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Preface

This master thesis is the final project of a Masters degree in Risk Management at the University of Stavanger, spring 2009, for and in corporation with ConocoPhillips Norway.

The author would like to express her gratitude to all people who have contributed with their valuable comments and suggestions, which are much appreciated. Moreover, the report could not have been made possible without the help from all the interviewees and others who have assisted me, for their insight and willingness to share their knowledge and experience.

Special thanks go to Terje Aven for his guidance, insight and constructive help throughout the thesis. The author would also like to express her gratitude to Nathan Langton, Ron Allred and Hans Meidell for contributing with information, resources and contacts for the thesis.

Stavanger, June 15, 2009

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Camilla Meidell

Executive summary

Project Risk Management (PRM) has in recent years become an important aspect of business organization and project management. There has always been a requirement for some risk management at COPNO. However about 3 years ago the process became much more defined and has become a requirement for the contingency used on projects to be based upon the risking process. Since risk management in projects is a requirement in the CP organization it is important that the whole organization understands the benefits of the risk management process.

In this thesis the objective is to review the risk management process in the Capital Projects organization at ConocoPhillips Norway (COPNO). Weaknesses and strengths will be identified through comparing the documented project risk management plan and guide at COPNO with other documented risk frameworks. A review of the definition of risk and the different steps described in the plan will be done.

The next step in this thesis will be an evaluation of the risk maturity level in the CP organization. To identify how far the risk management process is implemented at COPNO the Risk Management Maturity Model (RMMM) will be used. The information will be gathered through interviews with project managers and review of PRM documents at COPNO.

The RMMM is a staged model describing five levels of process maturity. The model is divided into 5 maturity levels, each level represents a maturity stage with different criteria which has to be fulfilled to be categorized at that specific level. The model defines 5 levels of capability and maturity: 1) Ad- Hoc, 2) Initial 3) Defined 4) Managed 5) Optimized (See figure: 4). Each level is clearly defined, to enable the organization to evaluate them selves and find the stage they are at. When the right level is identified, the organization can plan and choose ways or activities of improving their current status and decide how to achieve the next level. To collect data for the review of RMM level in interviews of 2 project managers and 1 project controller is done. The answers form the respondents are compared to the RMM model. After the review level of risk maturity is classified for each attribute. The classification of risk maturity level is an approach for identifying areas of improvements. Actions and activities for how the organization can advance to level 4 are suggested in the discussion section of the thesis.

Abbreviations

CBR: Contingency Breakdown Report

COPNO: ConocoPhillips Norway

COSO: Committee of Sponsoring Organizations of the tread way Commission

CP: Capital Projects organization

RMMM: Risk Management Maturity Model

RMML: Risk Management Maturity Level

FEL: Front End Loading

FERMA: Federation of European Risk Management Associations

ISO: International Organization for Standardization

PAG: Project Authorization Guidelines

PRM: Project Risk Management

PRMG: Project Risk Management Guide, Document No. CPMS-PMT-GU-001

PRMP: Project Risk Management Plan Procedure, Document No. CPMS-PMT-PR-013**.**

RM: Risk Management

RMG: Risk Management Group

RMMM: Risk management Maturity Model

RMML: Risk Management Maturity Level

RMP: Risk Management Process

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1.0 Introduction

Chapter 1 gives an overview of the background, purpose, scope, limitations and methodology for this thesis.

1.1 Background

Project Risk Management (PRM) has in recent years become an important aspect of business organization and project management. There has always been a requirement for some risk management at COPNO. However about 3 years ago the process became much more defined and has become a requirement for the contingency used on projects to be based upon the risking process. Since risk management in projects is a requirement in the CP organization it is important that the whole organization understands the benefits of the risk management process.

Few years ago risk management in the Capital Projects organization was very basic, a risk register and a report on identified top ten risks was in place, but very little work was done besides that. Within a five years period the organization has developed from using organization had very basic risk management, such as a risk register and a report on top ten risks, very little very simplistic not very coordinated risk registers, to guidelines on how to do things, to certain corporate requirements for how to report risk and how to do their analysis, to common tools that are used. The risk management culture within COPNO is continuously developing and the focus on risk management has increased much more than what it was just five years ago. How risk impacts cost and schedule for delivering the project, was seldom done earlier, but now it is a requirement. To be able to do that a risk management plan has to be implemented. Through continuous evaluation, updating and improvement of the processes in the risk management plan one can reduce risk and apply the plan as a competitive tool. Though the organization may have implemented the right tools for controlling and monitoring risk, there are still areas of improvement to be identified. Risk management is not only the calculation of the probability of a risk occurring. To achieve full effect; one of the most important things is to implement risk awareness and a risk culture in the project or organization which recognize the importance of continuous monitoring of risk. Proper PRM will in the future become even more relevant as a

competitive advantage, and as a tool for controlling uncertainties and achieving the organizations objectives.

1.2 Purpose

The purpose of this thesis is to:

Investigate and document the Project Risk Management Plan in use by ConocoPhillips Capital Projects organization, compare and contrast to other systems.

Classify ConocoPhillips approach to risk management in the Capital Projects organization, using the Risk Management Maturity Model approach.

1.3 Scope

In this thesis the objective is to review the risk management process in the Capital Projects organization at ConocoPhillips Norway (COPNO). Weaknesses and strengths will be identified through comparing the documented Project Risk Management Plan and Guide at COPNO with other documented risk frameworks. The next step in this thesis will be an evaluation of the risk maturity level in the CP organization. To identify how far the risk management process is implemented at COPNO the Risk Management Maturity Model (RMMM) will be used. The information will be gathered through interviews with project managers and review of project risk management documents at COPNO.

First, to review the PRMP in the CP organization, identification of different risk management frameworks will be done to find possible areas of improvement. Second, the PRMP will be reviewed using the Risk Management Maturity Model. To find the necessary information for the classification of risk management maturity level in the CP organization, interviews of 2 project managers and 1 project controller have been conducted to gain insights into how the PRMP is conducted in practice. Through the Risk Maturity Model the aim is to find areas of improvement, if the RM process is successfully implemented and at which RMM level the CP organization is.

After identifying areas of improvement and maturity level, a suggestion of how the CP organization can achieve the next level in the Risk Maturity Model will be discussed. Finally, suggestions for future work will be presented.

In chapter 1 research, background, objectives, scope, limitations and methodology will be specified. Next, in chapter 2, a short presentation of the risk management plan in the Capital Projects organization is given. Furthermore, the standards chosen for comparison of the RM plan in the CP organization are presented. In chapter 3 the definition of risk in the RM plan and the RM plan is reviewed and compared to the two standards chosen. The first section in chapter 4 is a presentation of the risk management maturity model and its five levels. Furthermore the results from the interviews are compared to the levels in the RMM model and RMM level is classified for the five attributes in the model. In chapter 5 a discussion of how the organization can advance to the next level will be presented. Lastly in chapter 6 a final conclusion is presented.

1.4 Limitations

In this thesis the focus will be on the RM plan in the Capital Projects organization at COPNO and Risk Management Group (RMG).

Several types of documented Risk Management frameworks are found through literature search, but given that many of the frameworks are somewhat similar in their definitions and documented risk management process, the comparison of PRMP in the CP organization have been limited to two of them. These two frameworks are AS/NZS 4360:2004 and FERMA. The review has been limited to two areas; how risk is defined in the RM plan and how the risk management plan is documented.

When classifying the Capital Projects organizations maturity level the RMMM is used for comparison. Here will model 5 attributes be evaluated such as; Definition, Culture, Process, Experience and Application. As a basis for the comparison interviews of staff in the CP organization have been conducted. The interviews have been limited to 2 project managers and 1 project controller because of difficulties with getting hold of people in the organization. All together the interview consists of 17 open-ended questions. Open-ended questions are chosen to encourage respondents to share their knowledge and theire point of views. Questionnaire forms have not been chosen as a tool for gathering of data because scaled answer alternatives might limit the respondents' freedom to answer, and eventually not represent the respondents' true opinions.

1.5 Methodology

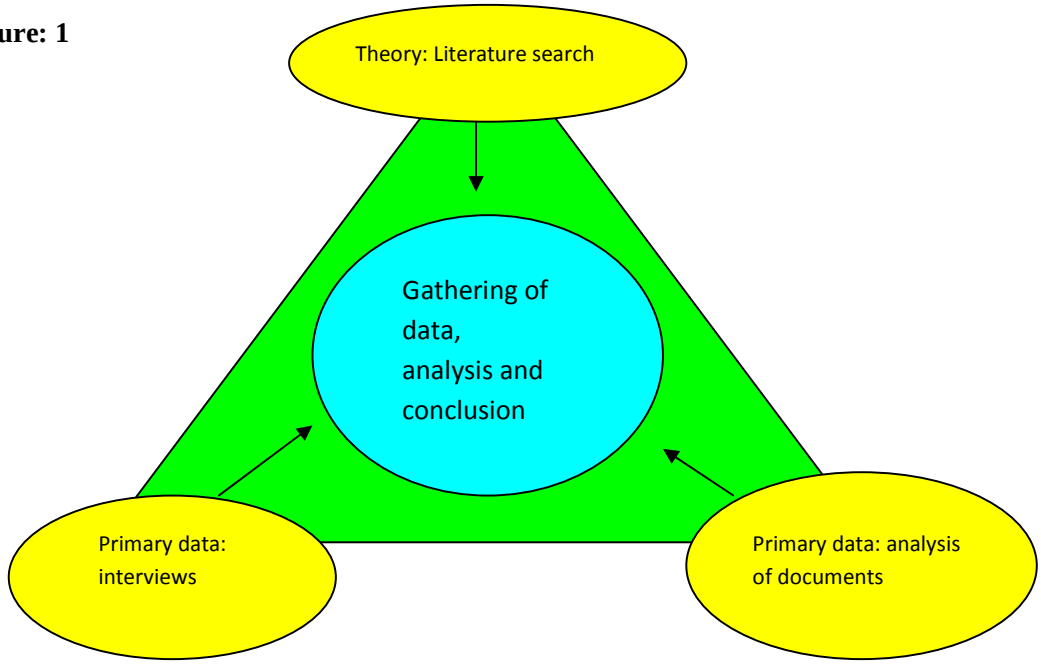
The first part of this thesis is based on a review of the documented Project Risk Management Guide and Plan in COPNO. To review the plan, the document has been compared to the AS/NZS 4360:2004 Standard and the FERMA Standard for RM. These are both RM standards developed by Risk management organizations in Europe, Australia and New Zealand. The intention of the comparison is to find areas of improvement and suggestions for how the CP organization can improve their risk management plan. Besides reviewing the steps in the RM process, other areas which might be mentioned in the other two standards will be suggested if they have any relevance to the RM in the CP organization.

