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Risk Management

Introduction, recommendations and project descriptions of risk management

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Sammendrag

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Summary

Report developed by sommerstudents from Chalmers. Students worked i prosjekt E6 Biri-Otta, region east. In addition to show arguments for risk management and how the risk prosess is done, the report summarize company visits and give recommenda-tions for improvement in the project and NPRA as well.

Risk Management

Introduction, recommendations and project descriptions of risk management

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1. Background

The current Risk Management model that is used in The Norwegian Public Roads Administration (NPRA) is a result from the research project PUS (Practical Uncertainty Management in a Project Owner's Perspective). The PUS - project is a comprehensive researcher project conducted in Norway between 2006 and 2010 and was collaboration between Norwegian Centre of Project Management (NSP), the Research Council of Norway and six of the major public actors on the Norwegian market. The actors that participated in the research project were The Norwegian Public Roads Administration (NPRA), Statoil, Telenor, Jernbaneverket (JBV), The Armed Forces, and Statsbygg. The main goal of the PUS-project was to develop the participating organizations when it comes to their theoretical and practical knowledge in the areas of governing and control of Risk Management in major projects.

This report is an extension from the master thesis *Risk Management in the Norwegian Public Roads Administration – a case study*¹ which has been developed during the spring of 2012 as collaboration, between NPRA's project E6: Biri – Otta, and two MSc students in Design and Construction Project Management at Chalmers University of Technology, Sweden. In the thesis a literature study and interviews with project personnel has been conducted and the current risk management model and practice has been evaluated against the literature. During the process of the thesis the organization has located some areas that need more focus on how to optimize their current process: meeting structure, communication of risks, involvement of project personnel, and how to estimate risk costs.

However, the main goal of this report is to give ideas and thoughts how the current project organization can develop their work in connection to their continuous Risk Management Process. To achieve this, three different projects from organizations that has been participated in the PUS-project has been visited. The main goal by these visits has been to study how they work with Risk Management. The visited projects took place at Statoil, Jernbaneverket, and one internal project in NPRA. Furthermore, one visit to The Directorate of Public Roads and one video conference with Agnar Johansen at SINTEF, who was the project manager for the PUS-project, has been conducted. The agenda with The Directorate of Public Roads was to discuss how the current progress with the model that has been developed during the participation in the PUS-project has been implemented and received in the organization. The video conference with Agnar Johansen was conducted to get some ideas and thoughts how other organization in the PUS-project work in practice with Risk Management and its associated process. Agnar has a lot of experience in practical risk management, especially from Statsbygg.

1.2 Readers guide

The author's intention with this report is not only to describe the different organizations that have been visited and to report findings from these. It has also been to make a description in basic risk management theory for readers who have little knowledge in the subject. Therefore has this report been divided into three different sections:

- Chapter 2-3 give the readers a basic description on Risk Management theory.
- Chapter 4-6 give a description on how the different organization's work with risk management in their projects.
- Chapter 7-8 reports findings from the visits that the authors thinks can be interested for the readers.

N.B: The authors would like to express that the findings that are brought up in this report are personal reflections on issues and techniques that can help an organization to develop their work with risk management.

¹ <http://publications.lib.chalmers.se/publication/161197-risk-management-in-the-norwegian-public-road-administration-a-case-study>

2. Why is Risk Management important

Risk Management is not an exact science and nor is it a new way of thinking. It has been handled in organizations for many years and has taken on many shapes during its years of development. The first big organization that actually called it Risk Management was the US navy in the 1960's and 70's. One could call Risk Management a form of common sense put into a systematic way of working. In essence Risk Management should help an organization to keep track of potential threats and opportunities that might occur and to take actions to reduce or enhance their probability of occurrence or impact. By taking these risks into account as early as possible the chance of handling them as economically advantageous as possible will increase. The later on in a process a risk is handled the more costly it will become, this can be described by the 1:10:100 rule.



Figure 1: Illustration of how risk costs increase the later in the project it is handled. The cost can be described according the 1:10:100 rule.

This rule shows that if one ignores a risk in the initial phase of a project the cost will get significantly higher in the later phases of the project to handle it. There are several examples of situations where this has been the case. For example the Swedish tunnel project "Hallandsåstunneln", where they did not account for risks early on in the project. This resulted in a cost overrun of more than 10 times its original budget (and counting). There are several aspects of this project that possibly could have been avoided if an appropriate Risk Management process would have been present. By not paying enough attention to the geotechnical experts and the technical data from the geological surveys, risk aroused which was ignored, and by not paying enough respect to the stakeholders in the adjacent areas when using the toxic filling material Rhoca Gil for the tunnel, even more risks aroused. These risks could possibly have been avoided with a Risk Management process and some common sense. For example by identifying insufficient geotechnical data as a potential risk and taking actions to increase the geological knowledge of the rock, the whole tunnel could have been moved some hundred meters to sounder rock and the project could have been completed on time and budget without the need of toxic filling materials.

Some could argue that this is just common sense. That might be true; however, by using a common way of working with Risk Management where the whole organization is involved the risk of failure will decrease for the project.

2.1 Uncertainty, the source for risk

One of the most used definitions to describe what a risk is for a project, is the definition given by the Project Management Institute. This definition states that a risk is:

“An uncertain event or condition that, if it occurs, has a positive or negative effect on a project’s objectives” (Project Management Institute, 2008).

In this report, **risks** will mean **either positive** risks (opportunities) **or negative** risks (threats).

All projects are to some extent unique to its character and complexity; this will lead to uncertainties surrounding information for the project objectives (time, cost, quality, etc.). Uncertainty can be found in a number of different areas in connection to the project, the figure below shows some general areas where uncertainties can be found.

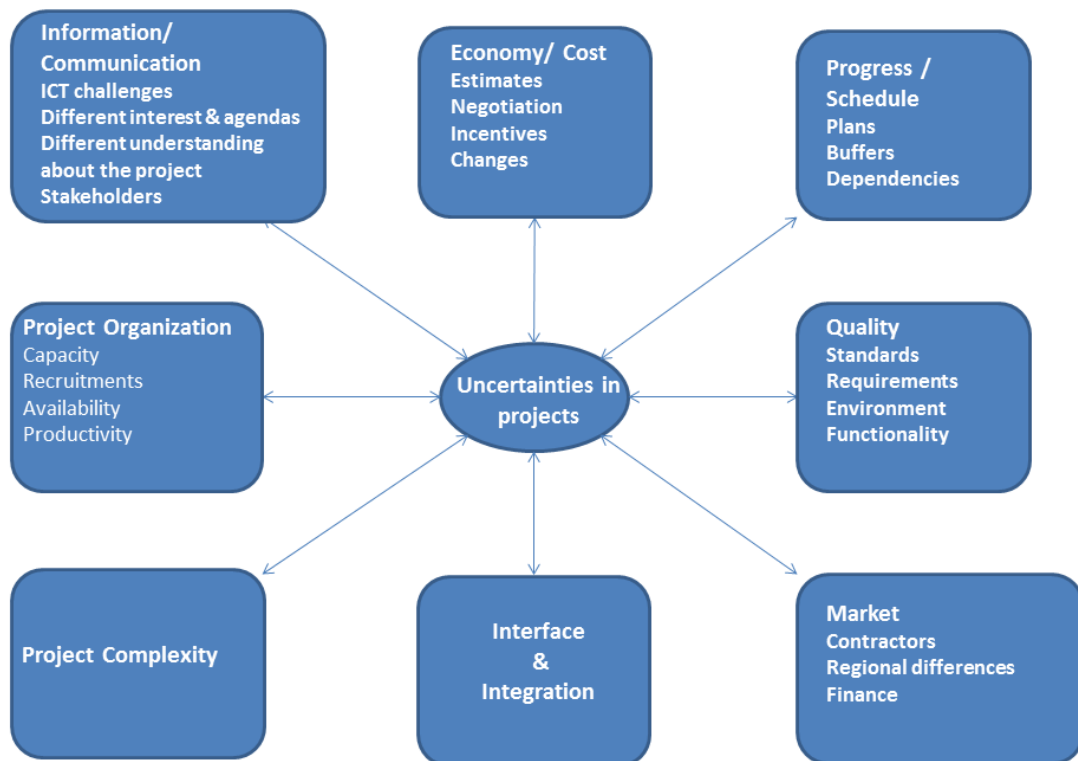


Figure 2: Examples where uncertainties in project can be found.

