portable topside testing for SLB, permanent installation both topside and subsea.
FE had the worldwide subsea market and topside market in the North Sea, and SLB had rest of the worlds topside market and the portable testing market. The business model was that 3PM developed, produced and delivered the MPFMs to FE and SLB that sold these to the end client.
The Vx-technology was launched around year 2000 as a new generation MPFM. The Vx is based on the early technology developments at FE and SLB. This is the technology used for today's MPFMs delivered by M&MS.

3PM grew from having 9 employees in the early beginning of 1998 to an organization consisting of 140 people in 2012 when 3PM officially were liquidated after SLB acquisition of FE. Since 2013 with the creation of OneSubsea the subsea MPFMs are the responsibility of the M&MS organization located in Bergen, Norway. The topside MPFMs are manufactured by a new SLB "Product Centre" in Singapore.

All in all approximately a total of 650 subsea -and 2000 topside MPFMs have been sold worldwide since the start-up of 3PM in 1998. (Source: former General Manager of 3PM)

Figure 2.1 - OneSubsea Subsea Multiphase Flow Meter (Source: OSS)

3. METHODOLOGY

This chapter will describe research methods and how data was collected and utilized for this thesis. The theoretical foundation is based on Kothari, 2004.

3.1 Research Approaches

There are two basic approaches to research, quantitative approach and the qualitative approach. The first involves generation of data in quantitative form witch can be subjected to rigorous quantitative analysis. The quantitative approach can further be sub-classified into inferential, experimental and simulation approaches (Kothari, 2004, p.5).

Inferential approach which purpose is to form a database from which the aim is to infer characteristics or relationships of a population. This is usually survey research where a sample of population is studied (questioned or observed) to determine its characteristics.

Experimental approach is characterised by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables.

Simulation approach involves the construction of an artificial environment within which relevant information and data can be generated. The term simulation in the context of business and social science refers to “the operation of a numerical model that represents the structure of a dynamic process.

The *qualitative* approach is the subjective assessment of attitudes, opinions and behaviour. The research is a function of the researchers’ insights and impressions, the results are either in a non-quantitative form or in the form which is not subjected to rigorous quantitative analysis. Techniques such as, but not limited to, observation and interviews can be used.

In this paper a combination of the two approaches will be used. To collect data from a large sample size a questionnaire will be used, this is the quantitative part of the research, the inferential quantitative approach. The qualitative aspect is the content analysis and the authors’ subjective assessment of attitudes, opinion and behaviour observed during the process of writing this report.

3.2 Collection of Data

When the objective of the research is defined the collection of data begins. When dealing with any real life problem it is often found that data at hand are inadequate and it therefore becomes necessary to collect more data on the subject. Several methods can be used but

as mentioned above the basis for the analysis in this thesis will mainly consist of the data collected from a questionnaire and the review of information available.

3.2.1 Content analysis

Content analysis consists of analysing the contents of documentary materials such as books, documents and the contents of all other verbal materials that can either be spoken or printed (Kothari, 2004, p. 110). In this report various risk management documents and procedures have been analysed which in turn have contributed to the final analysis and discussion.

3.2.2 Questionnaires

A questionnaire provides an efficient way of collecting relevant data from a large sample size. The questionnaire must be carefully prepared to ensure it proves efficient in collecting the relevant information. If it is not properly set up, then the survey is bound to fail (Kothari, 2004, p. 101).

To ensure a good result the questionnaire was constructed on the general form following the principles laid out by Kothari (2004, p. 118). A combination of closed questions where the respondents chose a reply from a given set of alternatives and open questions where the respondents are encouraged to come with their own response were given. The length of the survey was kept as short as possible while still being able to provide the necessary amount of data.

This way of collecting data has many positives, but also a couple of demerits it is important to be aware of. According to Kothari (2004, p. 101) there are 7 demerits to be aware of, I will highlight four of them here:

- Low rate of return of the duly filled in questionnaires; bias due to no response is often indeterminate
- There is inbuilt inflexibility because of the difficulty of amending the approach once the questionnaire has been dispatched.
- The possibility of ambiguous replies or omission of replies altogether to certain questions; interpretation of omissions is difficult.
- It is difficult to know whether willing respondents are truly representative

These are all things one has to be aware of when conducting a survey and evaluating the data collected. However it is also something one does not have much influence over other than preparing the survey thoroughly and having a sufficient sample size.

Before sending out the questionnaire to the M&MS department it was first sent to the management team for review and comments, afterwards it was distributed to the entire organization per email.

There are many different questionnaire providers online. I found the one provided by Google was the best fit, it is a free service which does not set any limitations on number of questions was can ask or the number of respondents. However this solution meant that I did not have any form of registration of the people leaving a reply, there is no way of controlling if one person left several replies. I do not believe this has been an issue as the survey was distributed to a department consisting of highly educated professionals with no motive for manipulating the results.

The full questionnaire can be found in the appendix.

3.2.3 Live chat

As an employee of OneSubsea I have access to the company's intranet and intra-company chat software, Microsoft Lync, both from my office and from home. This provides me with a great opportunity since as long as I am online, everyone in the company is accessible instantly. This means that if a question arises during the process of writing the report the person who may be able to clarify is just a mouse click away. It also enables me to ask follow up questions to key personnel as my knowledge about the subject investigated evolves.

4. THEORETICAL FOUNDATION

To ensure a common understanding of key concepts the following definitions and perspectives have been established. The following definitions and perspectives are selected by the author and are based on Aven 2008, Aven 2012, Hopkin 2012 and the ISO 31000.

4.1 Risk

Risk is related to future events A and their consequences (outcomes) C. If these events occur or not, and what the consequences will be if they do is unknown, e.g. there is uncertainty U associated with both A and C. The likelihood of event A occurring is expressed by a probability P, which is based on our background knowledge at the time K. (Aven, 2008, p.17)

Therefor risk should be expressed by (A, C, U, P, K) where
A = potential future events
C = potential consequences of these events
U = uncertainty associated with A and C
P = analysts probability for C given K
K = background knowledge the assessment is based on

4.1.1 Probability

The probability of an event A, P (A), can be defined in different ways. It is common to distinguish between three types of probabilities (Aven, 2012, p. 165):

- Classical – a finite number of outcomes that are equally likely to occur (rolling of a die)
- Relative frequency – fraction of time the event A occurs if the situation is considered repeated an infinite number of times
- Subjective / Knowledge-based – probability assigned by the assessor based on his / hers background knowledge.

In this report the knowledge-based probability will be the one referred to unless otherwise stated.

4.2 Risk Management

Risk management is defined as all measures and activities carried out to manage risk. Risk management deals with balancing the conflicts inherent in exploring opportunities on the one hand and avoiding losses, accidents and disasters on the other (Aven, 2008, p. 6).

Risk management relates to all activities, conditions and events that can affect the organization, and its ability to reach the organization´s goals and vision. In many enterprises, the risk management task is divided into three main categories, which are management of:

- Strategic risk, e.g. mergers, acquisition, technology, competition
- Financial risk, e.g. market risk, credit risk, liquidity risk
- Operational risk, e.g. accidental events, intended acts, loss of competence

Figure 4.1 shows the process of risk management as described in the ISO 31000. The descriptions below are taken from or based on ISO 31000 unless otherwise noted.

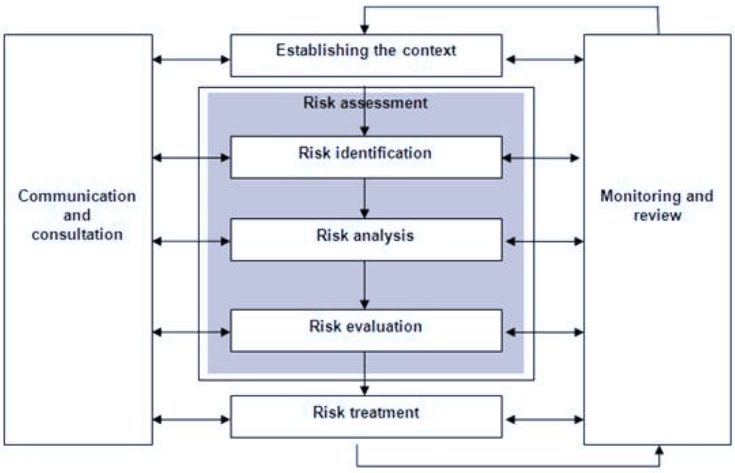


Figure 4.1 - The risk management process (ISO 31000)

4.2.1 Establishing the context

By establishing the context the organization defines the internal and external parameters to be taken into account when managing risk, and set the scope and risk criteria for the remaining process.