The assessment of risk management maturity level is a qualitative method based on comparing the PRM plan and guide in the CP organization to pre determined criterions in the RMMM. The model was suggested by the CP organization as a tool for reviewing the PRM process. The RMMM provides guidance for organizations who wish to implement or improve their RM process. The model ranges from the type of organizations which have no defined or implemented RM process, to organizations which have RM process integrated in all departments of the organization. Most organizations will fit into one of the 5 stages of this model (Risk Management Maturity Level Development, 2002).

As a basis for the assessment of maturity level, interviews of two project managers and one project controller is completed to compare the documented plan with actual practice in the CP organization. The interview consists of 17 open-ended questions to ensure that the respondents give their own description of how the procedures are done in the project. The questions in the interview are based on the information in the RMMM. The answers will be compared to the criterions under each RMM level. Appendix 1 presents criterions for a typical organization at each RMMM level under four attribute headings: Definition, Leadership and organization (Culture), Process, Experience and Application. These criterions are based on key failure and success factors identified in 51 cases and literature review of Complex Project Systems cases (See appendix 2). Further on, these case studies have been supported by field interviews of senior project managers (Yeo & Ren, 2008). Additional criterions from the Risk Management Maturity Level Development, 2002 have been included to the model.

The answers from the respondents will be compared and checked to the criterions in the model. The different criterions under each level represent predetermined factors which are required to be defined as a level 1, 2, 3, 4 or 5. Potential gaps between the criterions and answers will be considered as areas of improvement to accomplish a certain level. Figure 1 illustrates how collected data is discussed in the thesis.

Figure: 1



2. Presentation of the risk management plan in the Capital Projects organization and standards chosen for comparison.

Chapter 2 gives a brief description of the purpose of the risk management plan and guide in the Capital Projects organization. Furthermore, a short presentation of the chosen standards for comparison is given.
Risk management is dealing with risk in practice, which includes planning, assessment, handling and monitoring risk. According to Harold Kerzner RM should be an integrated part in all projects as a part of key processes, such as: overall project management, systems engineering, cost scope and schedule. Proper RM is proactive and attempts to reduce the likelihood and the impact of a risk (H. Kerzner, 2001). In the FERMA standard the objective of a risk management framework is to achieve a common agreement on:

- *terminology related to the words used*
- *process by which risk management can be carried out*
- *organisation structure for risk management*
- *objective for risk management*

(FERMA, 2003)

To ensure common agreement on the four points mentioned above COPNO has developed a plan and guide for risk management. The plan and guide will in the following chapter be reviewed and compared to other standards for RM chosen in this thesis.

2.1 Presentation of the RM plan in the Capital Projects organization

The RM process in the CP organization is documented in the Project Risk Management Plan Procedure, Document No. CPMS-PMT-PR-013 and the Project Risk Management Guide, Document No. CPMS-PMT-GU-001. The next two paragraphs will present the purpose of the two documents:

2.1.1. The purpose of Project Risk Management Plan Procedure (PRMP)

The Project Risk Management Plan Procedure, Document No. CPMS-PMT-PR-013 (PRMP) is a brief overview of who should be involved in the risk management process, and when and how the activities should be conducted.

"*Project Risk Management Planning set the tone for the rest of the risk management efforts. It involves deciding how to proceed, who should be involved, when and how the risk management activities should be conducted throughout the project life cycle." (PRMP)*

2.1.2. The purpose of Project Risk Management Guide (PRMG)

The Risk management plan at COPNO is documented in the Project Risk management guide, Document No. CPMS –PMT-GU-001. The purpose of this document is to identify and reduce project risks if possible at all stages of the project life cycle. Further on the plan is meant to be a tool for implementing risk management in CP capital projects, and at the same time assuring risk responsibilities and objectives are understood by the staff in the project organization.

2.2 Chosen risk management frameworks for comparison of the Capital Projects RM plan.

It is important that the RM process is established early in a project, and that risk is addressed throughout the product life cycle (H. Kerzner, 2001). Several different documented risk management frameworks have been developed to manage and avoid possible risk events. Through literature search these frameworks are identified:

- The AS/NZS 4360:2004 Risk Management standard, (2004)
- FERMA, Federation of European risk management associations, A risk management standard, (2003)
- Integrated risk management framework, Treasury Board of Canada Secretariat (Treasury Board Canada, 2001)
- The UK Cabinet office approach (UK Cabinet office, 2002)

- The COSO Enterprise risk management framework (COSO, 2004)
- The risk governance framework, IRGC (Renn, 2005)
- Project Risk Analysis and Management, (PRAM, 2001)

In this thesis the evaluation of risk management frameworks have been limited to:

1) AS/NZS 4360:2004 standard

2) FERMA standard.

The reason for choosing these two frameworks is their acknowledgement as risk management frameworks for projects.

2.2.1. The AS/NZS 4360:2004 Standard

The AS/NZS standard is applicable to many different industries, such as the public sector, public enterprises, partnerships and non government organizations, the handbook is based on the Joint Australian/ New Zealand Standard. It can be applied to both individual activities or to an entire business, and describes an overall approach to risk management.

2.2.2. FERMA, Risk Management Standard

The Risk Management Standard developed by FERMA is a result of work done by several risk management organizations in the UK; the Institute of Risk Management (IRM), The Association of Insurance and Risk Managers (AIRMIC) and ALARM the National Forum for Risk Management in the Public Sector. This standard has used the terminology for risk set out by the International organization for standardization; the team has also taken opinions of a wide range of other professional organizations with risk management interests into consideration.

3. Review of the documented RM plan in the Capital Projects organization

In this chapter a review of the documented RM plan in the Capital Projects organization will be presented. First a presentation of the areas which will be reviewed is given. Second the actual review is carried out, and finally the main findings and suggested steps which can be included in the RM plan are presented. Each step of the process is reviewed and compared to the two standards. Furthermore a list of key elements has been added in appendix 3 to illustrate which elements should be included in each step of the process.

3.1. Areas in the PRMP and PRMG which will be reviewed and discussed

To evaluate the PRMP in the CP two different risk management frameworks have been chosen as a basis for identification of possible areas for improvement, see paragraph 2.1.1 and 2.1.2.

Areas which will be evaluated and discussed are:

1) Review of the definition of risk in the PRMG at the CP organization
2) Review of the PRMP and the PRMG in the CP organization

Point 1 and 2 will be discussed in the following section.

3.2. Review of the definition of risk in the PRMG at the Capital Projects organization

Defining risk properly is an important aspect in the RM plan, because vagueness in relation to the definition of the word risk might lead to different implementation of methods later on in the RM process in the different projects in the CP organization. The definition of risk in the PRMP and PRMG will be compared to the definitions in the AS/NZS 4360:2004 standard and the FERMA standard. The selected frameworks define risk in different ways:

3.2.1. AS/NZS

In the AS/NZS risk is defined as: *"the chance of something happening that will have an impact on objectives"*

3.2.2. FERMA

FERMA uses the ISO/IEC Guide 73 definition of risk: *"Risk can be defined as the combination of the probability and its consequences"*

3.2.3. PRMG and PRMP

In the PRMG and PRMP documents risk is defined as: "*The degree of exposure to undesirable outcomes"*

The PRMG definition of risk is somewhat unclear. The definition does not define "*degree of exposure"* or "*undesirable outcomes*". The definitions should be more precise in explaining what is meant by "*the degree of exposure*" and "*undesirable outcomes*". First of all, "*the degree of exposure"* could be the probability or an initiating event causing an undesirable outcome. Second, an undesirable outcome is a wide concept which can result in not achieving the projects objectives in terms of cost or schedule or in the the worst case the project can be cancelled. A risk can be difficult to assess or monitor when the definition of what risk is, is unclear and perhaps perceived different in the projects.
Third, according to Chapman and Ward, 2004, the term risk should also include opportunities. When the PRMG use the term "*undesirable outcomes*" in the definition of risk, this excludes the possibility of including opportunities. When including opportunities in the definition of risk this may encourage the identification of factors which can affect the achievement of project objectives in a positive manner.

The other two definitions in AS/NSZ 4360:2004 and FERMA, differ in some degree in the way they define risk, but they refer to the terms objectives, consequences or probability in their definitions. Either "*objectives"* or *"consequences"* are used instead of the term *"undesirable*

outcomes", while "*probability"* is used as a term instead of "*degree of exposure*". A weakness may be the vague definition of probability. According to Ale B. et al. 2008, the definitions lack a sound scientific basis, when probability is not defined accurately. In PRMG likelihood is defined as "*Probability of occurrence"*. A more descriptive definition of probability could be introduced which takes into consideration important aspects of risks (see appendix 4).

To improve the definition of risk in PRMG, the terms "*degree of exposure*" and "*undesirable outcomes*" could be replaced by more accurate terms, which are consistent with the description of the underlying components for the risk for an event. The definition could also be extended to include opportunities as a factor of consideration, when identifying and analysing risk in projects. Finally an accurate and precise definition of probability could be included in PRMG or in the definition of risk.

3.3. Review of Project Risk Management Guide and Project Risk Management Plan Procedure

In this section the PRMG and PRMP will be contrasted and compared to AS/NZS 4360:2004 Standard and the FERMA standard. The review will mainly focus on areas mentioned in the documented plan and guide. The whole process of RM in the CP organization will not be described in detail. In addition to comparing the different steps in the RM process other areas that might be missing but should be considered, will also be suggested.