In literature uncertainty is often explained as the lack of information between available and required information to make a decision on a specific matter. The lack of information that is required to perform a specific task can by either opportunity-, or risk factors create a deviation of one or several of the projects objectives from the reference value. A factor is sources or causes that influence the uncertainty. If the consequence of the factor can be evaluated and measured by a probability of occurrence, they will become an opportunity or a risk and can be properly handled by the project organization.

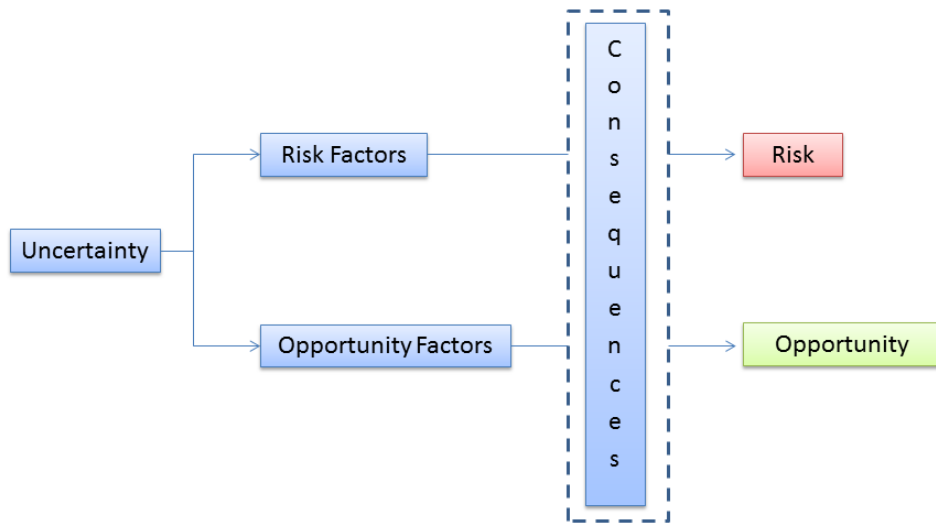


Figure 3: Illustration how risk or opportunity can be developed by factors and consequences.

The most common and basic way to both understand and calculate what a risk is for a project is to describe it as following; if a risk factor x, with an impact (consequence), have been identified with a probability of occurrence. Then risk will be calculated as following (the same approach can be implemented for an opportunity):

$$\text{Risk} = \text{Impact (Consequence)} \times \text{Probability}$$

3. The Four steps in the Risk Management Process

This chapter's intention is to provide the reader with basic knowledge in the four steps of the risk management process and some examples of how it can be used. **N.B:** *This is **not** a description of how any of the companies we visited works with Risk Management.*

The risk management process is usually described through four steps, in the figure below these steps are represented. The communication represents that the risk management would not work without active communication both with internal as well as external stakeholders.

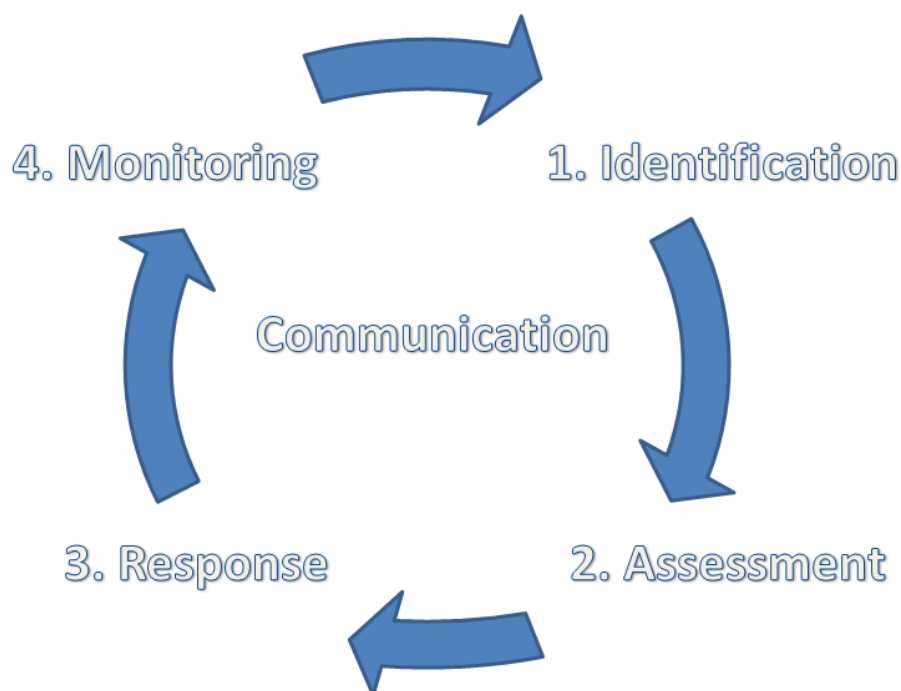


Figure 4: The different steps in the risk management process.

The process is divided into these four steps to make the work more structured and easy to understand. If one thinks about it, this is the rational way of thinking when it comes to risks. For example:

*You are at a construction site close to moving traffic. You **identify** that some construction workers are at risk because they are working too close to the traffic. You immediately start to **assess** the risk; what would happen if a worker is hit by a car, and how likely is it that it happens? This calls for an immediate **response**; you cannot accept this risk so you decide to prevent possible accidents by diverting the traffic to other roads. When this is done you **monitor** the results by inspecting the construction work to make sure it is safe as well as making sure the new deviation roads are not causing any new problems.*

There are several tools available to help an organization to perform these steps in a systematic way. Some of the tools that will be explained are used in NPRA's model for managing risks. By understanding the separate parts of the risk management process one will understand the whole model much better as well.

3.1 First step: Identification

The first step in the process is risk identification; in this step the goal is to determine which threat and opportunities that may have an effect on the project and to document their characteristics. The identification step should include the creation of a risk register where the project can document:

- **Affected area** - The area in the project most likely to be affected
- **Phase** - When the risk or opportunity is most likely to occur
- **Risk Owner** - Who is best qualified to be the accountable risk owner
- **Consequence** - What consequence the risk or opportunity will have

There is no right or wrong way in the process of identifying threats and opportunities, the important thing is that they are brought to attention and put in the risk register. The person who is assigned as the risk owner should be the one with the best qualifications to handle the risk and with the greatest knowledge in the specific area where the risk is present. Furthermore, as many employees as possible in the organization should be engaged in the continuous identification process so that the register can be as comprehensive as possible. This will be explained further in the part about communication. There are several techniques available that will help to identify risks, some are explained below:

Brainstorming

The most common way of identification is by brainstorming, both as individual and in groups. For example:

Five minutes of the project meeting is spent where everyone writes down what possible problems or opportunities they see with the project. Then all the relevant problems and opportunities for the project are discussed and documented.