External context is the external environment in with the organization seeks to achieve its objective, this can include, but not limited to, the cultural, political, legal, regulatory, technological, natural and competitive environment, key drivers and trends having impact on the objectives of the organization and perceptions and values of external stakeholders.

Internal context is anything within the organization that can influence the way in which an organization will manage risk. The process should also be in alignment with the culture, strategy and structure for the company.

4.2.2 Risk identification

Identification of risk sources, areas of impacts, events and their causes and their potential consequences. The aim of this step is to generate a comprehensive list of risks based on those events that might enhance, prevent, degrade or delay the achievement of the objectives. It is also important to identify risks associated with not pursuing an opportunity.

4.2.3 Risk analysis

Risk analysis is about developing an understanding of the risks and provides an input to risk evaluation and future decisions. Risk analysis involves consideration of the causes and sources of risk, their positive and negative consequences, and the likelihood that those consequences can occur. The three types of analysis methods can be seen in table 7.1 below.

Table 4.1 - Main categories of risk analysis methods (Aven, 2008, p.4)

Main category	Type of analysis	Description
Simplified risk analysis	Qualitative	Simplified risk analysis is an informal procedure that establishes the risk picture using brainstorming session and group discussion. The risk might be presented on a coarse scale, e.g. low, moderate or large, making no use of formalised risk analysis methods.
Standard risk analysis	Qualitative or quantitative	Standard risk analysis is a more formalised procedure in which recognised risk analysis methods are used, such as HAZOP and coarse risk analysis, to name a few. Risk matrices are often used to present the results
Model-based risk analysis	Primarily quantitative	Model-based risk analysis makes use of techniques such as event tree analysis and fault tree analysis to calculate risk.

4.2.4 Risk evaluation

Based on the outcome of the analysis, the risk evaluation assists in making decisions regarding risk prioritization and the treatment of analysed risks. It involves comparing the level of risk found during the analysis process with risk criteria established when the context was considered. If the risk does not meet the risk acceptance criteria, the risk is treated further.

4.2.5 Risk treatment

Risk treatment involves selecting one or more options for modifying risks, and implementing those options. These options are not necessarily mutually exclusive or appropriate in all circumstances.

Table 4.2 – Risk treatment methods (ISO 31000)

Approach	Action	Objective
Eliminate	Re-plan or re-design	Reduce probability
Mitigate	Actions taken to reduce or mitigate risk	Reduce probability
Transfer	Sharing the risk with another party	Reduce consequence
Accept	Retaining the risk by choice.	Reduce consequence
Avoid	Decision not to start or continue the activity	-

4.2.6 Communication and consultation

Communication and consultation with internal and external stakeholders should take place throughout the process to gain input to the process and achieve ownership of the outputs.

4.2.7 Monitoring and review

This should be a planned part of the risk management process. The responsibilities for monitoring and review should be clearly defined.

4.2.8 Risk Management Framework

To be successful, risk management should function within a risk management framework (RMF) that provides the foundations and organizational arrangements that will embed it through the organization at all levels. The RMF is not meant to describe a management system, but to assist the organization to integrate risk management within its overall management system.

4.3 Risk Culture

The culture of an organization is often hard to define, however it is generally accepted that it is a reflection of the overall attitude of every component of management within the organization. It can be described as how individuals behave, feel obligated, commitment, awareness and their attitudes towards various aspects of their professional life.
A good risk culture is vital for risk management to be effective, it will be the product of individual and group values and of attitudes and patterns of behaviour. Such a culture can be achieved by focusing on five factors: Leadership, Involvement, Learning, Accountability and Communication, LILAC (Hopkin, 2012, p. 110).

Table 4.3 – Five factors of a risk aware culture

LILAC	
Leadership	Strong leadership within the organization in relation of strategy, projects and operations
Involvement	Involvement of all stakeholders in all stages of the risk management process
Learning	Emphasis on training in risk management procedures and learning from events
Accountability	Absence of an automatic blame culture, but appropriate accountability for actions
Communication	Communication and openness on all risk management issues and the lessons learnt

4.4 Benefits of Risk Management

The successful implementation of risk management gives a range of benefits. Hopkin (2012, p. 51) summarize these benefits under the acronym CADE3 – compliance, assurance, decision making and efficient operations/effective processes/efficacious strategy.

Compliance refers to risk management activities designed to ensure that an organization complies with legal and regulatory obligations.

Assurance that significant risks have been identified and appropriate controls put in place to the board of the organization.

Decision making assisted by structured information gained from the undertaking of risk management activities.

E3 – risk management will enhance the efficiency of operations within the organization, help ensure that business processes are effective and that the selected strategy is efficacious, meaning that it is capable of delivering exactly what is required.

Finally, in order to achieve a successful risk management contribution, the intended benefits of any risk management initiative have to be identified. If no benefits have not been identified it becomes challenging to evaluate to what extent risk management initiative have been successful.

5. PROJECT EXECUTION IN ONESUBSEA

The Subsea Project Life Cycle (SPLC) defines project execution in OneSubsea, figure 5.1. The SPLC is a combination of groups, stages, phases and gates. Project progress is managed by a stage gate model, each phase is closed / started at a stage gate. The stage gates give each project phase a defined start and end. (Source: OSS RSK1)

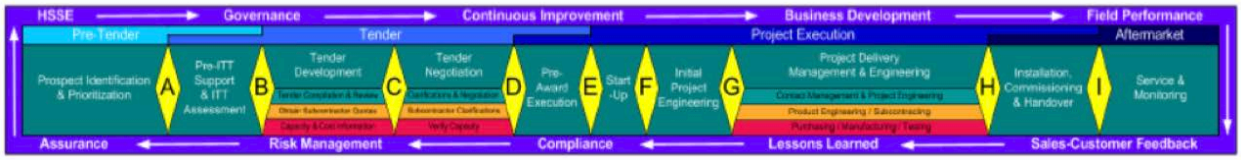


Figure 5.1 - Subsea Project Life Cycle (Source: OSS)

5.1 Groups

The project groups show which department / teams that are involved in the various stages of the project, figure 5.2.

Figure 5.2 - Project Groups (Source: OSS)

5.2 Stages

The stages show the various stages in the project life cycle, figure 5.3.

Figure 5.3 - Project Stages (Source: OSS)

5.3 Phases

The phases gives a more detailed view of the activities included in the various project stages, figure 5.4.

Figure 5.4 – Project Phases (Source: OSS)

5.4 Gates

The stage gates are the decision points in the project, where the decision to go forward is made. Each of the gates has a criterion that has to be made before the project continues. The gates in the SPLC can be found in figure 5.5.

Figure 5.5 – Project Stage Gates (Source: OSS)

5.5 Typical Project Organization OneSubsea M&MS

A typical project organization of an external delivery project in M&MS can be seen in figure 5.6 below. The Risk Management resource is available as a support function similar to how document control and planning. Whereas the other support functions are resources within the M&MS organization, the RM resource is taken from the P&SP organization. M&MS does not have a dedicated risk management resource.

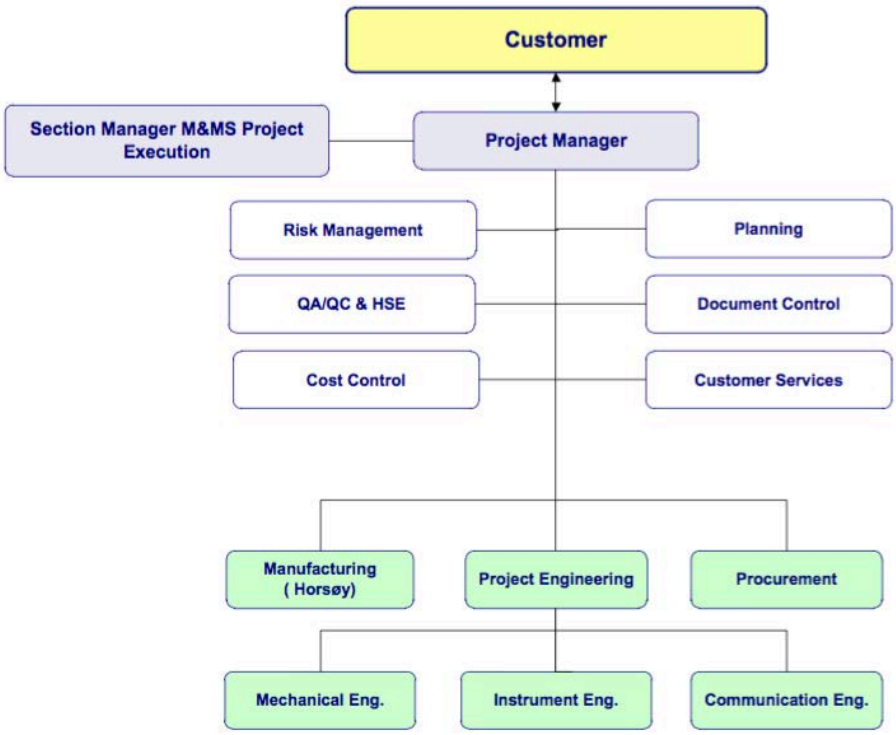


Figure 5.6 – Typical M&MS Project Organization (Source: OSS)

6. PROJECT RISK MANAGEMENT IN ONESUBSEA

This chapter will present the current risk management process as described in *OM-0011_Risk Management Rev.A.* All figures in chapter 6 - 6.1 are taken from this document.