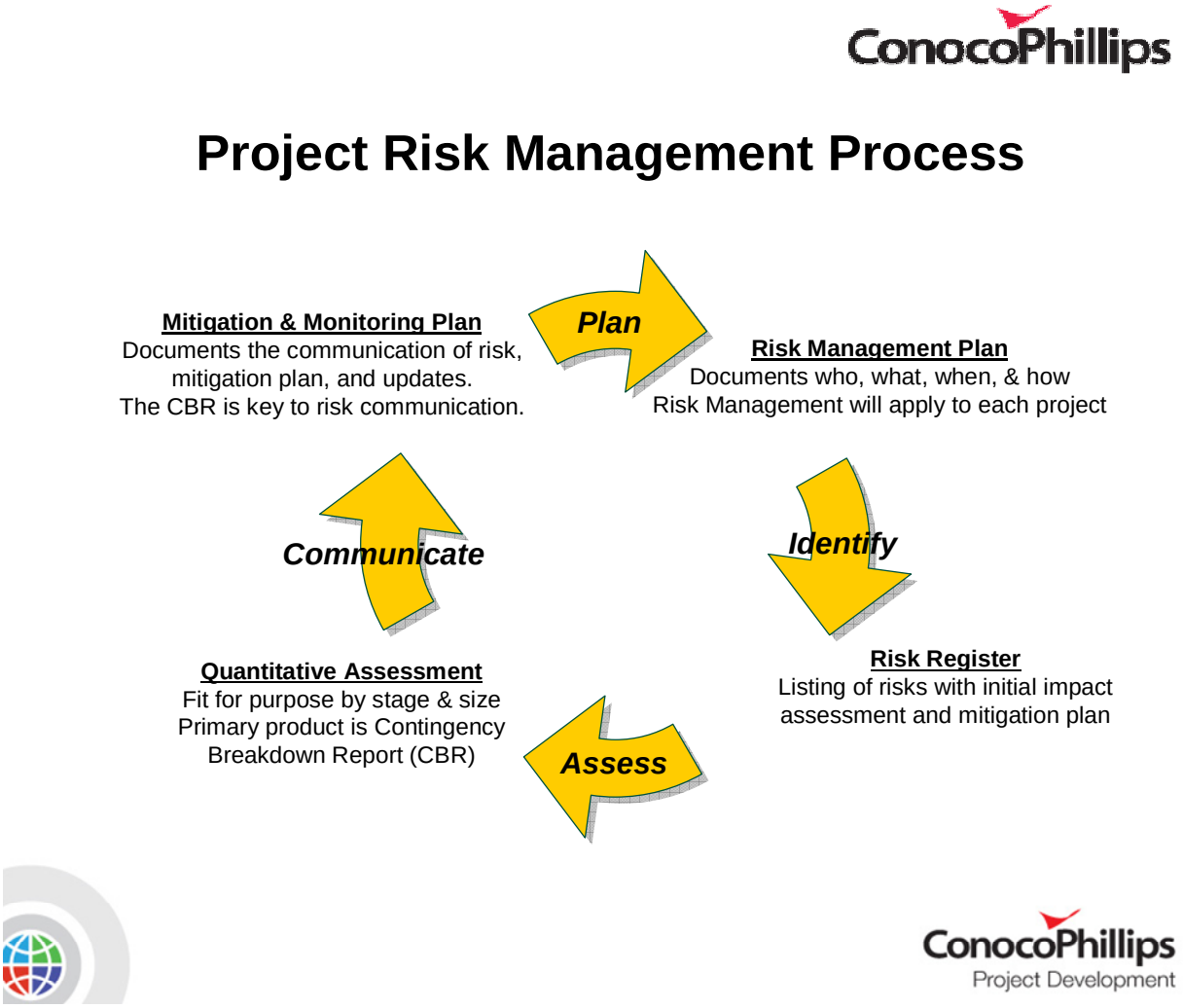


Figure 2: The Project Risk Management Process in ConocoPhillips

Figure 2 represent an overview of the RM process at COPNO, these steps are an ongoing process through out all phases of the projects. See appendix 2 for detailed description of which activities a RM plan should cover.

3.3.1. Step 1: Plan

In the PRMG this stage is defined as Step 1: Plan. At this stage the projects objectives are given, and the risk management plan is developed in relation to cost and benefits or health and safety amongst others. The project manager and functional managers decide who is responsible for the different activities and when and how risk management activities should be executed, throughout the project life cycle.

The risk management should according to the PRMG:

- Define roles
- Identify data needed and how to provide the data
- Document how the risk register should be developed and when and how it should be updated
- Develop Contingency Breakdown Report (CBR), define when to conduct the schedule and cost assessment.
- The plan should also be revisited and communicated with stakeholders in each phase of the project

The AS/NZS 4360 standard states that stakeholder identification is an important aspect of every risk management activity, the PRMG document does not mention who the stakeholders are or how to identify them. A suggestion or an example of how stakeholders can be identified should be mentioned in the PRMG. Through the identification of stakeholders and including them in the process early on, one can ensure that the objective of the risk management process meets the objectives of the stakeholders. Further on, the planning phase in the PRMG should give a short description of the different types of external and internal risks which are among the top ten risks for each type of projects.

This step in PRMG/PRMP does not deviate from AS/NZS 4360 standard or the FERMA standard. But could be more specific in explaining the actual process and what is being done in practice.

3.3.2. Step 2: Identify

Opportunities and risks affecting the decision- making process are identified through systematic search for events, examining the project and each critical technical process for risks. Identification of possible risks is of great importance to the project in order for them to manage and control them. Risks will vary with the type of project which is conducted. An example could be starting a new project using a type of technology which has never been used before, in such cases there exists no or little history data from earlier projects to you identify sources of risks (Universal risk project, 2006). Identification may include a survey of the project, customer and users for concerns and problems.

Identification of risks at COPNO is a three step process which involves data gathering, qualification of risks and documenting the risks in the risk register. The data gathering at ConocoPhillips is conducted through brainstorming workshops facilitated by a risk specialist. Risk data from other project sources or one-on-one interviews by the risk specialist may be used to identify risks that are difficult to identify. Other sources for risk identification may include:

- Lessons learned reports
- Integrated project reviews and assists
- IPA reports
- Project closeout reports
- Performance data on existing projects
- FEL assessments on similar projects

Furthermore, the identification of risk should be verified by a discipline risk advisor. A risk identification workshop includes participation from all functions, such as technical diciplines, procurement, HSE and commercial. The organization of risks is divided into four categories: Definition, Technical, Commercial and Stakeholder.

Next step after collecting the data is qualification of the data. The qualification is divided into a list of likelihood of risk occurrence and impact of the risk on the project. The likelihood is divided in 3 categories from Low, Medium to High. Low represents risk which have a probability of occurrence less than 20%, medium are risk which have a chance between 20%-80% of occurrence, high are risks which have a chance of occurrence greater than 80%. Impact is also sorted in low, medium and high categories. The impact is evaluated on the basis on the impact it has on costs or schedule. Low is defined as less than 5 % impact to cost or schedule, medium impact has an impact to cost or schedule between 5% - 10%, and high has an impact on cost or schedule greater than 10%.

The last step is to document the risk in the risk register on a monthly or weekly basis to document the history of the different risk types. The risk register is meant to be used actively by

the management. Areas which should be included in a risk register are: Risk ID, Functional Area, Title, Description, Likelihood of occurrence, Impact, Mitigation action, Risk owner and status.

A qualitative assessment of the identified risks is also conducted to identify the risks with the highest probable impact to the project. The overall impact of the risk is a combination of the risk probability and the risk impact. The probable impacts are used by the risk specialist to distinguish between risks that need quantitative assessment and modelling.

The description of these steps does meet the suggested approach for documentation of the identification step in the AS/NSZ 4360:2004. Four areas should be included when documenting of this step:

1) the approach or method used
2) the scope covered by the identification
3) the participants in the risk identification and the information sources consulted
4) a risk register

The risk register should be presented in this part to illustrate how a risk register should look like and what it should consist of. A detailed description of the risk register and explanation of how the tool is used could be applied to the document.

3.3.3. Step 3: Assess

An analysis starts with a study of the risks identified and focuses on estimation of the risks costs, consequence if the risk should occur and the probability of occurrence. Risks are analyzed, considering likelihood and impact, as a basis for determining how they should be managed (Kerzner, 2001). This stage also includes identifying the controls and their effectiveness. The risk analyses are often based on information from historical data. Such as: experience, results from tests, comparisons with similar studies, expert judgements, modelling and simulations or sensitivity analysis of alternatives. Both qualitative and quantitative analysis methods can be used to assess potential consequences (Kerzner, 2001).

In the PRMG document the objective of this phase is to find the appropriate cost and schedule contingency levels based on identified risk drivers. The key participants at this stage are risk specialists, risk coordinator and the project team members.
At COPNO the key risks are assessed using both qualitative and quantitative methods, such as Monte Carlo or Decision tree, to generate a range of outcomes for cost and schedule duration. In addition, information from analogous projects and empirical assessment will be done to determine if additional contingency is required for large complex projects. To determine an acceptable contingency all three sources of information are combined.

The procedure for quantitative assessment is modelling of potential costs and schedule impacts of risks. A brief explanation is presented in the actual document, accompanied by an appendix for detailed description. The potential impacts are characterized in a range of outcomes using estimates of P10, P50 and P90. Through a series of interviews risks are quantified on the P10, P50 and P90 basis afterwards the risk advisor will run Monte Carlo simulations. The risk model output consists of S- curves detailing the probability of arriving at a predicted cost or schedule date. The required contingency should be defined as the difference between the calculated P50 from the S- curve and the original deterministic estimate, where all the known costs are included.

For the quantification of risks PertMaster, Crystalball and sometimes @Risk are used. The mentioned methods used are not, but should be mentioned in the PRMG or the PRMP, and perhaps described in one of the documents. Including a description of the different analysis tools might increase further understanding of the risk management process and its benefits among other employees. The whole process might be perceived less as a field for “experts only” if the use of them is described.

Another thing that is left out but which might be important to include is a description of how to analyse opportunities. Most risk analyses are directed at identifying the negative consequences of risks. The likelihood of possible beneficial outcomes should also be evaluated. A suggestion for how to do a qualitative opportunity analysis is suggested in the AS/NSZ framework:

Level	Descriptor	Description
1	Insignificant	Small benefit, low financial gain
2	Minor	Minor improvement to image, some financial gain
3	Moderate	Some enhancement to reputation, high financial gain
4	Major	Enhanced reputation, major financial gain
5	Outstanding	Significantly enhanced reputation, huge financial gain

Table: 1

Together with a probability ranking figure (see figure 3) this table 1 can be used to combine the likelihood and consequence ratings to determine the level of opportunity.

"Very high opportunity: requires detailed planning at senior level to capture the opportunity

High opportunity: Senior executive management attention needed and management responsibility specified

Medium opportunity: manage by specific monitoring or response procedures

Low opportunity: manage by routine procedures, unlikely to need specific application resources" (AS/NZS 4360:2006)

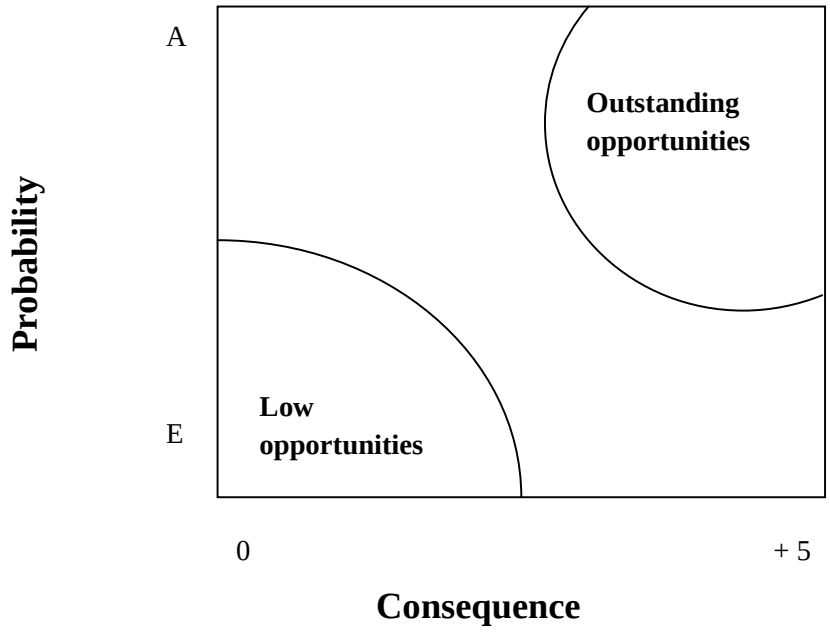


Figure 3

Further on the treatment phase, step 5, which is mentioned in the AS/NZS 4360 and the FERMA standard is included in step 3 the assessment of risk in the PRMG.