Checklists & Examination of Similar Projects

Using checklists can help the organization get structure in their identification process. These could be based on earlier experience. For example:

If the organization is familiar with the type of project they are about to undertake, they could create a checklist of areas where earlier problems and opportunities occurred. It is important to remember that checklists do not give the complete view of the problems and opportunities, but they are a great addition to brainstorming activities.

Identification through scenarios

When the project aims to identify new risks and opportunities a helpful method could be to use scenario techniques, or “what if” questions. One of the managers takes on the role as an initiative leader who describes a scenario. For example, what happens if there is a huge flooding during the execution phase of the projects. What opportunities and risks can you see in that situation? If this technique should be efficient the manager must come prepared with relevant and well worked though scenarios. It is important to keep focus and not wander too far off the projects boundaries in this technique.

3.2 Second step: Assessment

The overall goal with the risk assessment is to conduct analysis and evaluation of the risks that has been identified and put in the risk register. This includes evaluating:

- **Impact** - What impact the risk or opportunities will have on the project
- **Probability** - How big is the probability of occurrence
- **Cost** - The calculated cost of the risk, or savings of opportunities

In this phase the project should sort out and prioritize the risk according to their probability or impact on the project. This is often done to get a good view of which risks that are most important to address in an early stage. A common way of working with risk assessment is through a Probability and Impact Matrix.

Probability and Impact Matrix

In the probability and impact matrix the identified risks and opportunities are assessed through the matrix by simply putting them in the corresponding boxes matching their probability of occurring and impact on the project. However, the project must agree on the definitions of what the different scales in the matrix represent. In most projects cost, time and quality are the main attributes that are considered when defining the impact scale. Nevertheless, it can be important to include health & safety and environmental impacts as further aspects. By agreeing on definitions of the scales some of the subjectivity in the model can be eliminated. For example:

An organization is working with a road project with a total budget of 100M Nkr. They decide that the impact scales for threats should be; 5 Mn Nkr < Low, 5 Mn Nkr < Medium < 20 Mn Nkr, High > 20 Mn Nkr for impact and 20 % <Low, 20 % < Medium <50 %, High > 50 % for the probability. The organization identifies a risk that has an impact of 10M Nkr and a probability off occurrence of 40%. Hence, they place it in the appropriate box with a number that makes it easy to identify for example R.1 (this is illustrated by a cross in the matrix below).

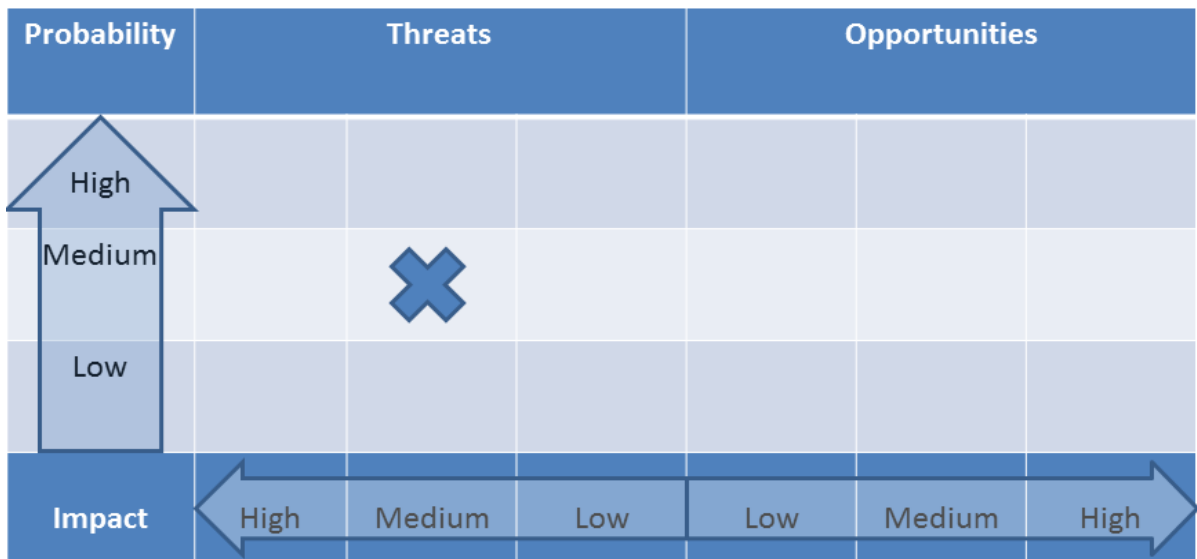


Figure 5: An illustration how probability and Impact matrix can look like.

When working with the probability and impact matrix it can be helpful to categorize the risks and opportunities by a common system to facilitate and keep track of them in the continuous work. When all the identified risks are put into the matrix it gives a good overview of which risks that are important to focus on i.e. the ones with high probability and/or high impact.

3.3 Third step: Response

The main purpose of risk response is to develop actions to maximize opportunities and minimize threats to the project objectives. This is done by choosing a risk or opportunity response. Moreover, the project should consider the financial cost for implementing each response. The same implies in the situation where the time and effort to develop a risk or opportunity plan is greater than the outcome. The chosen action must be appropriate to the risk, as well as, in terms of cost effectiveness and realism to the project context. The risk or opportunity response that has been chosen must be possible and manageable for the risk owner to perform and maintain. The following actions are available for opportunities and risks:

Opportunities	Risks
Exploit	Prevent
Enhance	Reduce
Share	Transfer
Accept	Accept
Ignore	Ignore

Figure 6: The different responses that can be used for opportunities and risks (threats).

Risk Response

When it comes to risks the ideal case is to be able to avoid it at as low cost as possible. However, if the implementation cost is higher than the cost of the consequence for the actual risk, it is more economically profitable for the project to accept the risk. The five risk responses are:

Prevent

In most cases, preventing risk is the best way of dealing with it. This is due to that one of the purposes of preventing risks as a strategy is that the project tries to eliminate it. There are numerous ways of preventing risks. For example: by working more with detailed planning so that the activities that are critical are less related to each other, and to break down long lasting activities to shorter more measurable units. Preventing risks also includes providing training and skill enhancement of team members, so that they can prevent risks in the future.

Reduce

The strategy of reducing risks involves reducing the probability and/or impact of the risk occurring. This strategy is usually most appropriate in the early phases of projects since the cost for risk mitigation will increase later in the project life cycle.

Transfer

This response strategy is used when the risk can be better handled by a third party that holds for example, more information about the risk or better capacity to manage it. Commonly used transferring techniques involves; contracting insurance, warranties, or guaranties. The actors that the risks are transfer to can be for example a client, contractor, subcontractor or designer.

Accept

Accepting the risk is usually not a strategy to aim for. However, if the cost of handling the risk is greater than to handle it this strategy is appropriate.

Ignore

To ignore the risk means that the organization does nothing to prevent it from occurring and nothing to reduce its impact. This strategy should be avoided.

Opportunity Response

Just like the risk responses the opportunity responses aims to achieve as much outcome from the opportunity as possible.

Exploit

The exploitation strategy tries to minimize the uncertainty connected with the opportunity. This is done to ensure that the opportunity in fact occurs.

Enhance

By enhancing an opportunity the project attempts to increase the probability and/or the positive impact of the opportunity. This can be done by identifying and pushing key drivers connected to the opportunity so that the probability of occurrence increases. One way of enhancing an opportunity is to allocate more resources to a certain activity or event that will impact the probability of occurrence in a positive manner.

Share

If an opportunity is shared with a third party involves allocating some or all of the ownership to the parties that are most suitable handling the opportunity. The benefits of the opportunity are then shared through for example: risk-sharing partnerships, joint ventures, special purpose companies, or teams.