The OM-0011 is based on an iterative process within each project. The project risk management and experience transfer cycle is illustrated in figure 6.1 and figure 6.2.
The OneSubsea risk management team is currently reviewing the OM-0011. This thesis will use revision A as basis for discussions unless otherwise stated.

Figure 6.1 – OneSubsea Project Risk Management Cycle

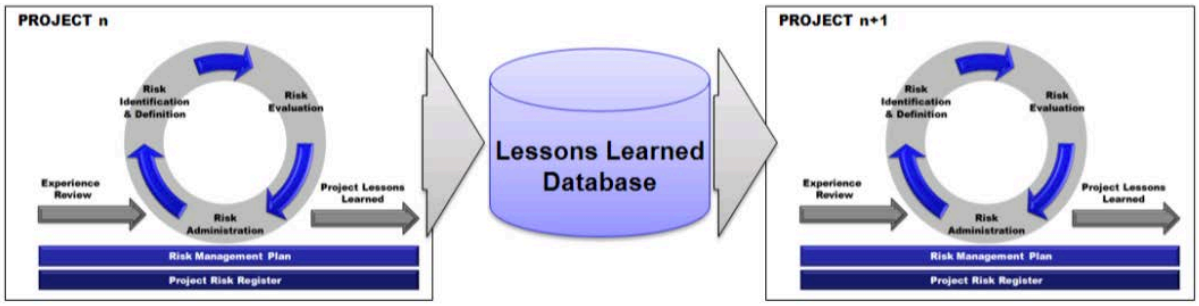


Figure 6.2 – Experience Transfer between projects

6.1 Risk Management Process

The Risk Management Process governs the activities of risk management within each project. The purpose of this process is to standardize a set of activities which enables identification, evaluation and administration of risks, definition and follow-up of risk mitigating actions, monitoring and reporting of project related risks, and ensure transfer of experience from one project to another. The process for risk management as described in OM-0011 is illustrated in figure 6.3.

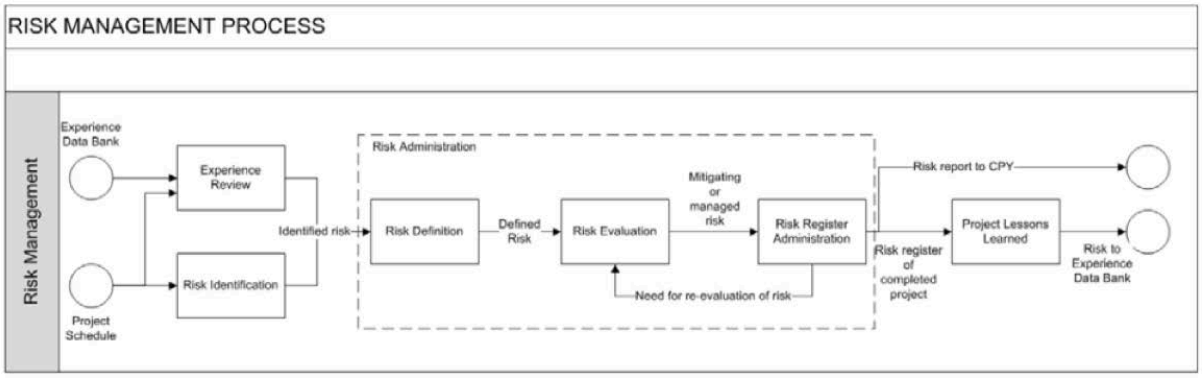


Figure 6.3 – OneSubsea Risk Management Process

The process starts with transferring experience from previous projects. This provides the foundation of the risk register of the project. During the project several risk identification activities should be conducted. The outcome of these sessions will be identified and defined risks, which will be prioritized based on an assessment of consequence and likelihood of occurrence during the Risk Evaluation process.

All useful experience from identified and treated risks in the risk management process of a project should be identified during the project lessons learned process at the end of each project.

6.1.1 Experience review

At the start of each project, an experience review workshop should be conducted. This workshop should go through the identified risks in the lesson learned database from previous similar projects, including identified risks from earlier project phases, such as feasibility and FEED.

6.1.2 Risk identification

Risk identification consists of a variety of activities.

Project Risk Review – sessions shall be conducted at the start-up and with suitable intervals during the project life. This to systematically evaluate every aspect of the project in relation to schedule and cost risks.

HAZOP – The basis for this study is normally the P&ID. During this session project expertise and external expertise focus on the system along formalized lines guided by a HAZOP chairman. The objective is to detect latent failures or hazardous interactions and to identify areas for safety and operability improvements. Operation Manual 0009 (OM-0009) defines the methods and circumstances by which a formal HAZOP is performed and documented.

HAZID – The objective is to identify potential hazards or risks inherit in a specific design, process or operation. The identified hazard may lie internally in the system design, process or operations or within external processes or operations. Operation Manual 10 (OM-0010) outlines the minimum requirements for HAZID workshops and hazard follow up.

Figure 6.4 – HAZID step-by-step process

FMECA – Failure Mode, Effect and Criticality Analysis is a tool used to investigate the effect of failure of each of the sub systems on the overall system. It is normally carried out as a "desk top analysis", or through a number of interview sessions. All components / functions of a system are considered with respect to failure modes, the effect these failures have locally and globally, and the criticality (frequency / consequence) of these failures.

The main objective of a FMECA is to create the foundation for reliability driven maintenance and operational strategy of the OSS systems. It may also be used in the early stages of the design process to improve the inherent reliability of the system. Operation Manual 0008 (OM-0008) specifies the detailed requirements and procedure for a FMECA analysis.

Design Review – A design review is a documented, comprehensive and systematic examination of a design to evaluate its capability to fulfil the requirements, identify problems and propose any necessary actions. Internal design reviews are to be held a minimum of three times, at 30% - conceptual design review, 60% - intermediate design review and 90% - design review. Operation Manual 0002 (OM-0002) and Operation Manual 0224 (OM-0224) specifies the detailed requirements and procedure for design reviews.

In addition to these activities, during the lifetime of the project, a number of other activities and meetings in which risk could be identified are held, such as project progress meetings, Lead-to-Lead meetings etc. Any risks identified during these activities should be described, defined and handled in accordance with OSS procedures.

6.1.3 Risk definition

OneSubsea uses the definition of risk from ISO 31000 – “An effect of uncertainties on objectives”. Risks are often expressed in terms of a combination of the consequences of an event and the associated likelihood of occurrence.

- All identified risks shall be related to an event which is of concern
- All risks shall be linked to a specific event which occurrence could be observed
- Risk description should be brief, but specific.
- All risks shall be assessed related to impact and likelihood of occurrence
- The owner of a risk is responsible for monitor and, if required, to mitigate the risk.

6.1.4 Risk evaluation

Risk evaluation consists of risk assessment, risk prioritization and mitigation definition. Where assessment is the activity of assessing the likelihood, or frequency, and consequence of an event. This is done based on frequency and consequence classes, which will derive the events risk class. The classes are categorized from 1 to 5, see 56.4 below. Both scales are logarithmic; meaning a risk of frequency class of 2 is, on average, 10-times more likely to occur than a risk of frequency class 1.