Management chooses risk responses, and develops actions for treatment of the risks. At this step the risk is evaluated to be acceptable or not. The objective for this stage is to develop cost effective solutions for treating the risk. Berg Heinz Peter recommends four treatment options:

a. Tolerate risk: is when the organization or project decides to tolerate the risk., this happens when the consequences are tolerable or when the cost of implementing the risk reducing action is too high

b. Share risk: share the risk with other parties who are capable of handling the risk, sharing the risk through a contract or joint venture

c. Reduce risk: taking action to reduce the risk.

d. Eliminate risk: Avoid performing the activity

This step is included in the assessment step in PRMG, here both risk mitigation and contingency plans are briefly described. A description of how the procedure for identifying how the responses are chosen is also presented in PRMG, but direct examples of how to do this are not presented. Another weakness in the PRMG is the lack of description of how the risks are evaluated as acceptable or not, a documented procedure should be in place to avoid any discrepancy between the evaluation criterions in the different projects.

3.3.4. Step 4: Communicate

At this point relevant information is identified, captured, and communicated in a form and timeframe that enable people to carry out their responsibilities. Effective communication also occurs in a broader sense, flowing down, across, and up the entity (COSO, 2004). In the PRMP the process of communications is described as the point where the project team should address the project risk profile at regular team meetings. The persons responsible for communicating the risk profile and plans of the project are the risk coordinator and project leadership. Through the contingency breakdown report (CBR) the cost and schedule risk profile is presented and

communicated to the senior management. The purpose of the CBR is to facilitate discussions on risks types and mitigations efforts undertaken. The communication process is expressed as an activity which should be a continuous process

The AS/NZS 4360 points out that an organization should ensure effective communication and updating of the risk register. To guarantee this the management in the CP organization could establish a team responsible for communicating how risk is managed and communicate the organizations policy on the subject of risk. The team should also establish greater awareness of the benefits of risk and risk management. Further on, effective management and implementation of risk should be a part of each projects philosophy, goals and accepted practices, it could also be a part of the projects training program.

Insufficient communication can increase the probability of doing the same mistakes in following projects, because of this COPNO should focus on ensuring the communication process and follow up with controls of the activities.

3.4. Main findings in the review

The document describes an overall procedure for project risk management which converges with the AS/NZS 4360:2004 Standard and the FERMA standard. The plan is an overview of the main points in the RM process. The steps in the PRMG are somewhat similar to AS/NZS 4360 and FERMA except from different terminology.

The PRMG is a document for describing the risk management plan, compared to the AS/NZS and FERMA, the document is very general and little details are given of the actual process, additional steps could be included in the plan. When contrasted to the other standards for RM it is a bit hard to follow and ambiguous and not very precise in what it is saying that needs to be done. It is a very general document.

Weaknesses in the PRMG document are lack of description of how the activities are intended to be carried out. Areas of improvement could be to focus on a better description of the activities in the process and document them. A description of the risk register and explanation of how PertMaster and other tools are used could also be applied to the document. Through better descriptions and explanation of the different tools and procedures greater awareness and understanding of the different benefits of RM can be improved. Further on, the importance of

identifying opportunities should also be an area that should be discussed further by COPNO and elaborated in the plan. If the identification is considered as an area out of scope for the RM plan it should be mentioned why these positive risks aren't included as a part of the RM plan.

3.5. Suggested steps that could be included in the PRMG or the PRMP

3.5.1 Analysis of the internal environment

Before the first stage set objectives/plan it is suggested to analyse the internal environment of the organization. The internal environment of the organization is where the basis for how risk is viewed by the organizations staff, their philosophy and ethical values. Both the AS/NZS Standard and FERMA include identification of internal risk factors. The importance of understanding the underlying culture in the organization is stated in both of the standards, through establishing the strategic, organizational and risk management context of the organization, and identifying the constraints and opportunities of the environment. Analysis of the internal environment can be conducted through a review if the regulatory requirements, codes and standards, industry guidelines as well as the previous years risk management and business plans. The PRMG does not describe the culture within the organization or mention that it should be taken into consideration. What it does mention is identification of organizational risks associated with leadership, and definition of roles and responsibilities of the employees. COPNO could do an analysis of the culture in the CP organization, to find and describe the attitudes among the employees towards risk and risk management. Through an analysis the need for any attitude campaign or other initiatives can be set. If an organization has a risk seeking attitude this could be found by doing interviews or questionnaires, and the results could hopefully be used as a tool for identifying activities to improve the risk culture.

3.5.2. Monitor and review

In the PRMG and PRMP there is not a separate section for how the monitoring process of the RM process is or should be. In figure 2 a documented monitoring and mitigation plan is mentioned as a part of the communication step, but there is not a separate section implemented in the document as stated in the figure. Information about the procedures for monitoring should be

added to inform about how the monitoring is done by management, third parties and the RMG. However, a short description of how the risk register should be updated and reviewed and how often is given in the PRMP, but the description is not very specific. A brief explanation of the procedure for updating and reviewing the risk register is given. As explained in the PRMP the review covers risk description and status, updates to impact assessment, review of mitigation actions review of modifications and how often the risk register should be reviewed. The different responsibilities of the Project manager, Risk coordinator, Risk specialist and the Risk owner are described in PRMG in the last section.

A separate step for monitoring is included in both the AS/NZS 4360:2004 Standard and the FERMA standard. The AS/NZS 4360:2004 Standard the monitoring part of the RM process is mentioned as an essential and integral part of managing risk, and is considered as one of the most important steps of the management processes organizationally. In addition to monitoring risks the effects of mitigation activities and strategies should be monitored. According to the FERMA standard a monitoring process should determine whether the activities resulted in what was intended and if the right activities were undertaken for mitigating the risk. Furthermore, the monitoring process should be a continuous activity throughout the execution of projects.

3.5.3. Include a short description of the Project Authority Guidelines

In the Project Authority Guidelines a recommended strategic approach project analysis is presented, this should also be included in the PRMG to assure understanding of when RM is a part of the project in the different phases.

The Project Authorization Guidelines is a framework developed to communicate a projects value and risks such that the management can make fully informed decisions. The individuals who are responsible for developing and presenting different projects must ensure that the guidelines are followed. The project framework in the PAG describes a structured approach to project analysis which is the same for projects regardless of size or complexity. The plan provides a description of activities and expected accuracy for guidelines at each phase and approval gate (See appendix 5). In the first decision gate, identify (FEL-0), risks and opportunities of a potential project are identified, before moving to next phase, Appraise (FEL-1). In the Appraise phase different alternatives of development are prepared and further analysis of risks, uncertainties and values are assessed. The next stage is the select phase, in this phase all risk are expressed as P10, P50 or

P90 ranges, with an accuracy of -20 % to +40%. The aim is to optimize value drivers within the constraints of technical, commercial, political and risk and uncertainty at each phase. The risks are identified and mitigated through the involvement of staff expertise and effective communication with the project team.

After having reviewed the documented RM plan at the CP organization it will be constructive to see how this actually is done in practice. To do this the Risk Management Maturity Model is used to assess how mature the projects are in relation to the implementation of the documented RM plan. The aim will be to identify if the RM plan is implemented successfully and serves its purpose. Furthermore the objective is to identify the risk maturity level and recommend how the next level can be achieved.

4. Review of RMML in the Capital Projects organization

In this chapter the risk management maturity level in the Capital Projects organization will be reviewed. First the risk management maturity model and the 5 levels in the model will be presented and explained. Second a comparison of the results from the interviews done in the Capital Projects organization will be compared to the RMMM. Finally, a level for the 5 specific attributes in the model is classified.

4.1 Presentation of the Risk Management Maturity Model

The RMMM is a maturity model aimed at evaluating the RM plan in projects or organizations. The model is based on the Capability Maturity Model (CMM) for software systems and the CMMI for Systems Engineering organizations. It was originally developed for software engineering by the Software Engineering Institute, at Carnegie Mellon University. The concept of maturity models is well developed and accepted (RMRP, 2002), and has been applied to many aspects of organizational, human resource, people, project, and product development as a framework for improvement of different technological and organizational processes. The benefit of the RMMM is the ability to identify areas of improvement and weaknesses related to processes and performance. The evaluation of the organizations risk maturity takes form of a reference model, guiding the development and building of a process.

The RMMM is a staged model describing five levels of risk management maturity. The model is divided into 5 maturity levels, each level represents a maturity stage with different criteria which has to be fulfilled to be categorized at that specific level (Mutafelija, Boris, 2003). The model defines 5 levels of capability and maturity: 1) Ad- Hoc, 2) Initial 3) Defined 4) Managed 5) Optimized (See figure: 4). Each level is clearly defined, to enable the organization to evaluate them selves and find the stage they are at. When the right level is identified, the organization can plan and choose ways or activities of improving their current status and decide how to achieve the next level.

Risk Management Maturity Level Development

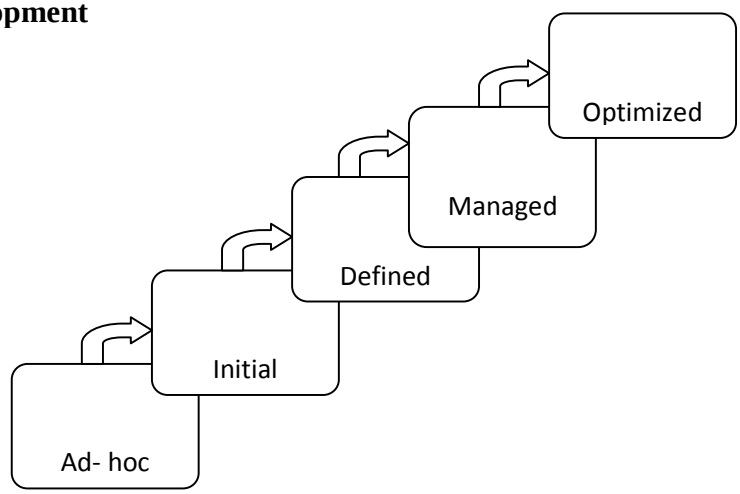


Figure: 4

4.2 Description of the five levels in the Maturity Matrix

In this section of the chapter each level of the risk maturity model is described to give the reader insight and knowledge of the content in the model before comparing the interviews to the RMMM.