Accept

By accepting an opportunity the organization will harvest the possible advantages as they come along. However, it does not include actively pursuing it by making any actions.

Ignore

To ignore the opportunity means that the organization does nothing to increase the probability of occurrence and nothing to increase its impact. This strategy should be avoided.

Although the chosen action to a risk or opportunity seems obvious when it is chosen it can be helpful to go through what the available actions will impact in the project. A simple example of actions and what the risk responses aims to reduce in the specific case is shown below.

Case	Response	Action	Aims to reduce
The geotechnical conditions of a specific hillside where a tunnel will be constructed has a history of being problematical.	Ignore	-	-
	Prevent	Re-design position or layout of tunnel	Probability
	Reduce	Hire experts consultants during pre project phases, conduct extra boreholes	Probability
	Transfer	Transfer risk by contract to third party	Consequences
	Accept	Accepting risk as they come	-

Figure 7: An example how responses can be used and what it aims to reduce.

3.4 Fourth step: Monitoring and Control

In this stage all the information about the identified, assessed and analyzed risks are collected and monitored. Monitoring risks means that the responsible risk owner keeps track of their assigned risks and makes sure that the risk register is up to date. Monitoring and control of risks should be done on a regular basis. It is important to get a continuous process working with risks; therefore, it can be helpful to have specific meetings where the risks are monitored, for example once a month in risk meetings or as a part of project meetings.

It can be misleading to name monitoring and control as the final step in the Risk Management process because it is actually a part of the continuous work in risk management. One could say that all the previous steps are included in the last step. However, the continuous work does not put that much focus on reassessing risk responses; it puts more focus on reassessing already identified risks. This includes to check if new information is available, if the action plan still is valid, if the actions has been performed within the given date, and to add eventual new actions.

During the monitoring and control there are several steps that are important to remember. Starting with the meeting structure, one of the focuses in project meetings should be to swiftly get an input from the entire organization by engaging them in the risk meetings. When working with finding new opportunities and risks in the continuous work it is not necessary to conduct brainstorming activities every meeting. A swift and efficient way could be to use a part of the project meeting to go around the table asking each employee what they see as the biggest opportunity and threat to the project. By performing this simple exercise all employees are to some extent engaged in the opportunity and risk work and hopefully their interest in the subject increases. Furthermore, the organization picks up opportunities and risks from the entire organization. In the figure below are the basic steps in the monitoring and control process.

	Monitoring and Control
1	Identify new opportunities and threats <ul style="list-style-type: none">○ Begin with identifying opportunities then threats
2	Assess new opportunities and threats <ul style="list-style-type: none">○ Use the same steps as in the assessment step
3	Reassess already identified risks <ul style="list-style-type: none">○ Begin with high probability opportunities and risks○ Identify new information and update action strategy○ Check if action plan is still valid○ Check if actions are performed by the owner○ Add eventual new actions
4	Update risk register <ul style="list-style-type: none">○ Make sure all risks has owners○ Communicate changes in register

Figure 8: Recommended steps in the risk meeting.

These steps will help to update the register so that the project always has the newest information when they are working with risks. The risk image is likely to change over time; therefore, a register that does not keep being updated over time is not very useful.

3.5 Communication and meetings structure

As described earlier the main Risk Management Process consists of four steps; identification, assessment, response, and monitoring but to have an effective process there is a need for a good communication and meeting structure. In the continuous RMP the project needs to have risk meetings on a regular basis. In NPRA's guideline for risk management it is recommended that risk meetings should be held once a month. These meetings should consist of 6-8 employees from the project, such as managers, economy-, and quality responsible from the organization, with the right experience for the process. During these meetings newly identified risks should be assessed and put in the risk register. Beside this, all risks that are already in the risk register should be reassessed with any new information surrounding them.

To be able to build a risk aware project organization it is important to engage and involve as many as possible in the process. One of the easiest ways to succeed with this is to communicate and inform the project organization on a continuously basis how the progress is going with opportunities and threats. If the managers in the organization do not succeed with this, then the risk management will become a tool that is only used by the managers and the basic idea that to be able to identify as many opportunities and risks that is possible is lost. It is commonly known in both risk management as well as in project management literature that one of the biggest reasons to failure is lack of communication.

To illustrate how important communication is in a project environment we are going back to the earlier example about the railroad tunnel, "Hallandsåstunneln":

"Even if all the geology testing from the ridge and all geological experts pointed out that it would be more beneficial for the project if they relocated the tunnel a couple of hundred meters east from the original location. Despite communication between engineers and the organ responsible for the final decision, politicians decided that they would not invest the extra money that was necessary to relocate the existing railroad. This lack of communication resulted that the existing tunnel project has overdrawn more than 10 times its original budget. As a consequence of this, the project has been necessary to end cooperation with the original contractor and contract a new contractor for the existing part of the project".

Description from the Visited organizations

In this part of the report our intention is to give a description how the visited project works with risk management. The focus will be on the risk management process, risk communication, risk meetings, and how they involve their project personnel in risk management.

4. Statoil

The first visit was conducted at Statoil in their office in Bergen. The aim of the visit at Statoil was to take one of their internal courses in risk management: Understand the risk management process-methodology, and to get an understanding how their main tool for risk management, PIMS R3, works. This meeting followed by a visit at Statoil's office in Vækerø, Oslo, where the goal was to understand how they was working with risk management on a project level. Statoil looks upon risk management in a strategic way, both on an enterprise level as well on project level, as a structured process. The topic is of such importance for the company that it has been incorporated in one of the points, under courageous, in the core values. Furthermore, risk management is an important part both in the operating model as well as in Statoil's corporate policies. As a result of incorporate risk management in all levels of the organization; Statoil has developed a risk awareness that is present, all the way from the top to the bottom in the organization. One of the major reasons that risk management have a big role in Statoil is that they perceive themselves as a risk taking company, they want to be in the front line when it comes to new inventions in the Oil industry. This is probably one of the reasons that Statoil has become a world leading company when it comes to deep-sea oil extraction.

Even if Statoil has been a part in the PUS-project their base for risk management has been taken from the risk model developed by the Project Management Institute. They are also certified by ISO 31000, an international recognized risk management standard provided by International Organization for Standardization. Nevertheless this, Statoil sees risk management as "common sense put into system" or business as usual but with a systematic frame of references.

Statoil emphasizes that risk can both have either an up-side (opportunities) or a down-side (threats). This view on risk is most likely a result that much of their base for risk management has been developed out of Project Management Institutes model and definition on risk management.

4.1 Identification

The identification process in Statoil consisted of two different steps. The first step was the start up identification process, where the whole project team participates in identifying risks. The second step was to continuously identify new risks, which was done on a regular basis by all in the project.

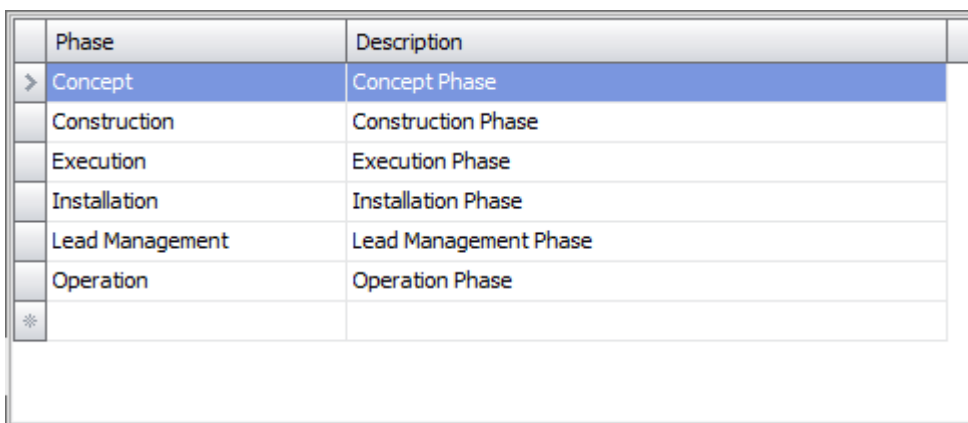
In the startup of projects the risk identification meetings had as intention to gather as many risks as possible so that they later could sort out and assess them. All the project employees were engaged in the identification so that the project could identify as many risks as possible.