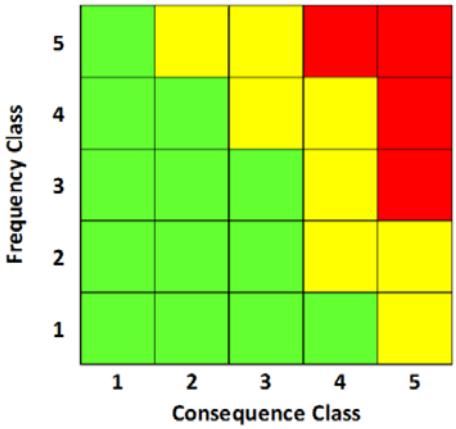


Figure 6.5 – Standard OSS Risk Matrix

All risks identified in the project will be plotted in the risk matrix. The matrix is divided into three risk levels; red, yellow and green, which is used for prioritization of risks. The risk level

will provide the basis for how the risk is to be treated and mitigated. The three levels are defined as such:

Risk Level	Definition
RED	***Unacceptable Risk*** – Risk will be mitigated as soon as possible.
YELLOW	***Borderline Risk*** – Risk will require Risk Management to establish a special mitigating action, and the progress of this mitigation will be followed up during the progress of the project. It is recognized, however, that some risks will not get to a lower level than yellow.
GREEN	***Acceptable Risk*** – Risk will, if no additional reasonable practicable mitigation exists, be mitigated through standard procedures, but will be monitored and followed-up by Risk Management.

Figure 6.6 – Risk level definition

When a risk is to be mitigated, a mitigating action should be described and entered into the risk database for follow-up. If the risk is assessed to be “green”, and no reasonable practicable mitigation exists, the risk is classified as managed risk and will be monitored by risk management.

6.1.5 Risk register administration

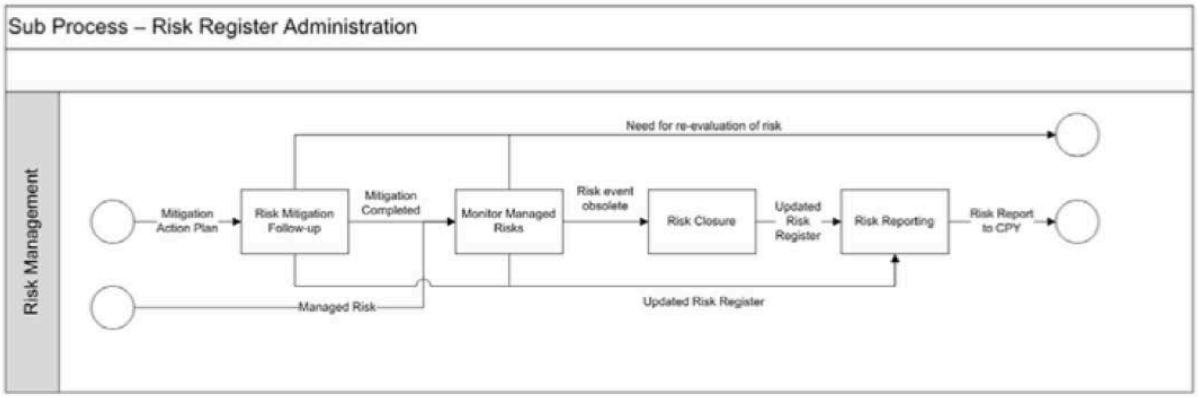


Figure 6.7 – Risk Register Administration Process

Project mitigation follow-up consists of activities to regularly follow-up risks and mitigating actions in the projects. The status of the mitigating actions shall be entered to the risk register for documentation and reporting purposes. As a consequence of progress in the mitigation, the risk may need to be re-evaluated. All managed risks will be monitored during the progress of the project, and re-evaluated or reopened if deemed necessary.
Standard OSS Risk Register database shall be used as a risk register tool together with the standard risk-reporting template.

6.1.6 Project lessons learned

At the end of each delivery project a lessons learned from the project should be analysed. Both negative and positive experience from the project should be registered in the Lessons Learned Database. This activity should be carried out as a dedicated workshop; the purpose for this database is to act as a knowledge bank for the successive project. Through this continuous improvement can be achieved. Project lessons learned are governed by OM-0554.

6.1.7 Risk management scope

The scope of risk management will vary through the different stages of the project. Included in the OM-0011 the RM scope for a typical P&SP project is presented, figure 6.8. This is a helpful tool to help the project team get an overview of which activities they have to initiate at what time.

Risk Management Activity	Applicable if	Internal / External	Governing Document	FEED	Delivery Project				
					Project Start-up	30% Engineering	60% Engineering	90% Engineering	Project Closure
Experience Review Workshop	Always	Internal	OM-0219		X				
Initial Project Risk Review / Criticality Assessment	Always	Internal	OM-0219	X	X				
Project Risk Review	Always	Internal*	OM-0219			X	X	X	
HAZID Major Assembly	Major Assemblies FE scope	Internal*	OM-0010					X	
HAZID SIT	Always	Internal*	OM-0010					X	
HAZID Transport, Storage, Handling and Mobilization	If FE scope	Internal*	OM-0010				X		
HAZID Operation and Maintenance (WERA) - Topside	PCM FE scope	External	OM-0010			X			
HAZID Installation, Intervention and Retrieval - Subsea	Always	Internal*	OM-0010				X		
HAZOP P&ID	Always	External	OM-0009	X		X			
System FMECA	Always	External	OM-0008			X			
Component FMECA - New Technology	New technology to be developed	Internal*	OM-0008				X		
Project Lessons Learned Workshop	Always	Internal	OM-0219						X
Supporting Tools/Processes									
Risk Management Plan	Always	External	OM-0011	X	X				
Risk Management	Always	External	OM-0011	X	X	X	X	X	X
Risk Register	Always	External	OM-0013	X	X	X	X	X	X

Figure 6.8 – Risk Management Scope – Overview

6.2 Risk Management Tools

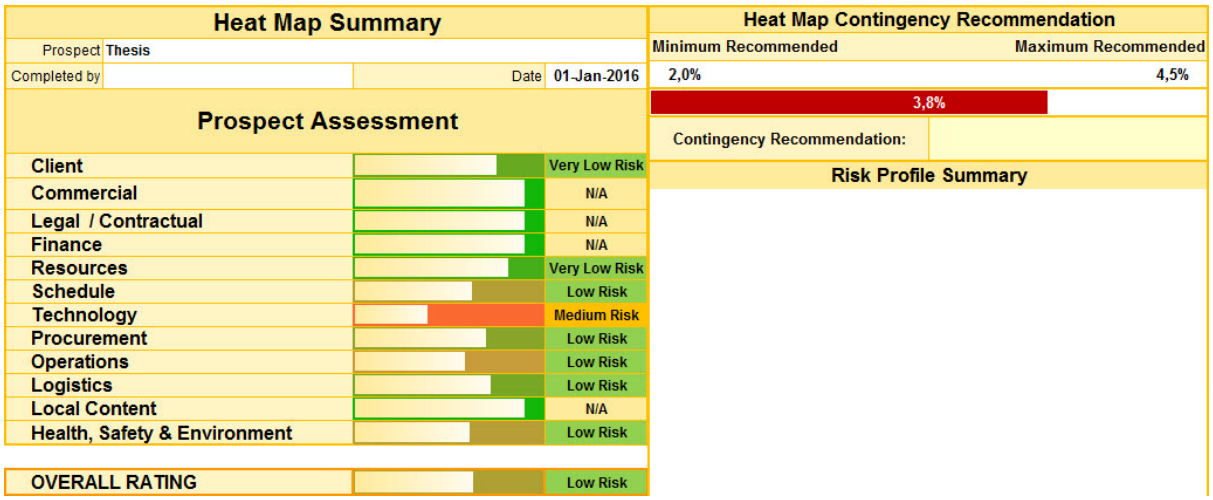
In OneSubsea there are a number of different risk management tools available, ranging from the “low-tech” qualitative to the more advanced quantitative software. As mentioned in section 2.1 OneSubsea is divided into six divisions, the processing division is further divided into P&SP and M&MS.

Due to the difference in scope of their projects, ref 2.2, they use different risk management tools accordingly. Where P&SP use both qualitative tools such as Risk Heat Map, they also use quantitative tools such as @Risk and PERTMaster to establish the risk of cost and schedule overruns, both of these software’s use MonteCarlo simulations. M&MS does not use the quantitative tools, as it is has been deemed not necessary due to how their projects often are significantly smaller in terms of cost and scope. These quantitative RM tools are therefore not described in this paper.

6.2.1 Heat Map

The Risk Heat Map (RHM) is an early phase risk management tool used mainly by the tendering and sales teams. The RHM is an Excel based tool consisting of three input section and one output section. It is an early, easy to use, qualitative tool which objective is to provide sufficient contingency based on the projects risk profile.