4.2.1. Level 1: Ad Hoc.

At the Ad-Hoc level, the organization has no structured approach for dealing with risk and uncertainty, and is unaware of the concept of risk management. Further on, processes are often repetitive and little effort is made to learn from previous projects, additionally there are not made any attempts to identify any risk which may occur during the project and prevent the organization to achieve its objectives (Risk Management Maturity Level Development, April 2002). Problems are dealt with after they have occurred, and there are little mechanisms to cope with unexpected events. The organization is weak in even basic systems approach in managing projects (Yeo K.T. and Yingtao Ren, 2008). If a project is successful, it is because of the effort

of the individuals in the project, not because of the process or RM plans. Often a project at a level 1 doesn't realize that a risk management plan is needed (Risk Management Maturity Level Development, April 2002).

4.2.2. Level 2: Initial.

At this level there are implemented some basic risk management activities in the organization, but only at an experimental level, usually through choosing a few persons in specific projects. The project organization might be aware of the benefits if risk management, but has not implemented any RM process activities (Yeo K.T. and Yingtao Ren, 2008). Some learning from past projects are done, however, there is no formal process which ensures that these lessons are spread to other projects or person s in the organization. At this level the organization is becoming aware of the potential benefits of RM (Risk Management Maturity Level Development, 2002).

4.2.3. Level 3: Defined.

At the defined level, a Risk Management system has been developed and implemented in the organization. Generic risk management policies and procedures are formalized and implemented in most projects (Yeo K.T. and Yingtao Ren, 2008). New projects are planned and managed based on experience from earlier and similar projects. The benefit of RM is understood at a higher level of the organization. A risk management plan is developed to identify probability, impact and severity of risk events qualitatively, predictable or known risks are dealt with, and risk owners are identified. All projects have an assigned project manager, who tracks costs, schedules, and track reduced quality (Risk Management Maturity Level Development, April 2002). The risk manager also collaborates closely with contractors to develop a strong relationship.

4.2.4. Level 4: Managed.

At the managed level a risk aware culture has been established and a proactive approach risk management. The risk information is actively used to improve the organizations probability for achieving its objectives successfully. Processes implemented in level 3 are used and further improved, a risk management plan is also documented and implemented across the organization. To assure proper communication to organization management, a group of personnel is established to be responsible for risk management and control. Further on, at this level, a training program is implemented to ensure that the staff and managers have the knowledge and skills required to fulfil their assigned roles (Risk Management Maturity Level Development, 2002).

At this level, measurable process goals should be established for each of the RM process in identification, assessment and response. The impact and severity of the different risk variables can be measured quantitatively, further on measures of the different risk response strategies are developed and documented, and risk mitigation outcomes and performance are monitored and analyzed. This improves the organizations ability to predict performance of risk mitigation measures.

At this level risk management includes both internal and external key projects stakeholders, such as contractors, suppliers, clients and internal corporate management. The organization has also established a risk awareness mindset that requires a proactive approach to the management of risks.

4.2.5. Level 5: Optimizing

At the optimizing level, the organization has established a comprehensive RM plan, with defined RM goals and use of both qualitative and quantitative measures. A high level of risk awareness is established into corporate culture, attitude and behaviour, along with adaptive project organization, team empowerment and self-organizing guided by corporate protocols to reduce systemic risks and deal with unforeseen emergent risks. Societal networking, comprehensive institutional arrangements and partnering with external stakeholders and government agencies are in place. Project team members are sensitive to risks and opportunities and the needs to communicate freely and build a teamwork environment. This level is rarely achieved by any organizations and is therefore not included in the model in appendix 1. The criterions in the model have been selected form two RMM models, the first is a RMMM from the Risk

Management Maturity Level Development, 2002 and Risk Management Capability Maturity Model for Complex Product Systems (CoPS) Projects, (Yeo K.T. and Yingtao Ren, 2008).

Figure 5 is an example of the five levels for the attribute, definition. At level 1 one can see that there is little risk awareness and no investment in training and management. The model moves on from level 1 to a level 5 where risk management is explained as an ability to manage both known and emergent risks, furthermore the organization understands the benefits of RM and is able to actively use information to improve organizational processes and gain competitive advantage. In appendix 1 the complete RMMM is attached.

Figure 5

	Level 1 Ad Hoc	Level 2 Initial	Level 3 Defined	Level 4 Managed	Level 5 Optimizing
Definition	- Approach to risk is unstructured (ad hoc approach) - Limited or no awareness of current legislation -No understanding of risk management principles or language - Little interest in the subject - No investment in risk management or training - Risk events are treated after they have occurred -Little or no attempt to learn form past projects	- Recognition of benefits of risk management, but ineffective implementation - Some risk management training - No structured approach - Organizational support at organizational level - Experimenting on some aspects of risk management process and tools application	- RM process are integrated in most or all projects - Benefits understood at all organizational levels - Proactive behaviour to risk and threats - Effective management of known risks - Management support to formal RM system - Formalized generic process	-Appointment of a risk manager - active use of information to improve organizational processes and gain competitive advantage - Capable of managing almost all predictable risks, and manage some emergent risks - High risk awareness - Risk sharing with other parties - Institutionalized RM process	- Ability to manage both known risk and emergent risk - Develop strategic alliances and partnering with external stakeholders - Strategic business risk planning - Involvement of stakeholders and affected parties in the RM process

4.3 Comparison of results from interviews in the Capital Projects organization with the RMMM

The Risk Management Maturity Model is as mentioned a tool for assessing how mature an organization is in relation to identifying, assessing, mitigate and monitor risk. To evaluate the risk management maturity level in the CP organization the attributes: Definition, Culture, Process, Experience and Application will be reviewed. Maturity level will be identified for each attribute (See figure 6).

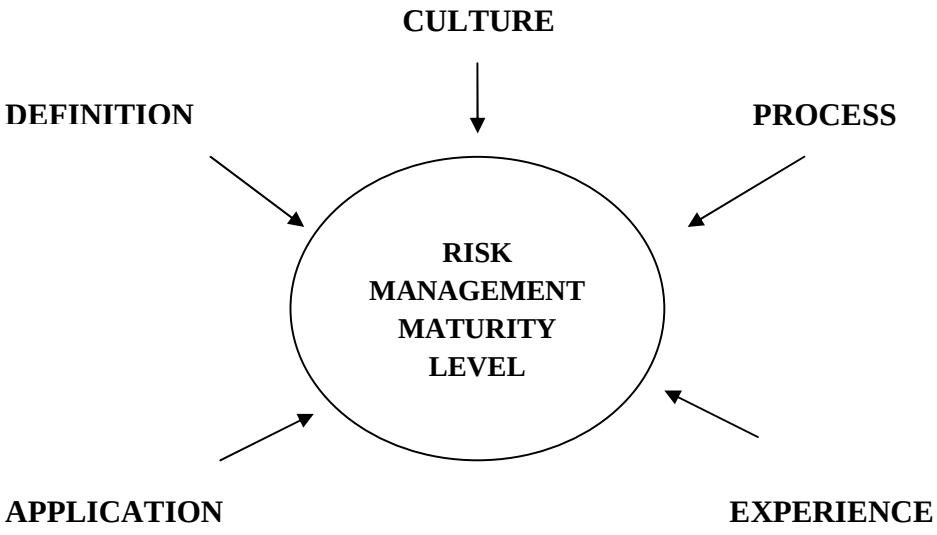


Figure: 6

Interviews with two project managers and one project controller employed in the CP organization have been done to collect relevant information for the comparison. The interview consists of 17 open ended questions based on data from the RMMM (see appendix 6). Open ended questions have been chosen for the interviews to ensure that the respondents explain and share their own knowledge and experiences. The reason for choosing open ended questions is because an interview with closed questions would limit the respondents answer to predetermined

alternatives. Finally, the answers given in the interviews will be compared and checked to the criterions in the model.

The different criterions under each level in the RMMM represent predetermined factors which are required to be defined as a level 1, 2, 3, 4 or 5. Potential gaps between the criterions and answers will be considered as areas of improvement to accomplish a certain level. Appendix 1 gives a presentation of the RMMM and the criterions which should be present at for each attribute and maturity level in an organization.

4.3.1. Definition

The objective of this attribute is to review to which extent the organization is aware of the need of managing uncertainty and the benefits of having a structured approach in place in the organization.

In the CP organization a risk manager is appointed and the management supports a formal RM system. As discussed in section 2 a guide and plan for risk management is documented, but it should be mentioned that the plan has limited description of the actual RM process.

All of the respondents agreed to that the CP organization has a structured RM process approach in place for dealing with risk in all projects. Each of the projects are responsible for reporting all types of risk identified to the Risk Management Group (RMG), either through workshops or interviews, the Risk coordinator and the project team members have the responsibility of updating the risk register. Procedures for risk identification, assessment, evaluation, monitoring and communication are implemented as a requirement in the CP organization. One of the respondents mentioned that on of the weaknesses might be less formal procedure for risk management in smaller projects.

All of the interviewed respondents pointed out that risk information are gathered through workshops, interviews, similar projects, communication with stakeholders and meetings and discussions with other operator companies. Furthermore the effectiveness of a mitigation action is documented in the risk register and applied to new projects if the information or lessons learned from previous projects are applicable. A weakness mentioned by all of the respondents was that the risk register might be forgotten after closure of a project.

Two of the respondents mentioned the PAG as an example of a proactive culture in the organization. Through the project framework in the PAG it is required that the upper management approves the risk responses/risk or contingency plans for costs and schedules before the project can enter next phase of the project. Contingency plans are developed for risks which have a low probability for occurring but will have high impact if they should occur. This illustrates that a proactive behavior to risk exists in the organization, the procedure is a requirement for all projects and needs approval from the RM department before entering the next FEL phase of the project.

When asked about the benefits of RM all of the respondents answered that RM is beneficial to prevent risks form occurring or to reduce the impact of possible risks. Other benefits mentioned were also to avoid exceeding schedules and cost and one interviewee also mentioned the benefit of identifying opportunities to increase quality.

4.3.2. Leadership and organization (Culture)

Culture is often defined as a common held set of beliefs (Pickett & Pickett, 2005). The aim of this part is to uncover if the culture in the CP organization is risk aware and acknowledges the benefits of RM. To attain the benefits of RM it is important that the project managers and the employees understand this to achieve the best possible implementation of the PRMP and PRMG.

When the respondents were asked about the benefits of RM all of the respondents mentioned that RM should identify and diminish the risks impacts on costs and schedule. Further it was acknowledged that a risk could change over the different phases of a project. Because of this it is necessary to continuously update the risk register. They also recognized the fact that the probability of an identified risk occurring identified in the start phase of a project might diminish at the end of a project and new risks may be identified.

One of the respondents reported that the culture was not always proactive but sometimes depends on person and situation. The area of safety is always proactive, but proactive behaviour within cost control can be improved. Because of this the respondent emphasized the importance of leader follow up, such as asking the leader for a report of the CBR, by requesting this the leaders have to understand the content of the report.

All of the respondents mentioned that analogous projects outcomes are used to check on the contingency necessary. If the project is not analogous, the project is broken down in components and compared with similar project components.

The organization is defined as risk averse by the respondents, by this it is meant that the project teams focus on identifying possible risks to avoid that any mistakes are done. All three respondents mentioned that sometimes the focus on opportunities could be underestimated compared to the identification of risks.