The second step consisted of the continuous work that was carried out during the entire project life cycle. Managers encouraged the project employees to take the risk thinking with them out in their daily work and to continuously report what they considered as the biggest threat or opportunity to the project. To encourage having a continuous process; they begin all their project meetings by asking the project employees about what they had identified since the last meeting in form of threats or opportunities.

To make the continuous work with risks more relevant and easily understood they choose to focus on what opportunities or threats they could see the next two weeks. By doing this they kept the risk process alive in the sense that the time span until the next meeting was relatively short and that it is easier to relate to events in the near future than events likely to happen in for example one year. This is one of their strategies to identify risks in both a long and a short perspective.

4.2 Assessment

The assessment in Statoil is a continuous process where meetings are held at least once a month. In the assessment phase they divide the risks in different project phases to get the holistic view of the situation. An example of the phases that a project can be divided into is shown in the illustration below:



Phase	Description
> Concept	Concept Phase
Construction	Construction Phase
Execution	Execution Phase
Installation	Installation Phase
Lead Management	Lead Management Phase
Operation	Operation Phase
*	

Figure 9: Illustration how different phases in a project at Statoil can be divided.

The assessment phase in Statoil involves all the project employees to some extent. To facilitate and document the work Statoil is using the program PIMS R3; which is a tool that all employees at Statoil has access to.

However, there are “superusers” who are administrators in the program, they have the highest accesses to all functions in the program, and they can add and edit risks as well as to change options and layout of the program. PIMS R3 is mainly designed to register identified risks and to create and follow up risk actions and is the main tool used throughout the whole risk management process. Furthermore, the program gives opportunity to track risk assessment history and has a powerful built-in risk report generator that gives the project and management a good insight in the risk image. The program consists of a matrix structure where the scales are defined by categories such as reputation, quality and financial impact etc. When all the financial data and time scope of the project is put in the program it will help the user to create appropriate scales

automatically. However, the user can chose to insert specific parameters instead. An example of the scales generated by PIMS R3 is shown below.

Consequence	Health And Safety	Reputation	Enviroment	Quality	Financial Impact	Schedule Impact
+C1	First aid injury or occupational illness/effect with minor impact on health and ability to function	Negative exposure with limited importance	No or very limited impact on natural habitats. No impact on population level, only on individual organism level	None	< 1mNOK	1 day
+C2	Medical treatment injury or occupational illness or short term psychological stress	Local/regional negative exposure in mass media or from authorities and costumers	Adverse short term impact on natural habitats	Minor effects on capacity/regularity	1-10 mNOK	2 days
+C3	Serious injury, psychological stress or illness with possible permanent effects	National negative exposure in mass media. Negative exposure from national authorities/regulators	Adverse medium or long term impacts on a significant part of habitats (e.g. restitution time 1-3 years)	Minor effects on capacity/regularity	10-100 mNOK	Project Spesific

Figure 10: Example how impact and consequence scales can be described.

When the consequences and impact scales are described the project uses a matrix with the same scales as described above, these are represented on the axis of the matrix. The organization evaluates the risk according to the different scales in the table above and chooses the one with the highest consequence for the project. The program will store the risks in the matrix, hence, making the risk process traceable backwards in time. This is very handy when it comes to tracking the risk pattern and track changes in the process. Below, is an example of a risk that has moved in the risk matrix from the probability category “less likely” to “unlikely”:

		Consequence				
		Negligible	Minor	Moderate	Major	Huge
Probability	Very likely 75-100%					
	Likely 50-75%					
	Less likely 25-50%				○	
	Unlikely 1-25%				○	
	Very unlikely 0-1%					

Figure 11: Illustration from PIMS R3 how risks have been moved.

One of the biggest advantages with the computer program is that it can be adjusted according to the project. There are many parameters in the program that can be used in complex projects, in contrary, where simple “by the dozens” projects may only need a simple layout. However, there are some key parameters that are considered essential to Statoil’s assessment phase.

- Probability - The probability of the identified risk
- Consequence - The consequence of the identified risk
- Cost - The cost if risk occurs
- Schedule - The impact on schedule if risk occurs
- Impact - The impact on MHS, Environment, Reputation, Quality
- Date - The date the risk was identified
- Deadline - The date the risk action should be completed
- Owner - The risk responsible employee

By including an adequate description of the risk action, Statoil makes it easier to handle it by the responsible employee. When all the assessment steps are done a focus list is generated; the ten most important threats and opportunities are chosen to create this focus list. The focus list will be further explained in the part about risk communication in Statoil.

4.3 Response

Statoil works with risks response in a manner that is very close to the theoretically one described in the introduction part of this report. Statoil always evaluates which is the most efficient strategy in terms of cost to response to the risk. When the company introduces new employees to the risk management process they become familiarized to the different techniques that can be used as responses and what each of them implements in risk scenarios. This way of scenario learning was described to be rather common in Statoil when training employees in the risk management process so that they later on in real project could remember the simulation and make the most advantageous decision.

4.4 Monitoring and Control

The monitoring and control is essentially a continuous process in Statoil where all project employees have accesses to the program PIMS R3, where they can monitor and control if they are responsible for any risk actions. However, if they identify new risks they have to contact the super user to add them to the identified risk list. The constant access to the computer program makes the reassessment less time consuming on project level and the risk process is kept up to date. This continuous system helps the leaders and managers to be aware of how much of the actions, and at what stage the different risks are in without having to wait for the next project meeting. Furthermore, this enables the managers to put extra focus and resources where they were needed and in time. The biggest focus is usually put on the top ten risks that are most important to the project. However, Statoil also requests the entrepreneurs that are contracted to report their top ten risks and opportunities to the project. This helps the project to widen their opportunity and risk image.

4.5 Risk Communication

During the visit at Statoil, it was soon clear that to be successful with risk management it is important to have a clear structure of how risks should be managed and communicated. Every month the ten most important risks are collected and reported one step up in the organization, see figure. These reported risks are not only those that have been identified by the project but also risks that have been identified and reported by subcontractors. (Statoil stipulates in their contracts that contractors must have a risk management process and report every month on risk image and progress).