The team completing the RHM enter information concerning client, location and estimated cost and schedule for the project as requested in the first page. On the second the delivery is, if applicable, split into different packages. Finally, the third input page consists of various questions regarding Client, Legal, Finance, Resources, Schedule, Technology, Procurement, Operations, Logistics and HSE, where the assessors assign the perceived level of risk for each item. Based on all the input a Summary and Contingency recommendation is presented on the output page. In figure 6.9 below, an outtake from the output page is presented. It indicates a low risk and a recommended contingency of 3,8%. The contingency is the monetary “buffer” recommended for the project.



Heat Map Summary

Prospect	Thesis
Completed by	Date: 01-Jan-2016

Prospect Assessment

Client	Very Low Risk
Commercial	N/A
Legal / Contractual	N/A
Finance	N/A
Resources	Very Low Risk
Schedule	Low Risk
Technology	Medium Risk
Procurement	Low Risk
Operations	Low Risk
Logistics	Low Risk
Local Content	N/A
Health, Safety & Environment	Low Risk
OVERALL RATING	Low Risk

Heat Map Contingency Recommendation

Minimum Recommended	Maximum Recommended
2,0%	4,5%

3,8%

Contingency Recommendation:

Risk Profile Summary

Figure 6.9 – Risk Heat Map Summary Page (Source: OSS)

6.2.2 Risk Register

Any risks identified are registered in a risk register (RR), in M&MS. The risk register is in the form of an Excel workbook. This Excel file is generated during a risk workshop where people with different roles in the project are invited. The RHM is the foundation for the creation of the RR as the identified risks from the RHM set the basis for the RR. Risks are identified, and mitigation strategies are laid. The people responsible for the risk, risk owner, are also identified.

All of the risks and / or opportunities identified are assessed and assigned a score that will place it within the corresponding matrix, figure 6.10.

RISKS

Probability		Impact				
		Very Low	Low	Medium	High	Very High
	Very High	6	9	18	36	72
	High	4	7	14	28	56
	Medium	3	5	10	20	40
	Low	2	3	6	12	24
	Very Low	1	1	2	4	8

OPPORTUNITIES

Probability		Impact				
		Very Low	Low	Medium	High	Very High
	Very High	6	9	18	36	72
	High	4	7	14	28	56
	Medium	3	5	10	20	40
	Low	2	3	6	12	24
	Very Low	1	1	2	4	8

Figure 6.10 – Risk Register Matrix (Source: OSS)

6.2.3 CRITER

CRITER – Cameron RIsk TrackER is a more comprehensive tool than the Excel-based risk register. CRITER is a web-based program where all identified risks are stored in a database that can be accessed by anyone with the necessary privileges. This database serves as a resource for all projects and is always up to date, which means that each CRITER created contributes to the continuous improvement of risk analysis and awareness.

6.2.4 Application of different tools

The risk management process in P&SP is more comprehensive compared to M&MS. Both departments use risk heat map from the start, pre gate A, however the P&SP department launch all their other tools, @Risk, PertMaster and CRITER between gate B and C. M&MS on the other hand rely on the risk heat map all the way from start to gate E, when they are awarded the contract. At this point they create the Risk Register in Excel, which serves as the main risk management tool for the remainder of the project.

7. QUESTIONNAIRE RESULTS

A questionnaire was distributed within the M&MS organization, this was in form of an online question sheet where the employees where asked both “tick the box” and open-ended questions. This method was chosen, as it is a very efficient way of collecting data from a large sample size. The questionnaire was distributed to approximately 80 people.

The questions were formed according to the principles explained in Kothari 2004, ref 3.2.2, to ensure that they could best give an insight to the risk culture and awareness, but also trying to get a sense of the knowledge level and current utilization of risk management tools within the organization.

7.1 Validity

With any questionnaire you have to critically assess the validity of the results. The survey was completed by 39% of the organization. The ideal number would be a 100% but I believe that the answers I have received are representative for the rest of the organization. There is a good mix of people from different roles that have answered, see figure 7.1 for survey demographic.

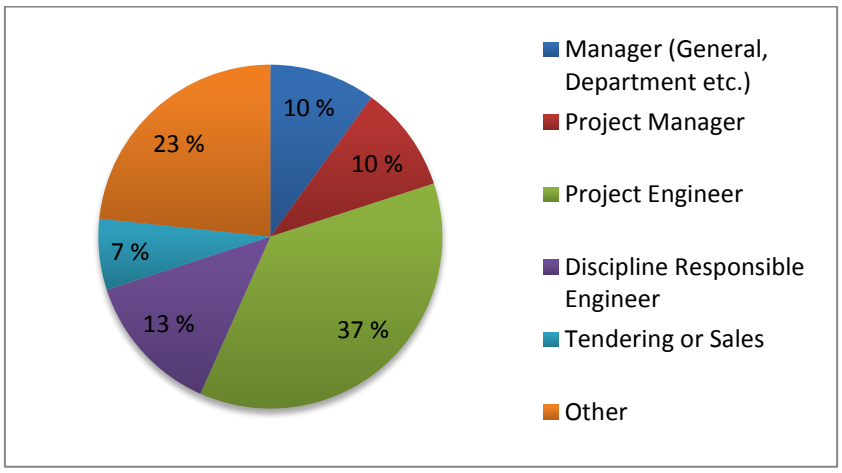


Figure 7.1 – Questionnaire demographic

There is however one group that unfortunately is underrepresented, the project managers. The project managers are in a key position in regards to risk management as it is often their focus and dedication that set the tone for how much emphasis is put on risk management by the project team during the life of a project. It is hard to interpret the bias of nonresponses, ref 3.2.2, I have chosen not to read too much into this.

This being said I do believe the results from the survey are representative for the organization as a whole, and it will be used as the foundation for the evaluation in chapter 8.

7.2 Process

The risk register process for the Processing division is explained in the OM-0011 document, ref chapter 9. I wanted to find out to what extent people were familiar with this document and if so, did they use it as a part of their projects.

The results were quite clear, there is some knowledge about the document, 63% said they knew where to find it, but only 35% of those actually use this document in their work. This means that only 22% of the organization incorporates the OM-0011 process in their risk management during projects.

One might think that this low awareness and utilization of the OM-0011 is due to a lot of new employees and that they therefore have not yet been able to incorporate this document in their project execution. However the results show that almost 50% have been working in M&MS for more than 6 years, and only 13% for less than 2 years.

It is also an experienced division where each employee has a large number of projects under their belt, almost 80% of the department have been involved with 10 or more projects during their time at M&MS. The most common type of project is delivery projects with external or internal (other OneSubsea divisions) clients but also FEED and R&D projects. Going through each reply individually there is no clear indication that one type of project or role, figure 7.1, has a higher use of the OM-0011 than others.

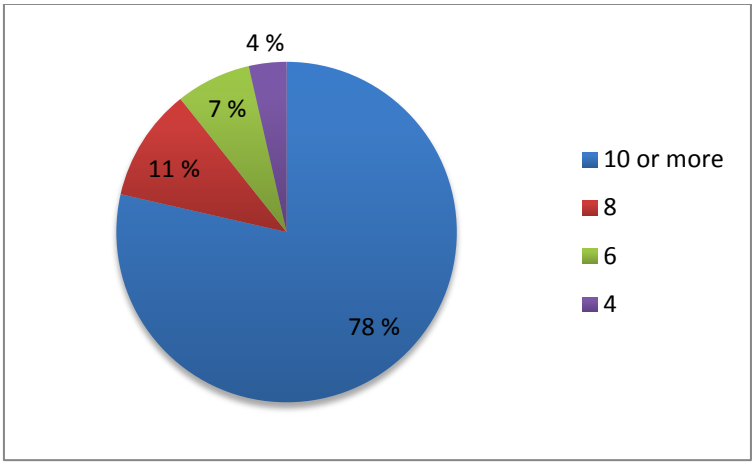


Figure 7.2 – Number of M&MS projects

7.3 Tools

The main RM tools utilized in M&MS project execution is the RR and RHM. Therefore, one of the most important questions to answer was to what extent the organization were familiar with them and to what extent these tools were used.

Only 16% of the respondents were familiar with or have used both RR and the RHM, an additional 32% have used only the RR and 13% have only used the HRM. This means that as much as 39% are not familiar with or have used any of these tools during their time with M&MS. To achieve more clarity on how these tools were used an open-ended question was asked where the respondents were asked to elaborate on how the tools had been used in projects they had been involved in. The response indicate that the tools were mainly used in the early project phase and pre-project (tendering / sales), some state that it is also used to follow-up identified risks. Based on these replies it seems that the use of RM tools has received the same attention during the execution phase of the project.