All three respondents answered yes to the question if RM was considered as an important part of the project execution. But one of the respondents answered that it might be seen as “extra work” by employees who typically are specialist within one field of expertise. It is significant that other parts of the organization also recognize the benefits of risk management and its importance. Another of the respondents mentioned that the contingency might not cover the risk if worst case scenario actually occurred.

There is little knowledge in the projects of the tools used in the quantification of uncertainty and risk. When interviewing the respondents none of them had any knowledge about Pert Master. Monte Carlo simulation, excel sheets and Crystalball were mentioned as known assessment tool.

4.3.3. Process

The aim of this attribute is to identify if the projects has a formal RM process implemented and how extensive the use of quantitative or qualitative risk analysis is. This is an essential part of the PRM, where an evaluation of the RM process and how mature the project is in relation to implementation of the different RM tools and how they are applied/used.

The most important aspect in the process of monitoring risks was mentioned to be the facilitator. All of the respondents emphasized the importance of a good facilitator who asks the right questions to get the team to come up with new risks. One of the respondents reported that some of the staff members in a project sometimes might be biased, meaning that the job of identifying

has become a routine. According to this respondent a good facilitator will challenge established thought patterns.

Two of the respondents pointed out that the risk register might be forgotten after a project is closed. Focus should be on using the risk register as a tool which is constantly updated and reviewed and a part of the project which is used on a regular basis.

Process effectiveness depends heavily on the skills of the project risk team and the availability of external support. The RMG is involved in all of the projects in the CP organization, there is not a risk manager appointed for each of the projects. The RMG group consists of 3 risk specialists, who are the in house- core expertise on risk management.

The respondents were asked if external and internal stakeholders are included in the decision making and risk identification. All of the respondents confirmed that external and internal stakeholders were included in decision making. The external stakeholders are included through contracts and agreements. Internal stakeholders such as management and headquarter are also included.

The respondents were asked if the identification of opportunities were prioritized to same extent as risks. Two of the respondents answered that it was not the same focus on identification of opportunities. One of the respondents pointed out that identification of opportunities is more difficult than identifying risks, but if an opportunity came apparent during one of the phases of the project this opportunity would be taken advantage of. Another respondent also mentioned that because the organization is risk averse and want to stay within the budget which has been set, the focus is mainly on identifying risks. Further the respondent pointed out that a good analysis should consider both negative and positive risks. An experienced coordinator will focus on both sides during a workshop.

4.3.4. Experience

It is important to understand how experienced the managers and risk professionals are in the project; is there a trained group who does the analysis, assessments and risk monitoring or is there a lack of understanding of risk principles and procedures.

COPNO has an in-house core expertise which is formally trained in basic risk management skills. The risk management group at the CP organization consists of 3 risk specialists, their responsibilities are to facilitate risk assessments to determine project contingency requirements. Furthermore, the risk specialists operate the risk model and are responsible for communicating results of risk quantification to the team and project manager. The risk coordinator ensures that communications on project risks to project management, maintains the risk register and ensures consistency, quality and accuracy of risk descriptions in the project risk register.
All of the respondents acknowledged that the facilitators experience was a vital factor for the quality of the results from the workshops. A good facilitator will challenge old thought patterns and motivate the team to come up with new risks.

The respondents were asked if they had any knowledge to the PRMG or PRMP, two said they had little knowledge about the document, but had read through it. The last respondent reported participation in the development of several risk management plans within different projects. None of the respondents could mention any weaknesses of the plan, this could be due to little knowledge of the details in the plan or a belief that it covers all aspects of is required.

Two of the respondents reported that it was normal procedure to discuss and solve problems together with other employees with similar experience or knowledge form earlier projects.

All of the interview respondents gave a good description of the overall risk management process in the Capital Projects organization, none of them showed any lack of knowledge.

4.3.5. Application

The aim of the area of application is to uncover if the tools and resources are dedicated to all of the projects in the organization. This is an important aspect to consider; if the RM process is only implemented in one or two projects it is at an early level of the maturity matrix, if the organization is to be identified at level 4 or 5 the RM process should be implemented in all projects.

In the CP organization there is a structured application of the RM process in place through PRMP and PRMG, where the RM process is documented, both qualitative and quantitative analysis methods are used to quantify risks.

The respondents reported that the project manager is responsible for implementing the risk management process and plan, and updating the risk register and mitigation plan monthly. The respondents were asked if they had any knowledge of the tools use din the risk assessment phase, none of the respondents had used any of the tools or had any knowledge of how to use them. None had any knowledge of PertMaster, but all three knew about Crystal ball and Monte Carlo simulation. Two of the respondents agreed that better understanding of the tools used in the risk quantification phase could improve the quality of the input information and thereby improve output. One of the respondents mentioned that better understanding of statistics or improved understanding of the basic mathematics behind the quantitative models and tools, have shown improved results according to the respondent, quality of the input improves the quality on the output. The respondent agreed to that education of the staff could be an idea to increase the level of theoretical knowledge. An example of how to achieve this could be a theoretical course for the staff, in addition to the Decision and Risk Analyses course held by a Risk specialist.

One of the respondents mentioned that sometimes the process was not always properly implemented in smaller projects, because of time and cost constraints. The process of identifying risks is sometimes based on risk registers from other projects because of time and costs constraints.

All of the respondents responded that the results of a mitigation activity are known through the execution of the activity, the close out report, risk register and sometimes in the lesson learned register, but a structured evaluation of the effects of the risk mitigation actions does not exist.

4.4. Classification of RMML in the CP organization

To classify maturity level in the organization, a level for each of the five attributes Definition, Process, Culture, Experience and Application will be set. The classification of maturity level is

set on the basis of the author's interpretation of the content in the RMMM. Classification of a single overall level for the organization will not be done because level of maturity varies across the different attributes. Often it is complicated to set an overall level because an organization will have difficulties maintaining a constant level for all attributes for the entire organization over time.

4.4.1. Definition

The interviewed respondents in the CP organization are aware of the need of management of risks; RM is built into all aspects of the organization, through the PRMG, the PRMP, the active use of workshops for identifying risks and stating that a RM plan should be established in all of the projects of the organization. For this attribute the organization can be defined as a level 3 in the RMMM.

4.4.2. Leadership and Organization (Culture)

The management is involved in the RM process through establishing standards and routines for RM and requiring risk reporting in the risk register. The benefits of RM are expected and known among the interviewed respondents, such as reducing risk for exceeding schedule and cost.

When failures are done the failures are recorded as a lesson learned to avoid making the same mistake in similar projects. Since the organization is risk averse the idea of mistakes are not accepted in the projects and RM group, but the organization in general accepts the idea that mistakes are done to encourage staff to report mistakes in close out reports. Further on the management use risk information in decision making and the culture is to some degree proactive through implementation of PRMG, PRMP, risk register and establishing contingency, but as pointed out the organization can not always predict all risks which will occur.

The level of maturity set for this attribute is set to level 3.

4.4.3. Process

A formal process is applied into all of the projects, but the effectiveness is dependent on the skills of the project risk skills and on external support. The process is in place which qualifies for a level 3, but since the effectiveness is so dependent on the RMG it will also partially fit the description of level 2.

RM culture is not permeated in the entire organization, because one of the respondents mentioned that there might be specific parts of the organization which might consider RM as “extra work”. Because of this the organization does not qualify for level 4.

The key suppliers participate in the risk management process through agreements and contracts. Further more the customers are not included in this process which is a requirement for level 4 considering this the organization fits the description of level 3.

The communication between the management is both informal and formal through the established requirements of documenting lessons learned and reporting the effects of risk mitigation in the risk register. Concerning this point the organization fits the description of level 3 and level 4.

For this attribute the level will be set to level 2 for effectiveness of the process, a level 3 for communication and for applying the RM process into all projects.

4.4.4. Experience

Concerning the attribute experience the organization has an RMG which is the in-house core expertise for risk management and develops and uses specific processes and tools. Learning from experience is also mentioned as a part of the process. A weakness with an in- house core expertise is that RM can be considered as a field for experts only. The suggested level for this attribute is level 3.

4.4.5. Application

According to the respondents in the interviews the CP organization has a consistent application of RM in all projects, but not always properly implemented into smaller projects. Both quantitative and qualitative methods are in use when quantifying and assessing the identified risks. The results form the interviews demonstrate that there is little understanding of the quantification process and the tools used to quantify risks. Suggested level for this attribute in the CP organization is level 3.

5. Discussion

In this chapter possible actions and activities which can help the Capital Projects organization to proceed to the next level in the RMMM are discussed.

5.1. How can the CP organization move to the next level in the risk management maturity model

After classifying the maturity level for each of the different attributes in the CP organization action plans for moving towards the next level can be developed.

5.2. Moving from repeatable to managed, level 3 to 4

To move to the next RMM level, which in this case means moving from level 3 to level 4 for all of the attributes, implies that identifying, assessing and managing uncertainty has to become second nature and built into all the activities and business processes of the project (Risk Management Maturity Level Development, 2002). At level 3 processes, documents and the right tools has to be in place, but to achieve a level 4 a risk aware culture which permeates all of the projects in the entire organization has to be established. Different activities have to be implemented to reach next maturity level for each of the five attributes.

5.2.1. Update the RM plan

One of the main findings in section 3 is that the PRMP and PRMG have limited description of the actual RM process performed in the organization. The plan describes only the main activities in the RM process. In addition only one of the respondents refers to good knowledge of the contents in the plan. Further on, one of the respondents mentioned that sometimes there could be a less formal procedure for risk management in smaller projects. Another interviewee said that the implementation of the RM activities in the projects may to some degree depend on person and situation. All of these comments point towards a problem with the implementation of the actual RM plan and guide. The PRMP and PRMG in the Capital Project organization should be reviewed and updated to fit the actual RM process which is performed in the organization. A detailed plan will increase the credibility of the document and hence the importance of RM in the organization. Through conversations and discussions with the RMG it is apparent that there is a

lack of resources to assist all of the projects through all of the stages of RM. This can imply that a solid RM plan and guide with clear guidelines and thorough explained procedures sets the basis for the RM in some of the projects. If the importance of the plan is not understood properly it can lead to an underestimation of the importance of RM in some projects, though RM is a requirement in the organization. The plan should be an important tool for RM and used actively by project managers to avoid the fact that RM in some cases can become dependent on situation or person. To achieve level 4 the RM process should be implemented properly in all of the existing projects and most of all the benefits of RM ought to be understood at all levels of the project.

5.2.2. Use the risk register as a tool for future projects and document the effectiveness of risk mitigation activities

Another weakness mentioned by all of the respondents was that the risk register might be forgotten after the closure of a project. The risk register should be an important tool for future projects besides documenting risks in the ongoing project. Through reviewing earlier risk registers from projects which are similar to the project under development, one can identify pitfalls which might be relevant to the actual project. Reviewing risk registers can be an important source for transferring knowledge into future projects. Mistakes done in earlier projects should be discussed and analyzed to avoid that same mistakes are repeated. One of the criterions for a level 4 under the attribute Organization and Leadership is to accept the idea that mistakes are done by staff.