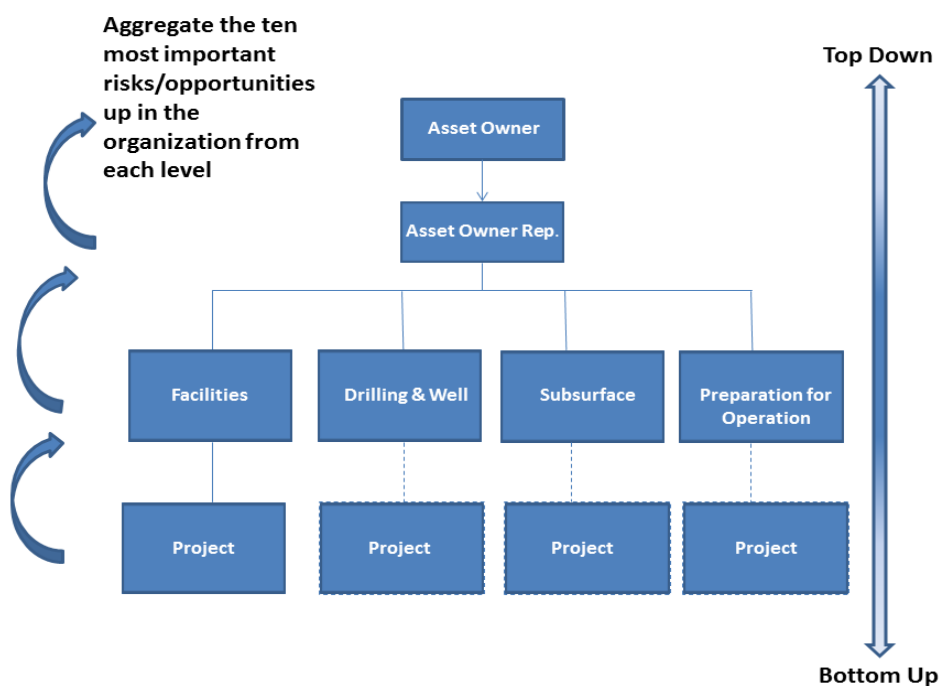


Figure 12: Aggregation and communication of the most important risks in Statoil.

In the continuous work on a project level all project meetings are started by giving the participants an opportunity to give their view on what they see as the most important risks they have to address until the next project meeting. This view should not only reflect risks for the project but also risks in connection to their own work. This means that Statoil has a structured way of working with identification on a regular basis. Beside this, by involving all the personnel in the project to discuss and identify risks that they see as important for the project to address, it is also encourage the organization to build risk awareness.

Other means that are used to communicate risks and risk related issues besides project meetings and risk meetings are lunch meetings for quality and risk managers. Statoil encourages personnel that are actively involved in risk management to participate in these meetings on a continuous basis to share experience.

5. Jernbaneverket

In the second visit we participated in an early cost estimate process for the railroad project Eidsvoll – Langset at Jernbaneverket (JBV). The Eidsvoll – Langset project is a part of the Norwegian investment initiative, the Inter –City project. Today Eidsvoll – Langset is a part in one of Norway’s busiest single tracks for the railroad, and the purpose with the project is to develop a double track for the entire section. The biggest uncertainties for the project are connected to the new bridge over Minnesund (which after it is built will be the biggest railroad bridge in Norway), and uncertainties around material for landfilling.

The meeting was held during two days and the intention with the visit was to study how JBV was taking uncertainties in consideration during the early cost estimate. The main process in the early cost estimate was conducted and lead by consultants with experience from similar processes. Additionally, on the second day we were given the opportunity to have a dialogue with a lead engineer from JBV about how they are working with risk management in their daily work.

In the cost estimate process the main goal was to identify uncertainties, both with a positive or a negative impact on the project, and to assess the identified risks with an economical value. This was done to get a realistic value for the total cost for the project. The models that was used was based on Monte Carlo analysis and costs were estimates with a pessimistic, realistic, and optimistic value for each of the groups of uncertainties. The first analysis that is done is a P50 estimate; this means that the probability for the estimated cost with uncertainties has a 50 % probability of occurrence. The second analysis is an estimate with 85% (P85) probability of occurrence.

The process starts with an introduction to the project and discussions concerning how the project could perform better than previous projects. That was followed by an individual brainstorming activity in which all involved participants participated in. They found that if there was more than one option for the specific project, you should always start with the most complex option. The brainstorming started with focus to identify uncertainties with a positive impact on the project, followed by identification of negative uncertainties. After that the identified uncertainties that were relevant for the project are inserted into a template provided by the consultants. Then scales, both for economic impact and probability, which are going to be used for the Monte Carlo analysis, are developed. The scales that were used were divided into low, medium, and high interval:

The scales could for example be divided into the following intervals:

Economic (Nkr): Low < 5 Million, 5 Million < Medium < 50 Million, High > 50 Million

Probability: Low < 10%, 10% < Medium < 30%, High > 30%

After the uncertainties had been inserted into the template they were sorted after their belonging into different groups; the groups that can be used are for example: project framework, project governance, market, local conditions, planning and management, addition and change, stakeholders, etc. The next step in the process was to undertake a new brainstorming in small groups of 3-4 persons. This time the aim for the brainstorming was to look at optimistic, realistic, and pessimistic perspective on the different groups that the uncertainties had been divided into. The brainstorming activity involved performing a scenario analyze were the groups should predict the outcome of the uncertainties if the project was carried out ten times in a row. The results from the groups were discussed and the result was inserted into the model. The next step was to analyze the result from the previous step with an estimated probability of occurrence and cost, this was also carried out for the optimistic, realistic, and pessimistic perspective for the project. The estimates that are provided in this step should be in consistency with the scales that had been developed earlier on in the process.

5.1 Continuous Risk management in Jernbaneverket (JBV)

On the second day the opportunity for a brief discussion how JBV works with risk management was given by a lead engineer. We were told during the discussion that JBV has a structured way of working with risks, that includes identification, assessment, response, and monitoring and control. The risk log that is used is shown below (the log is divided into two parts due to size).

Prosjektnavn	Nr	Risiko (kortversjon)	Risikobeskrivelse	Suksessfaktor (Kostnad, Fremdrift, Omdømme, Kvalitet, Sikkerhet) andre KSF
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			
	12			
	13			
	14			

Vurdering av Risiko		Risikokategori		Tiltak	Frist	Ansv	Utført	Sortering
S	K	Forrige mnd	Denne mnd					

Figure 13: An example of a Risk log used within Jernbaneverket.

This model does not differ a lot from other models that we have seen, but the one thing that stands out most is the absence of focus on opportunities.

Most risk work was done single handedly and the lead engineer was responsible for the risk management process in his/her part of the project. The lead engineer identifies, assesses and choses response for the risks. If the risk is better handled by someone else in the project, that person will become responsible for monitoring and control. During project meetings the risk image is reported and discussions are held if there is anything unclear.

6. The Norwegian Public Roads Administration: Trondheim

The Norwegian public roads administration in Trondheim is currently undertaking a massive infrastructure project involving tunnels, advances junctions in many levels and roads in close connection to both industry, as well as, residential areas. The project that was visited is the E6: Trondheim – Stjørdal project and is currently in its execution phase. The intention with our visit at their project office was to get an insight in how their Risk Management process worked. During our visits we participated in financial control meetings as well as a separate risk meeting.

The Norwegian public roads administration in Trondheim used the PUS-risk model as a base of operation. However, they used several other tools that involved risk management:

“PUS-model”	The PUS-model is the model that is meant to be used in all NPRA’s projects and is made up of an Excel based working method. This is the same model that the NPRA project in Lillehammer currently is using.
Risk sheet	The Construction manager for one of the tunnels have developed a risk-sheet that he uses to communicate with the entrepreneurs so that they could contribute in a greater extent. This risk sheet basically includes the same steps as the “PUS-model”, however, it has a less complex layout and focuses more on the risk- actions and deadlines.
G-Prog	G-Prog is one of NPRA’s own financial control program that is regularly used in projects. For the execution phase a plug-in has been developed, this should be used for follow-up of risk costs.
Financial control	A tool developed by the organization that included an Excel based risk management step where the cost of a pessimistic, realistic and opportunistic costs for events was estimated. This tool was developed so that the project could document more information and comments to the risks that was possible in the existing G-prog program.
Change log	A change log accounting for costs that has occurred due to changes in contract or risks that has been realized during the projects execution phase.