The usage of other RM methods was also mapped and it is clear that the respondents are familiar with several different methods. The most commonly used method is the FMECA, 58% of the respondents identify this as a methods they are familiar with and have used the most during their time with M&MS.

Analysing the responses individually there is no clear pattern of who is utilizing these tools and who is not, (project roles ref figure 7.1). However the one group with the highest utilization according to the replies from the survey are upper management.

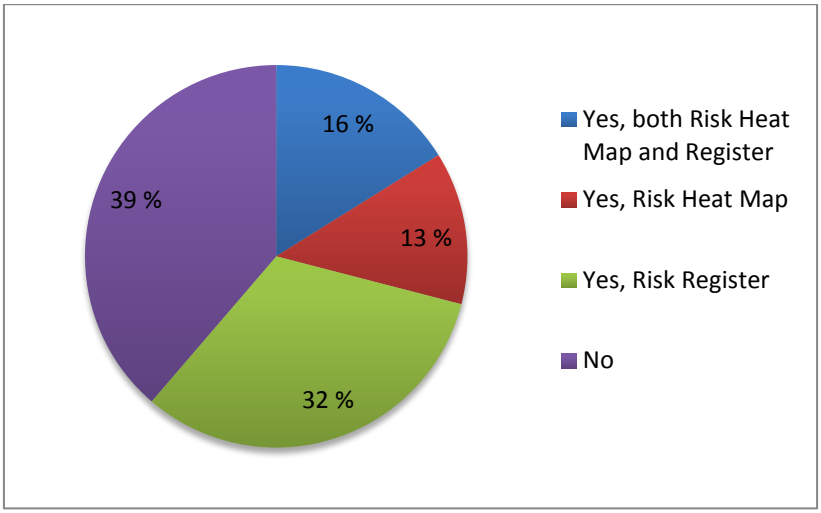


Figure 7.3 – Familiarity with RM tools

7.4 Training

Mapping the level of risk training the employees had received was important to paint a picture of one; how much resources OneSubsea put into developing their employees on subject of risk, two; if it was possible to identify a pattern between the employees that had received training and the utilization of RM tools.

As much as 57% of the respondents had not received any training during their time in OneSubsea. 27% had taken an e-learning course and only 13% had received classroom training. There were also 3% that had completed both e-learning and classroom training. A follow up question in regards to training was asked to uncover if any respondents had any previous training in risk, either during their formal education or at previous employers. Two respondents stated that they did have risk management as a part of their degree, either as a part of the degree itself or during project management courses. Further two respondents had received some training during their time with a previous employer.

Trying to establish a conclusive pattern between the respondents having received training and the extent to which they make use of the various RM tools (RHM, RR) was difficult. It was found that 62% of the people that had received training used at least one of the mentioned tools. Comparing this to the whole sample where 61% had used at least one of the tools it is clear that there is not a significant change in awareness or utilization of RM tools. However, if one only considers the ones that have received classroom training we see that as much as 80% of them make use of the tools. Whereas for the ones that only have received e-learning it was as low as 50%.

M&MS has a significant room for improvement when it comes to the training of their personnel on the subject of risk management. We also see that there is a clear correlation between classroom training and the awareness of risks.

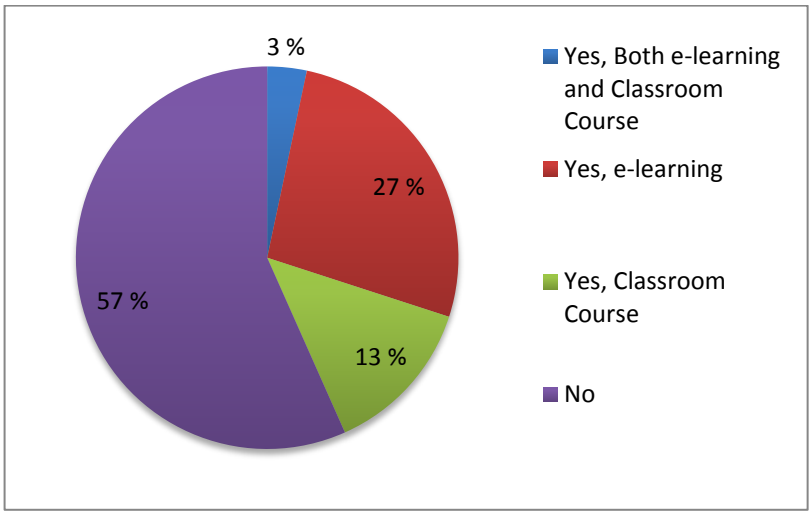


Figure 7.4 – M&MS Risk Management Training

7.5 Leadership and Culture

To establish a basis for evaluating the leadership and the employees' attitude towards risk a few open-ended question were asked. As the questionnaire was sent out to the whole organization, input from the entire hierarchy was gathered. This information can present an interesting picture of how the different groups view risk and if possible try to establish a pattern.

68% of the total numbers of respondents chose to give their views in these open questions. When asked to describe their own attitude towards risk and the focus risk had in their daily work replies ranging from limited to high. Some stated that their lack of training on the subject made them feel constrained in their ability to handle and manage risks even though they describe their personal attitude towards the importance of risk as high. The clear majority of the respondents state that they take risk management seriously and consider it an important subject that has to be given the necessary attention. In regards to what their impression of M&MS management's focus on risk the responses also here differ from low to high. There is however a consensus that the focus and attitude by the management towards risk has increased lately, particularly during the last 6 - 12 months.

The increased focus risk management have received may be down to a few different reasons, as described earlier in the thesis M&MS have experienced a lot of changes in the last few years, both in ownership and organizational. If the recent increased focus is down to changes is the organization or as a result of new corporate policies introduced after the joint venture between SLB and CAM is not clear. It is however a positive, which can lay the groundwork for the improvements ahead.

8. EVALUATION

In this chapter risk management culture in M&MS will be compared to a risk maturity model aiming to find the risk maturity of the M&MS organization. The analysis is based upon reviewed documentation, processes, the questionnaire and own experience.

Four categories will be evaluated to determine the risk maturity level of the organization. These categories are Leadership and organization, Experience and training, Processes and Tools.

8.1 Risk Maturity Model

The level of risk maturity in the organization is a measure of the quality of risk management activities and the extent to which they are embedded within the organization. Risk maturity models can be used to measure the current level of risk culture within the organization. Risk management activities are more embedded in the organization with a greater level of risk maturity. Hopkin, 2012 p. 114, describes a system for determining risk maturity within an organization with regard to risk management process, table 8.1.

Table 8.1 – The four levels of risk maturity (Hopkin 2012 p. 116)

Level	Classification	Description
1	Naïve	Level 1 organizations are unaware of the need for the management of risk or do not recognize the value of structured approaches to dealing with uncertainty. Management processes are repetitive or reactive, with insufficient attempt to learn from the past or to prepare for future threats or uncertainties.
2	Novice	Level 2 organizations are aware of the potential benefits of managing risk, but have not implemented risk processes effectively and are not gaining the full benefits. The organization is either experimenting with the application of risk management or is operating a risk management process that has fundamental weaknesses
3	Normalized	Level 3 organizations have built the management of risk into routine business processes and implement risk management throughout the organization. Generic risk management processes are formalized and the benefits are understood at all levels of the organization, although they may not be consistently achieved.
4	Natural	Level 4 organizations have a risk-aware culture with a proactive approach to risk management in all activities. As a result, the consideration of risk is inherent to routine processes. Risk information is actively used and communicated to improve processes and gain competitive advantage

8.2 Comparing M&MS risk management with the risk maturity model

This is a subjective classification of M&MS´ risk maturity based on personal experience, document review and the results from the survey. The attributes that contribute to the overall risk maturity level is illustrated in figure 8.1 below.

Figure 8.1 – Risk Maturity Level Attributes

8.2.1 Leadership and organization

This attribute lays the foundation for good risk management. The attitude and focus the leadership have towards risk management is key to develop a risk aware culture, ref section 4.3. The success of initiatives towards achieving a risk aware culture has to start at and needs the commitment and backing from the highest management level.