According to the interviews no document for reporting or analysing the effect of the mitigation activities exists in the organization. There is therefore no auditable track record of what risk management can achieve, resulting in a lack of credibility and a reluctance to adopt risk management more formally. A post analysis of the effectiveness of the activities should be performed to have a foundation for future risk mitigation activities. Documenting both successful and ineffective activities can be an important lessons learned and source of information.

Both successful and failed effects of risk mitigation activities could be announced in a separate report to make sure project team members fully understand the benefits of risk management, or to avoid that staff are losing interest in the process or think of risk management as “extra work”.

5.2.3. Focus on identification of opportunities

Since risks can lead to below standard performance or results these have to be tackled. Often opportunities can be present in many projects where objectives can be exceeded if these are exploited. A similar argument is that a fear of risk means a reluctance of trying out new things, and it is the new thing that can move an organization or a project forward and help them become more successful.

All three of the three interviewed respondents mentioned that sometimes the focus on opportunities could be underestimated compared to the identification of risks. The CP organization is mainly risk averse because of this the job of identifying risks is prioritized. Both the PRMG and the interviewed respondents illustrate that the identification of opportunities is not a priority. The purpose of risk management is to identify different types of risk which may impact the project in a negative or positive manner. By systematic identification and management of project related risks, the overall project performance can be improved. Chapman and Ward highlight the importance of focusing on exploitation of opportunities to improve the overall project performance, not only reduction of downside risk (Chapman and Ward, 2004).

To move up to a level 4 the CPN organization should create further awareness of the benefits of identifying opportunities, not only identification of risks.

5.2.4. Increase risk awareness

Two of the respondents mentioned that risk management though it is a requirement can be considered as “extra work”, mainly by staffs who are experts within one field of expertise. One of the respondents reported that the culture was not always proactive but dependent on person and situation. As discussed in section 5.2.1. a detailed RM plan in the organization can strengthen the importance of RM. besides a documented RM plan a risk aware culture has to be established. It is significant that other parts of the organization also recognize the benefits of risk management and its importance. To develop a risk management culture and to encourage all personnel to think risk, the organization has to build risk awareness into the organizational culture. A risk aware culture means having the same set of beliefs on the subject of risk in the entire organization. According to K. H. Pickett et al.2005, risk management appreciation tends to be high among specialist support staff in an organization. Here there is generally a good understanding of risk, RM and internal controls reporting. Other parts of the organization where RM is not a part of daily routines might not have same familiarity wit risk and control agenda (Pickett, 2005). Though there is a risk aware culture established the importance and benefits of RM should be understood by the entire organization. To ensure higher risk awareness in the organization, four points mentioned in the AS/NZS 4360:2004 standard could be considered as activities to increase risk awareness:

1) Developing a risk management philosophy and an awareness of risk at all senior management levels. This could be facilitated by training, education and briefing of executive management and by examining how risks have been managed in the past
2) Success stories should be developed and sold
3) An endorsed person at a senior level may be appointed to sponsor or champion the initiative.
4) Managers need to encourage and support staff to manage risks. Failure to manage risks may result in lost opportunities or pose threats to staff and the objectives of the organization. (AS/NZS 4360:2004)

To advance to level 4 these areas should be further developed and implemented. Staff surveys could be carried out at regular intervals whenever representative information is required to assess the state of awareness of risk management and controls in an organization.

5.2.5. Staff training

A problem uncovered when interviewing the respondents was a lack of knowledge of the tools used in the quantification phase. None of the respondents had any knowledge of PertMaster. Two of the respondents mentioned that education of using or understanding how the tools are used to quantify risk, could enhance the quality of the input and hence improve the quality of the output. To avoid that the quantification of a risk is considered as a field for experts only where the risk specialist presents the calculated numbers when quantification is done, courses in basic statistics or mathematics and an introduction course in PertMaster could be arranged.

Dependence on the skills of a few in-house staff could limit the overall effectiveness of the risk management process and negatively impact both existing projects that use risk management and projects attempting to implement the process for the first time. Through educating and involving staff in the risk quantification process, the project team could feel a certain ownership and feel as a part of the process.

A continuous improvement process is required to stay at level 4 or any other level; without such a process it is of course possible to move down the RMMM framework and drop to a lower level or risk management capability. At RMMM level 4 organizations will be threatened by contentment and boredom and should consider a number of actions to counter these problems.

6.0 Conclusion

This thesis is a review of the RM plan in the CP organization. Areas of improvement have been identified and discussed. Based on the AS/NZS 4360:2004 standard, the FERMA standard, and the RMMM, the RM plan and interviews of 2 project managers and 1 project controller in the Capital Projects organization have been reviewed.

The document describes an overall procedure for project risk management which converges with the AS/NZS 4360:2004 Standard and the FERMA standard. The plan is an overview of the main points in the RM process. The steps in the PRMG are somewhat similar to AS/NZS 4360 and FERMA except from different terminology. The PRMG is a document for describing the risk management plan, compared to the AS/NZS and FERMA, the document is very general and little details are given of the actual process, additional steps could be included in the plan. When contrasted to the other standards for RM it is a bit hard to follow and ambiguous and not very precise in what it is saying that needs to be done. Weaknesses in the PRMG document are lack of description of how the activities are intended to be carried out. Areas of improvement could be to focus on a better description of the activities in the process and document them.

Through comparison of the interviews done and the RMMM the risk maturity level for the attributes; definition, leadership and organization (culture), process, experience and application have been classified. All of the attributes have been classified as a level 3. To achieve level 4 the RM process should be implemented properly in all of the existing projects and most of all the benefits of RM ought to be understood at all levels of the project. A weakness mentioned by all of the respondents was that the risk register might be forgotten after the closure of a project. The risk register should be an important tool for future projects besides identifying new risks. One of the criterions for a level 4 under the attribute Organization and Leadership is to accept the idea that mistakes are done by staff.

A post analysis of the effectiveness of the activities should be performed to have a foundation for future risk mitigation activities. Documenting both successful and ineffective activities can be an important lessons learned and source of information. Both successful and failed effects of risk mitigation activities could be announced in a separate report to make sure project team members

fully understand the benefits of risk management, or to avoid that staff are losing interest in the process or think of risk management as “extra work”.

To move up to a level 4 the CPN organization should create further awareness of the benefits of identifying opportunities, not only identification of risks. Through educating and involving staff in the risk quantification process, the project team could feel a certain ownership and feel as a part of the process, and hence get a further view of possible RM benefits.

Though there is a risk aware culture established the importance and benefits of RM should be understood by the entire organization. As a suggestion for future work staff surveys could be carried out at regular intervals whenever representative information is required to assess the state of awareness of risk management and controls in an organization.

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Appendices

Appendix 1- Risk Management Maturity Model

Appendix 2- Overview of the key elements of project risk management a plan

Appendix 3- Risk and success factors in a project

Appendix 4- The definition of risk

Appendix 5- Corporate Project Authorization Guidelines

Appendix 6- Interview

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Appendix 1: Risk Management Maturity Model

	Level 1 Ad Hoc	Level 2 Initial	Level 3 Defined	Level 4 Managed
Definition	- Approach to risk is unstructured (ad hoc approach) - Limited or no awareness of current legislation -No understanding of risk management principles or language - Little interest in the subject - No investment in risk management or training - Risk events are treated after they have occurred -Little or no attempt to learn form past projects	- Recognition of benefits of risk management, but ineffective implementation - Some risk management training - No structured approach - Organizational support at organizational level - Experimenting on some aspects of risk management process and tools application	- RM process are integrated in most or all projects - Benefits understood at all organizational levels - Proactive behaviour to risk and threats - Effective management of known risks - Management support to formal RM system - Formalized generic process	-Appointment of a risk manager - active use of information to improve organizational processes and gain competitive advantage - Capable of managing almost all predictable risks, and manage some emergent risks - High risk awareness - Risk sharing with other parties - Institutionalized RM process
Organization and leadership (Culture)	- No risk awareness or upper management involvement - No learning from previous projects - Resistance of change in a passive culture -Unaware of the need for risk management and management of uncertainty	-Management encourage RM - Initial assignment of responsibility for risks -Project coordination style - Risk management used only on selected projects	- Recognition of risk ownership and responsibility - Risk awareness at the organizational level -Informal training of RM skills - Benefits recognized and expected - Management requires risk reporting	- Risk information is used when decisions are taken by management - Formal training RM training for project teams - Organizational philosophy accepts the idea that people make mistakes - Willingness to change in the organization -Proactive risk management encouraged and rewarded

Process	- No formal process is available - No RM data have been collected or analyzed - No RM tools are implemented - No formal risk management plan exists	- Informal RM process, some specific formal methods may be in use - Improvements limited to previous project experience - Fragmented risk data are collected	- Formal RM system defined to identify, evaluate and mitigate risk - Participation from key suppliers in the RM process - Risk data is collected - Use well established methods for RM	- Systematic RM for projects - RM culture in the entire organization - Evaluation and improvement of the RM process - Data are analyzed quantitatively - Post project evaluation are conducted -Suppliers and customers are
Experience	- No understanding of risk principles or language - No understanding or experience in accomplishing risk procedures	- Limited to individuals who may have no or little formal training	- In house core of expertise, formally trained in basic risk management skills. - Development and use of specific processes and tools	- All staff are risk aware and capable of using basic risk skills -Learning from experience as part of the process - Regular training for personnel to enhance skills
Application	-No structured application - No dedicated resources - No risk management tools in use - No risk management analysis performed	- Inconsistent application of resources -Qualitative risk analysis methodology used exclusively	- Routine and consistent application to all projects - Dedicated project resources -Integrated set of tools and methods -Both qualitative and quantitative risk analysis methodologies used	- Risk ideas applied to all activities -Risk based reporting and decision-making - State of art tools and methods - Both qualitative and quantitative risk analysis methodologies used with great stress on having valid and reliable historical data sources - Dedicated organizational

				resources

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Appendix 2,

Risk management activity	Overview of key elements of project a project risk management plan
RM planning	Assign risk management responsibilities Risk parameter definition Plan risk management activities Strategic risk planning Steps/process outline Process launch Establish the context, up- front planning
Identify	Define risk areas/categories Identify risk events Describe risk events
Assess	Qualitative risk analysis Evaluate impact (I) and probability (P) of risk events P x I analysis Assumptions analysis Classify/categorize risk events Prioritize risk events Quantitative risk analysis
Response/handling	Risk response planning Use of different strategies (avoid/transfer/mitigate/accept) Risk ownership allocation Implement risk response plans Risk monitoring and control Communication and consultation
Closure/Post- project learning	Documentation lesson learned Record lessons in the risk management system (AS/NZS 4360:2004 Standard, Risk management guidelines)