6.1 Identification

The continuous risk identification is usually done once a month in the project. However, effectively, risk identification is done in several separate processes such as the PUS-model and their own developed risk sheet. This means that the identification process usually is performed more often than once a month. The identification of risks is greatly dominated by threats. So far the organization has not identified any major opportunities for the project. The organization finds that changes and demand for additional work not stated in contracts is, by far, the greatest risks for the project.

The main goal with the risk sheet that has been developed was to simplify the communication between the construction managers and entrepreneurs, both in meetings but also at the construction site. Their experience was that the PUS-model and the focus on risk cost made the entrepreneurs losing interest in the risk management process. The figure below shows how each identified risk gets a specific number, an explanation and the reason why it occurs.

Aktivitet			Uønsket hendelse	Årsak
1	Prosjektering og planlegging	1.1	Feil i grunnlag for utførelse	Manglende kontroll av prosjekteringsgrunnlaget
		1.2	Feil i grunnlag for utførelse	Manglende kontroll av prosjekteringsgrunnlaget
		1.3	Forsinket godkjenning	NCC forsinket i sine
		1.4	Forsinket godkjenning	Forsinket myndighetsbehandling

Figure 14: An extraction from a risk sheet used to communicate with entrepreneurs in NPRA's project E6: Trondheim – Stjørdal.

6.2 Assessment

The project found that the PUS-model was focusing too much on the cost of a risk instead of having focus on the risk actions. Therefore they put more effort on the response than to estimate the costs. The PUS-model did not have as much impact as their own risk model that was used with the entrepreneurs.

The risk model used in their own developed risk sheet had scales of 1-5 for estimating the probability and impact. In the first step of the assessment these two are multiplied to calculate the seriousness of the risk. This index is then used to rank the risks. The projects own risk model includes four different objectivities that the risk could impact:

- H: Health, working environment and safety
- M: Environment
- F: Progress
- Ø: Economy

Sannsynlighet	Konsekvens	Type				Alvorlighet	Rangering
		H	M	F	Ø		
2	Forsinkelser			F	Ø	4	8
1	Kollaps i konstruksjon	H	M	F	Ø	5	5
2	Forsinkelser			F	Ø	4	8
2	Forsinkelser			F	Ø	4	8

Figure 15: An extraction from a risk sheet used to communicate with entrepreneurs in NPRA's project E6: Trondheim – Stjørdal

The second step of the assessment is shown in figure below and includes writing an action list for the risks so that they can be appropriately handled. The responsibility to handle risks is given to a risk owner, either in the own organization or at one of the entrepreneurs, and a date is set when the action should be done.

Tiltak	Ansvar	Frist
Tilstrekkelige ressurser for kontroll	Jon	25.06.2012
Tilstrekkelige ressurser for kontroll, fortløpende målinger ved utførelse	Henrik	26.06.2012
Tilstrekkelige ressurser for prosjekteringsledelse, styring av prosessen	Jon	05.06.2012
Oppfølging og styring av prosessen. Program og forutsetninger avklares med godkjenningsmyndigheten og bygges inn i konkurransegrunnlaget	Henrik	03.02.2012

Figure 16: An extraction from a risk sheet used to communicate with entrepreneurs in NPRA's project E6: Trondheim – Stjørdal

6.3 Response

The way of choosing response to a risk was done in different ways according to which model that was used. The "PUS-model" provided the project with concrete options to choose from. The most common in the project seem to be: trying to prevent the risk, or to reduce its impact. However, their own risk model does not provide the user with concrete options of risk response; instead this is to some extent included in the risk action description that describes the action that really is the product of chosen response tactics.

6.4 Monitoring & Control

One of the largest elements of monitoring and controlling risks was the change log. This log consisted of an excel sheet where all the contractual changes that had a financial impact on the project was noted. The follow up of this log consisted of updating the cost estimate of the changes as well as to update the description and status of the actions taken. This log assisted the project to track in which part of the project changes were done and in which contracts the costs will impact. The sheet was linked to E-Room where additional data to clarify in what part of the contract the change will affect is stored.

6.5 Communication

The managers in the project found the PUS-model hard to communicate to the entire project because they found it to academic. Since the project already found that they had a functional risk management process, the urgency of implementing the "new" PUS-model was somewhat low. This resulted in that the PUS-model was communicated as a necessary but to complicated tool. The managers were nevertheless very aware of that risk management was important and found that their own model was easily communicated to both the project and the entrepreneurs. The managers found that it was easier to communicate the risk management importance if the risk action and response was tangible and that the process actually realized something concrete. However, they acknowledged that their own model was merely focusing on the risks in a project.

7. Conclusions and recommendations from our visits

In this chapter we will summarize opinions and thoughts of recommendations and ideas in risk management that we have encountered during our visits at the different companies. The recommendations and ideas are mainly targeted to the NPRA's project E6: Biri - Otta. However, we hope that our thoughts can be of help to other organizations and projects within NPRA as well. We will concentrate on how the project can develop their continuous risk management process as well as how the managers can inspire and develop the risk awareness in the project. Furthermore, we have divided our recommendations into the steps that are explained earlier in the report; identification, assessment, response, monitoring and control.

Be clear about risk management and uncertainty management

All organizations work with threats and opportunities in similar ways. However they chose to name the parameters in different ways. The companies that has English as company language naturally chooses the English terms and definitions. However NPRA's company-language is Norwegian, this creates some misunderstanding as the terms and definitions sometimes translate unfittingly to English. The initiative to call Risk Management for Uncertainty Management in NPRA can create some confusion when it comes to academic literature. However, we find that the initiative is good since it increases the focus on opportunities. The most common process of how to work with risks is provided by the Project Management Institute where they call it Risk Management. However, all the steps that are included in NPRA's model are also present in the Project Management Institute's recommendations. The only difference really is that the English definitions usually describe Risk Management as dealing with "upside risk" or "downside risk", this corresponds to the terms used in NPRA that is "opportunities" and "risks". Furthermore, the term "risk" corresponds to the uncertainty in NPRA. We thought that this could be important to know if one reads English literature in the subject and gets confused.

7.1 Identification

We think that one of the main goals for the project should be to develop a good structure in the identification of risks. This to insure that as many risks as possible are identified. This is only possible if the entire project is actively involved and working with identification of new possible risks for the project.

The identification should preferably be done on a continuous basis during the projects life cycle and not only in the beginning of the project and the focus should be to identify risks not their consequences. During the visits it was told that the risk list should only contain identified risks that could be handled by a response.

NB: We do not consider that this way of thinking is wrong, however, some of the risks that have been identified and cannot be handled with a response are still important for the project to monitor. Our suggestion is that if the risks are not incorporated in the risk-log the project should develop a list with important risks that need monitoring. This should be done so the project can keep track of them before they develop into real measurable risks. Some risks might have different characteristics in the different project phases hence, making them important to monitor for later purposes.

Brainstorming activities

In the initial phase of a project the most used method to identify risks is in brainstorming sessions. These are usually performed both in groups of 3-5 persons and as individual brainstorming sessions. Risks identified during this process usually become the risk base for the project. In most organization this is a standardized way of how to identify risks; however, the problem arises when the project should identify risks on a continuous base.

When the project is entering a new phase or reaches important milestones we consider it to be a good idea to hold new brainstorming sessions with the personnel. Earlier identified risks that affect the new phase can be a basis for the brainstorming activity.

Involving project personnel in identification

To involve as many as possible in the organizations identification process and to get such a holistic risk image as possible Statsbygg uses a “risk-board” in the project office. Everybody who has identified a risk can use the board to give it a short description and make a note in what area of the project it is most likely to occur. Beside this, the board should contain space to note the date the risk has been identified, and by whom. If the project contains different subprojects it is also important to make a note in what project the risk is most likely to impact.