The results from the survey indicate that the upper management is the group that is the most risk aware, meaning they have a good understanding of the benefits from efficient risk management. For the rest of the organization the risk awareness varies within roles and time employed in the company, no groups (senior / junior / roles) as a whole stands out as having a higher level of awareness than others. From the answers received in the survey, it appears that risk is something negative, there is no mentioning of risk being an opportunity to be exploited, it is solely something that has to be mitigated and controlled.

The organization is aware of the potential benefits, but it is no uniform understanding of risk across the organization. This may be due to the fact that there is no policy in place that sets the framework for good risk management. There is however one major positive on this attribute, many of the respondents in the survey stated that risk management have been gaining an increasingly level of attention from the management during the last 6 - 12 months.

8.2.2 Experience and training

This attribute aims to establish the level of experience and the level of training the personnel have received on the subject of risk management. It is apparent that the experience within M&MS varies from the very experienced where risk management is a natural part of their daily work to the naive. To achieve a higher level of experience, knowledge and increased risk awareness training on the subject is key. This is the attribute that is most easily changed and will immediately impact the organization as a whole as a common understanding of risks is achieved.

It is safe to say that training of employees on the subject of risk management need to be a priority shall the group develop a level 4, natural relationship with risk**.** As much as 60% of the respondents stated that they had not received any training on risk management during their time in M&MS and only a few had had risk management as a part of their degree or as a part of project management classes or training from previous employment. Most of the respondents also identified increased training as a measure to achieve a better risk culture and increase their ability of dealing with risks.

The experience and knowledge level is not adequate, but the employees are aware of this fact and have identified the need for more training and knowledge.

8.2.3 Processes

This attribute aims to identify whether or not M&MS have a process for risk management and how this is implemented and used. The risk management process is described in the operation manual, OM-0011. This is a 15 pages document were current revision dating back to 2012, it outlines the risk management steps to be taken in a typical category A, high CAPEX, delivery project, ref chapter 6. However, the document is created with P&SP projects in mind, and might be too comprehensive for a typical M&MS project. The manual appears to be unfinished, were some of the documents referenced in the manual does not exist or exist only as empty templates.

The survey revealed that the M&MS project teams do not commonly use this process. More than 60% state that they know of and know where to find the operation manual, but as little as 22% have actually used it in their time with M&MS. For a risk management process to be efficient everyone in the project team needs to be both aware of and familiar with it. Risk management is the responsibility of the whole project team.

There is a process in place, but it has not yet been implemented across the entire organization and they are not gaining the potential benefits of following this process.

8.2.4 Tools

The purpose of this attribute is to identify to what extent the RM tools are being used by the employees and establish to how familiar they are with their use and potential benefits. For an organization to be efficient in risk management, RM tools must be used as a natural part of the day-to-day work. To achieve this, all parts of the organization have to be familiar with the tools available and their purpose.

Risk Register and Risk Heat Map are the two main tools used within M&MS, where RHM are used until the contract is awarded, gate E, once the contract is awarded a RR is created. Both of these tools are qualitative and their effectiveness is based upon the knowledge the people performing / using the tools have at the time and to what extent the risks identified are followed up as the project evolves.

The survey revealed that the use of RM tools is not common practice throughout the organization, their use and knowledge of them varies. Only 32% state that they have used the RR and 13% have used the RHM, there is an additional 16% that has used both of the tools. This means than less than half of the organization have been involved with or used the RR, this lack of involvement and experience with the use of RM tools is clearly a weakness that again shows that the system is not fully implemented. However it is natural that there is a lower usage of the RHM as this is mainly a tool for the tendering and sales teams.

8.2.5 Summary

The maturity level of M&MS in regards to risk management can be classified to level 2, *novice*. The organization is aware of the importance of managing risks, however they are not at a level where they are gaining the full benefits of risk management. There is no coherent understanding of risks and the level of training and knowledge on the subject of risk across the organization is not adequate. The risk management process has not successfully been implemented through the entire organization, the RM tools are not being used as a routine activity. It appears that the attention and focus given to risk management varies from project to project and is dependent on who is involved.

9. DISCUSSION

In this chapter, findings and observations made during the work with this assignment will be discussed. Areas of improvement, suggestions for further work and benefits to be gained by achieving a higher level of risk maturity in the organization are among the topics that will be discussed in addition to the four attributes contributing to risk maturity.

9.1 Findings & Areas of Improvements

9.1.1 Training

Training or the lack of it is the first attribute the management of M&MS should address. It is prudent to ask if the training of risk management has not had a high enough priority through the history of the M&MS department. The level of experience in the organization is not adequate. The survey showed that more than half of the organization had not received any training on the subject. This attribute was the one M&MS scored the lowest when compared to the maturity model. Fortunately this attribute is the easiest to improve, and OSS has risk management courses in-house held by the risk management team from P&SP.

There was observed no significant change in the utilization of RM tools by the people who had conducted e-learning courses on risk management, however the group that had completed the classroom course had a significantly higher usage of the tools and process. This suggests that any risk management training efforts would yield the best results if it is focused on classroom courses rather than e-learning courses.

9.1.2 Tools

The P&SP department have a well-developed suite of risk analysis tools, ranging from the simplistic informal brainstorming sessions to the advanced quantitative model-based analysis tools. The M&MS department tool suite is narrower, ref 6.2.4, consisting of the standard risk analysis tools RR and RHM. This is mainly due to the difference in the two departments' project scope.

Were P&SP use CRITER, M&MS use their own Excel based register, the CRITER was deemed to comprehensive and "overkill" for the needs of the M&MS department. However the CRITER has an advantage over the RR as it has an online database where all previously identified risks are recorded and stored for future risk identification sessions. M&MS should seek to create such a database of their own so that there is a resource available when

creating new RHM and RR. The database would be a resource for the people conducting the analysis and would contribute to the collective knowledge of the organization.

One area where M&MS have a lot to gain in regards to their risk management efforts is by achieving a higher utilization of their tools. It appears that any risk management initiative is taken on a personal level and is not considered a routine activity which will contribute to the success of the project, but more of an option if the project team deems it necessary. By highlighting the benefits of RM and setting a higher focus on the subject in parallel with educating the personnel this can be changed.

As said the survey indicates that the employees that have received classroom training have a higher utilization of the RM tools, another benefit of increased training on the subject is that as the employees' knowledge and awareness of risks increases it will result in better risk assessment, ref section 4.1. Using qualitative tools as the risk register and risk heat map the better the knowledge the people conducting the assessment the better the result will be. *All probabilities are conditioned on the background knowledge that we have at the time we quantify our uncertainty*, Aven 2012 p. 52.

9.1.3 Process

The risk management process M&MS are following is not ideal, and more importantly it is not used by the entire organization. As little as 22% of the organization say that they have used the process in their project work, this tells us that the process is not a routine part of the project execution in M&MS, which is also evident when we look at the operation manual for project execution, OM-0526, where risk is not mentioned at all.

The OM-0011 is currently being reviewed by the risk management team, an updated version of the process diagram, figure 6.3, will be presented, all sub-processes diagrams will be removed. This will make the document more orderly and hopefully make it more intuitive to follow. The current revision is created with big projects in mind and is more comprehensive than what the needs of the M&MS department are. A new revision should include the risk management process to be followed also for the less complex projects, it is apparent that without a process tailored for these projects the document will not be used outside the P&SP department.

9.1.4 Leadership and organization

The leadership will play a key role in increasing the risk awareness of the organization, any initiative will have to have the support from the management to be successful.

The survey revealed that the employees' impression of the management's focus towards risk management was varying, however most of them acknowledged that the focus had increased over the last couple of months. The reason for this may be a result of the joint venture as Cameron business policies were implemented in OSS, or due to the organizational changes in recent time or a combination of the two.

Even with this apparent increased focus on risk management by the leadership team the survey revealed that the organization does not have a satisfactory risk-awareness overall. Most of the respondents state that they are risk aware, but some feel that they do not have enough knowledge on the subject to deal with risks efficiently.
Overall the employees have the necessary focus but are lacking the knowledge and experience to handle with them effectively.

9.1.5 Risk-Awareness

There are several aspects one needs to consider when aiming to improve the risk-awareness culture of an organization, LILAC ref section 4.3.

To ensure the involvement of all stakeholders it is important to achieve a common understanding of risks through the entire organization. Communication is the key, there has to be a platform for communication where information can be displayed and shared efficiently, the intranet or a monthly, bi-monthly communiqués distributed by email are examples of such a platform. A more active communication strategy will help increase the awareness of the employees and put risk on the agenda. As described by Hopkin, 2012 p. 118, one can only ensure a consistent response to similar risk events by sharing information and experience.