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Appendix 3: Risk and success factors in a project

Category	Risk factors (From 51 cases and literature review)	Success factors as required capabilities (From 51 cases and literature review)
Culture	1. Fear- based culture, poor risk awareness 2. Lack of assumptions testing and learning 3. Resistance to accept changes in management approach or technology 4. Rigidity of formal methods and systems 5. Poor cross- project learning, failure to learn from previous projects 6. poor sense of risk ownership 7. lack of continuous viability and profitability analysis	1. Open culture to recognize risks and mistakes 2. Double loop learning, assumption testing 3. Learn the lessons of previous projects, utilize historical information from post-project reviews 4. Accept changes in culture and attitude, also in technology management 5. Informal methods, experience and trust were viewed as important 6. Clear risk ownership allocation 7. Continuous viability and profitability analysis
Stakeholder coalition	1. Lack of user involvement and inputs in defining requirements in design phase 2. Poor relationship with client or customers 3. Communication problems with customer/user 4. The contract offered no clear clauses on incentives and penalties 5. Adversarial relationships among different parties 6. Lack of support from affected parties (such as community and public) 7. Supplier and contractor delays 8. Regulation changes 9. Lack of long term arrangements	1. Closer user involvement and capture requirements 2. Close relationship and collaboration with the client or customer 3. Good communication with the customer/user 4. The contract include risk/reward arrangements, or incentive clauses to motivate contractors 5. Flexibility in compromises and agreements 6. Communicate with the community and public and address their concerns 7. Good relationship with key supplier 8. Collaboration with regulators 9. Use partnership strategy
Leadership	1. Lack of top management support and priority 2. Project members are not involved in decision making, authoritative management style 3. Poor relationship with corporate senior management 4. Poor communication and collaboration with external network partners	1. Top management support, project championship 2. Project team members are empowered and self organization are encouraged in certain contexts 3. Collaboration between project manager and function managers 4. Build external networks

Organization structure	1. Weakness in matrix structure 2. Lack of cross functional collaboration 3. Poor teamwork, lack of communication between teams 4. Weak team identity	1. High extent of project-based organization or strong matrix 2. Develop and use cross-function teams 3. Collaboration between project manager and function manager 4. Build external networks
Risk management process	1. No earlier or clear identification of risks 2. Poor risk analysis/assessments 3. Insufficient contingency planning 4. No mitigation of identified risks 5. Lack of risk management process and practice	1. Develop formal risk management systems and procedures for: -Risk identification -Risk analysis and prioritizing -Risk response planning -Risk mitigation Continuous improvement in risk management process, formal process and information system.
Project management process	1. Ad hoc or inadequate project planning and control systems 2. Poor front- end planning 3. Poor requirement analysis 4. High personnel turnover in project teams 5. Late involvement of key parties in the project 6. Lack of regular review of project progress 7. Poor oversight and monitoring, poor tracking of performance 8. Unclear roles and responsibilities 9. Contractual disputes 10. Excessive change orders, changes in user requirements 11. Lack of financial reserves 12. Lack of project baseline systems 13. Unrealistic timeline 14. Lack of integrated planning, control and monitoring information system 15. Dislocation of different teams	1. Formal management processes and approaches 2. Adequate pre- project planning 3. Quality or requirement analysis and capture, clear definition of requirements 4. A process of personnel continuation and sharing 5. Key parties involved early in the project core team 6. Regular reviews and monitoring 7. Measure project performance continuously 8. Clear roles and responsibilities 9. Appropriate contract structure and administration 10. Change management and control procedures 11. Build in contingency reserves in setting the project budget 12. Robust baseline/budgeting system 13. Realistic time schedule 14. Integrated project information system for planning, control and monitoring 15. Co-location of teams preferred when feasible
Technology/system design	1. Ill-defined product/systems requirements and functionalities 2. Changing technical standards 3. Use technology to fix management problems	1. Well defined requirements and functionalities and good communication with customers 2. Use proven standards; have design flexibility to

	4. Lack of in-house technical experience and capability	accommodate changes 3. Use appropriate and proven technology; No technology fix to solve management problems 4. Develop in-.house technical capability and system engineering competence

Yeo K. T. and Yingtao Ren, Risk Management Capability Maturity Model for Complex Product Systems (CoPS) Projects (2008)

APPENDIX 4

The definition of risk

Many risk definitions describe risk as having only adverse consequences. There are, however good reasons for not restricting the risk concept to undesirable consequences, and many definitions of risk accommodate both desirable and undesirable consequences. One may wish to avoid a discussion on whether a consequence is classified in the correct category. What is an undesirable consequence or outcome, to some, an outcome can be undesirable, while it is desirable to others. In a short term context an event may be considered undesirable, but it may turn out that the consequences are highly desirable in a ling term perspective.

A probability (the distribution and derived measures such as the mean, variance and quantiles) can be interpreted as a quantitative measure of uncertainty. But a probability P can also be interpreted as a relative frequency (the fraction of successes when considering an infinite number of similar situations as the one being studied). In that case, the uncertainty about P and the estimate of P need to be addressed. If however P refers to a subjective or knowledge based probability (P= 0.1 means that the uncertainty- the degree of belief- is the same as making random making a random draw of a ball out of an urn comprising 10 balls), there is no uncertainty in P (as P now expresses the uncertainty), but the assigned probability depends on the background knowledge K. Uncertainties may be suppressed through assumptions in K, which may be correct or wrong. The analysts need to clarify what is uncertain and subject to the uncertainty assessment and what constitute the background knowledge. From a theoretical point of view one may think that it is possible (and desirable) to remove all such uncertainties from the background knowledge, but in a practical risk assessment context that is impossible. We will always base our probabilities on some type of background knowledge.

Source: B. Ale et al. 2008, Review of basic concepts and principles in integrated risk management.

Appendix 5 Corporate Project Authorization Guidelines

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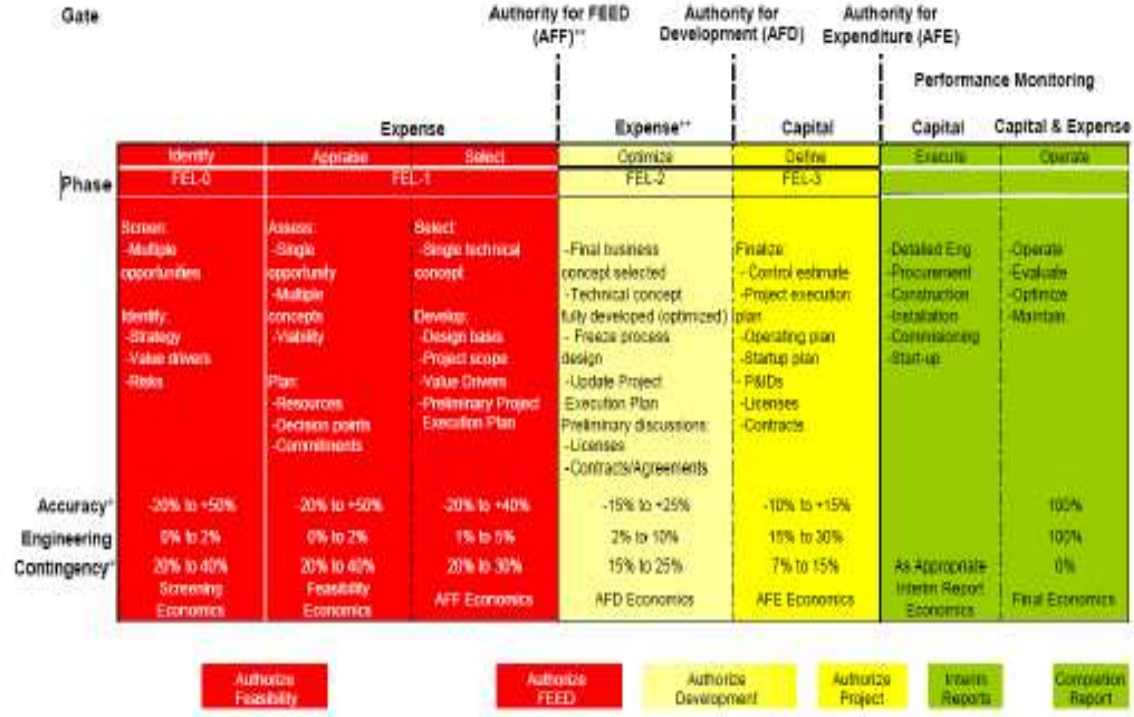
PROJECT AUTHORIZATION GUIDELINES

Figure 1: Project & Funding Schematic



* - The ranges shown serve as guidance only and are superseded with risked values once the risk assessment is complete for each project.
** AFFs are typically expense but may contain capitalized elements. See Section 3.4.6 for additional detail.

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Appendix 6

Introduction

The organization should establish the degree of risk maturity that is in place among its employees and business processes and seek to develop a strategy that makes sufficient progress to achieve a satisfactory level of risk maturity, taking into account expectations of key stakeholders.

This interview is done to identify the organizations maturity level, how the documented PRMG is conducted in practice and to contrast the answers from the respondents to the RMMM.

Interview with project managers in the Capital Projects organization

1) **Have you read the Project Risk Management Guide? Do you think there are any weaknesses in the document?**

2) **Is an RM plan established for each project, with defined risk management objectives and the use of quantitative and qualitative methods?**

3) **What are the procedures for identification of the different types of risk? Who records them in the project before reporting them to RMG? Could you describe any strengths or weaknesses?**

4) **Besides the identification of risks, is there a focus on identifying opportunities?**

5) **Do you know what kinds of RM tools are used when assessing risks projects (Crystalball, pertmaster, @risk)? Could you describe any strengths or weaknesses?**

6) **What are the procedures for the monthly updating of risks? Who has responsibility for updating and reviewing the plan? Could you describe any strengths or weaknesses?**

7) **What do you consider to be the main benefits which can be achieved with RM?**

8) **Are external and internal stakeholders included in the decision making? How are they included?**

9) **How would you define the risk management culture in the organization? Would you say that the organization has a proactive or reactive culture? Could you explain how?**

10) **Is it accepted that mistakes are done? Is there a common belief that RM is an important aspect of the organization?**

11) **How is the risk reported to the upper management? Are risk results and effects reported to the rest of the organization? In such case to whom? Which Communication Channels are used?**

12) **How are the mitigation responsibilities of the risk owners controlled?**

13) **Does the upper management include the risk information in their decision making?**

14) **Does the organization use regular staff surveys to measure the extent to which employees understand PRM and are able to employ the techniques and approaches of effective identification, assessment, and management of risk to the achievement of objectives?**

15) **Are experiences from earlier projects applied to the project? Could you explain how it is done?**

16) **Could you describe any strengths or weaknesses of the use of risk register?**

17) **How would you describe the risk attitude and risk appetite in the project? Is there a common understanding of what the risk appetite is in the project/organization?(Risk averse, risk seeking or risk neutral?)**