9.2 Recommendations

Another goal with this thesis was to arrive at specific measures M&MS could initiate to improve their risk management. It has been established that there is a need to achieve higher risk awareness across the organization, the first step here is to put RM on the daily agenda with increased attention from the management and to raise the knowledge level of the organization by educating the employees on the subject.

M&MS also needs a risk management policy. This policy is a part of the risk management framework and sets the overall strategy of the organization towards risk management, it describes what the organization is seeking to achieve with respect to RM, and it also defines roles and responsibilities and the protocols to be followed.

The current use of the excel based risk register should be reviewed, by having it in a form of a document held on a server you run the risk of the information recorded in the register will not be used in a dynamic way. As Hopkin (2012 p.89) warns, you risk that it becomes a static document that only records the status of risk management activities at a moment in time. Instead of regarding it as a register it should be considered as a risk action plan that records the status, provides a record of the controls that are in place and the details of any additional controls that need to be introduced.

The risk heat map has only been in use by M&MS for a couple of months and is, as to my knowledge, the only RM tool used by the tendering and sales teams. We know that we have the highest influence in the early phases of the projects, pre gate E. It is therefore crucial that the risk assessment performed at this stage is of the highest quality. Therefore the personnel conducting this assessment have to have a high level of technical competence and knowledge of potential risks that may arise.

This thesis has been looking at intra project risk management, risks encountered within the project during its execution. In the process of writing this thesis it appears that M&MS does not have a system of looking at the collective risk from all their activities. The departments collective risk exposure is not managed, this should also be addressed as M&MS is increasing their risk management efforts.

It would be beneficial to review the current project execution procedure, OM-0523, and integrate risk management activities to this process. When the revised OM-0011 document is released, M&MS should review it and evaluate the need for adding additional procedures tailored to their needs.

With the recent acquisition of Cameron by Schlumberger OneSubsea is now part of the world's largest oil service provider and will gain access to the SLB risk management system as the integration moves forward. It may be beneficial to evaluate the SLB policies, tools and practices for adaptation into M&MS risk management practise.

9.3 Benefits

There are several benefits to be gained by having a well-functioning risk management system and a developed risk culture as summarized by Hopkin (2012 p.50) in the acronym CADE3 ref 4.4. It ensures compliance with legal and regulatory obligations and assures that significant risks are identified and that the necessary controls are put in place. Risk management is also a valuable tool for decision-making as can help shed light on potential hazards and opportunities that may be exploited.

In the RSK1 course held within OneSubsea a project from Leeds is highlighted. The delivery project had two phases, the first phase consisted of delivery of three subsea christmas trees and the second one consisted of 3 new trees and rework. Special for this project was that this was the first project to utilize the SPLC, ref 5, and risk management tools from start to finish. This resulted in an increase from the original bid margin of 37,7% to an end margin of 46,6% for the first phase and from 43% to 46,2% for the second. This is a great example of the benefits that can be gained by efficient risk management. It is tempting to believe that M&MS can achieve the same success in their MPFM deliveries in the future.

10. CONCLUSION

This thesis set out to identify and evaluate the risk management tools and processes currently being used by M&MS and if possible, obtain an understanding of the overall risk culture in the organization.

After reviewing the risk management system in M&MS it is apparent that there is significant room for improvements. The impression is that the subject of risk management has not received the necessary level of attention and therefore the risk awareness of the department is not as high as it should be.
This being said the department has already implemented different principles for good risk management, and the company has a well-developed suite of risk management tools and several individuals with a high level of competence on the subject of risk management. The resources are already available within the organization so the foundation for further development and improvements are in place.

The utilization of the risk management tools and process is not sufficient. It is not a natural part of the project execution. It also appears that the attention given to risk management is dependent on the personnel involved in the projects instead of being a result of a developed risk culture. The process for risk management, OM-0011, was created with P&SP projects in mind and is therefore not ideal for the needs of the M&MS department, which in turn and may be contributing to the low level of utilization.

Several areas of improvement are identified. Educating the employees on the subject of risk management has to be prioritized. The usage of risk management tools must become a natural part of the project execution. Internal communication of risks that the organization and projects are facing would improve the risk awareness and put risk management on the agenda. A policy stating the objective and goals of the risk management efforts should be developed or adopted.

The overall impression is that a lot of the principles for good risk management have been implemented and that the subject of risk is receiving increasing attention by the organization. However at this moment in time it is not a natural part of the project execution. The current M&MS risk management system is not ideal and the potential for improvements is substantial.

REFERENCES

ISO31000 Risk Management (2009) – *Principles and guidelines on implementations*

Paul Hopkin (2012*). Fundamentals of Risk Management: Understanding, evaluating and implementing Effercive Risk Management* (2nd ed.) (ISBN: 978-0-7494-6540-7) Publisher: Kogan Page Limited

Kothari, C.R. (2004) – *Research Methodology: Methods and Techniques* (ISBN: 978-81-224-2488-1) Publisher: New Age International

Terje Aven (2008). *Risk Analysis Assessing Uncertainties beyond Expected Values and Probabilities* (ISBN 978-0-470-51736-9) Publisher: John Wiley & Sons Ltd

Terje Aven (2012) *Foundations of Risk Analysis* 2nd ed. (ISBN: 978-1-119-96697-5) Publisher: John Wiley & Sons Ltd

Terje Aven (2014) - *Risk, surprises and black swans* (ISBN: 978-1-315-75517-5) Publisher: Routledge Ltd

[1] http://www.oilandgas360.com/ep-capex-first-double-dip-since-86/ – 22.05.16

http://onesubsea.com/about.aspx – 05.02.16

http://www.tradingeconomics.com/commodity/brent-crude-oil – 22.05.16

http://riskczar.com/risk-quotes/ 10.06.16

OneSubsea documents:

RSK1 – *Intro to Project Risk Management* (PPT-Slides)
RSK2 – *PCS Cameron Risk Tracker* (PPT-Slides)

CPS-TG-1.1.002 – *Risk Heat Map Purpose and Use*

OM-0011 – *Risk Management*
OM-0523 – *M&MS Project Execution*
OM-0010 – *HAZID*
OM-0009 – *HAZOP*
OM-0008 – *FMECA Procedure*
OM-0012 – *RAM Analysis Procedure*
OM-0554 – *Project Lessons Learned*
OM-0582 – *D6150 Tendering Contracts Processes*
OM-0138 – *Fare og Risikohåndtering HSE Risk Assessment*
OM-0224 – *External Design Review Procedure*
OM-0002 – *Design Review*

APPENDIX

RISK MANAGEMENT QUESTIONARE:

What is your role in M&MS?

- ○ Manager (general, department etc.)
- ○ Project Manager
- ○ Discipline responsible engineer
- ○ Project Engineer
- ○ Tendering or Sales
- ○ Other :

How many years have you been with M&MS?

- ○ Less than a year
- ○ 1-2 years
- ○ 2-4 years
- ○ 4-6 years
- ○ More than 6 years

How many projects have you been involved with in your time with M&MS?

Choose

What kind of projects have you been involved with?

- ☐ FEED
- ☐ Delivery - External Client
- ☐ Delivery - Internal OneSubsea Client
- ☐ R&D
- ☐ Other:

How has risk management been handled in the projects you have been involved with? Please explain

Your answer

Do you know where to find the process (Operation Manual) for risk management ?

- ○ Yes
- ○ No

If yes, have you completely or partly used this process (OM) for risk management in your project work?

- ○ Yes
- ○ No

Are you familiar with, or have used Heat Map or the Risk Register as a risk management tool?

- ○ Yes, both Heat Map and Register
- ○ Yes, Heat Map
- ○ Yes, Risk register
- ○ No

If yes, how was it used?

Your answer

Have you used HAZID, HAZOP or FMECA as a risk management tool in M&MS projects?

- ☐ Yes, HAZID
- ☐ Yes, HAZOP
- ☐ Yes, FMECA
- ☐ No.

Have you in your work participated in workshops, reviews etc related to risk? Please explain

Your answer

During your time in OneSubsea (M&MS) have you received any training in risk management?

- ○ Yes, e-learning
- ○ Yes, classroom course
- ○ Yes, both e-learning and classroom cource
- ○ No

Have you had any previous training in risk management? Please explain

Your answer

How will you describe your attitude and focus towards risk in your daily work within projects? Please explain

Your answer

What is your impression of the management in M&MS´s focus on risk management?

Your answer

Do you have any suggestions for improvements to achieve good risk culture and management of risk in M&MS?

Your answer

SUBMIT