The figure below is an illustration how a risk-board can look like. The manager responsible for the risk management process should collect the identified risks from the board on a regular basis. For example, they could collect the newly identified risks in a document once a week so that they can be properly assessed during the next risk meeting.

Date	Project	Description of Opportunity / Risk	Impact	Stage of Occurrence	Identified by

Figure 17: An illustration how of a risk-board can look like, idea from Statsbygg.

Identification in Project meetings

In Statoil all project meetings begins with that the project manager asks all the involved personnel what they see as the biggest opportunities and threats in connection to the project or their own work for the following two weeks. The identified threats and opportunities are documented and then discussed during the course of the meeting. The ones that are considered of such importance to the project are included in the risk-log. This is a not only an effective way of involving all project personnel in the process of identifying risks but also a good example on how the project can, in the long run, develop a risk awareness in the organization.

7.2 Assessment and analyze

Different industries and organizations will value threats or opportunities dissimilar to each other. We find one important aspect in the assessment phase, to include how to adjust the assessment techniques to a specific project and how to handle threats and opportunities that are dynamic throughout the projects life cycle. The criteria of an assessment cannot be copied; these have to be developed to suit the specific project. For example the scales from a tunnel construction will not contain the same parameters as a road construction project.

Using quantitative analysis?

We observed that it was very rare to have a quantitative analyze involved in the continuous risk management process. However, in the initial phase of projects quantitative analyzes with uncertainties are common in the basic cost proposal. Moreover, when dealing with projects with more complexity and with large budgets we recommend, if possible, the organization to conduct quantitative analysis. Performing a quantitative analyze will take some training, but it will provide the projects with rather accurate and realistic guidelines depending on how much data that is put into the simulation. One commonly used model that we recommend is Monte Carlo analysis.

In order to create accurate quantitative analysis the project must provide the model with data. Most simulations use existing data from earlier projects with risks that are similar to the one that needs to be analyzed. This is one reason why it is important for the organization to build up a database over time with data that can be used. We recommend the organization to start by storing risk data in a systematic way so projects in the future can locate and use it for quantitative simulations.

Qualitative estimations and dynamic risks

It is important to remember that risks are dynamic, in most cases they will change from meeting to meeting and hopefully the unknown factors involved with the risks will reduce over time making the estimation more accurate. With this in mind, we recommend and encourage the employees to not be afraid to question the current risks and their estimations. If the risk register does not change over time there is no need for a risk process. The worst risk management is a static risk management.

The risk matrix and its scales

The most common way to visualize the risk image in the visited projects was done through the risk matrix; the matrix layouts were almost identical. However, the scales used in the matrix differ from each other. Some companies adjusted the scales according to the budget of the project; other had additional criteria listed such as quality, safety and company reputation. We argue that it is important to not only set the parameters with the budget in mind but also consider other aspects that can impact the organization. Furthermore, we recommend that the project considers adjusting the impact scale when moving from one phase to another; this because there are different kind of risks arising in different project phases.

7.3 Response

Most projects we visited had a list or tick-box system where they listed the available risks responses. In that sense most projects knew what the possible responses were. When deciding risk response the choice is usually rather straight forward, most responses could be seen as common sense; others require some thought and calculations to decide which one to choose. However, we consider it to be important to weigh the economic aspects and consider a lifecycle perspective when deciding response and action.

Lifecycle perspective

It is hard for a project to foresee what the consequences of a risk will be in the future. We observed that many projects chose to delay the handling of risks that had a long life span. This means that the projects focused on risks that were closest in time. This is off course the easiest and most manageable way of working with risk. However, as we described in the first part of this report with the 1:10:100 rule the longer the project waits with the risk response the greater impact it will have on the project. By considering the whole life cycle of the project the effort of risk response will hopefully be put in the appropriate phase of the project. The lifecycle approach is not always easy to understand. The term lifecycle implies that everything during the entire life of a project should be considered. So what is the entire life cycle? Since a project usually is limited in time and budget this aspects is trickier to understand. Usually a life cycle implies the stage from creating something until it is recycled or something new takes its place. However, when considering for example a

road project there are many areas around the project that are affected and most roads have a life span of many decades. The life cycle of a motorway is hence very tricky to define. Is the projects life cycle the completion of the motorway? Or is it also to take responsibility for the environment during the usage of the motorway and the safety of the road? We recommend that the life cycle and the project boundaries are discussed and defined before the risk management work begins.

Are there risks that should be ignored?

We consider it important to have a clear strategy in the risk response as well as in the risk action response. However, if the project cannot identify any risk responses to handle the risk, it will often be hard to choose the proper response. In these cases it is common to just ignore the risks. To ignore the risk is off course one way of choosing a risk response. However, in these cases we consider it to be important to consider if the risk can be transferred to a third party that can manage the risk more properly. A risk that has a low impact on the project might be appropriate to ignore, but always consider the financial impact.

Chose more than one

We argue that sometimes a single risks response might not handle the risk in an optimal manner. By considering more risk responses the project will be able to improve in their risk handling. For example, the organization can handle parts of a risk on its own while they are transferring one part of a risk to a third party that has better knowledge in the matter.

Insurance as a risk response?

Just like banks insure themselves against risks and losses a project can insure themselves against risks and losses in the project. We recommend this especially when risks that the company lacks concrete actions or strategy and the impact could be significant, for instance: fire or theft at site, liquidation clauses in contract etc. A benefit with liquidation damages clauses in contracts is that it can be a good incentive for the contractor or suppliers to actively work with their own organizations RMP.

7.4 Monitor & Control

Issues concerning monitoring and control are usually connected to the continuous work with risk management and how the organization chooses to divide the work load to keep the risk list accurate and up to date. Monitoring and control also puts much focus on responsibilities and the engagement of project employees. There are several areas we found important to discuss and evaluate to get a successful monitoring and control process, these are discussed below.

“All employees should be involved”

There are several techniques available to make the project employees engaged and involved in the risk management process. By including project employees as responsible for risk actions their personal responsibility and interest in risk management will increase. Hopefully, this will include taking initiatives to learn more about the process and to develop their own risk awareness.

However, there are some mistakes that we observed during our visits when projects selected risk owners. When a risk owner is accountable of a risk that has risk actions that are not detailed, accurate or descriptive enough the risk owner can lose focus and interest. The risk owner should feel encouraged to work with the actions given to him/her therefore they need to be specific and tangible. The risk owner should have short term goals in his/hers risk work, this can be handled by breaking down long lasting activities to more tangible units to handle. For example; a risk that has a time span of a year will feel overwhelming and contra productive to the risk owner and when it comes to building a risk aware culture it would not be especially encouraging. However, if this risk is broken down to smaller parts with concrete goals the process will become easier to follow and short term goals that are fulfilled will encourage the risk owners to continue the work.

Choose the best qualified risk owner

We found that many organizations lacked standards and guidelines when choosing risk owners. Some organizations chose the employees that were present during the assessment meetings; others chose managers in the organization while some chose the employee that was responsible for identifying the risk.

We argue that the risk owner should be chosen so that the organization makes sure that the person responsible for the risk also is the person with the highest knowledge in the risk. Furthermore, the organization and the risk owner should feel comfortable in that the owner can manage the risk actions. This may imply that one specific person in the organization can become responsible for many risks to handle. A common way around this is to let the risk owner allocate resources from other employees to help him/her in performing the risk actions and to monitor and control the risk.

Make all employees risk mitigation accountable

It is obvious that an organization that has risk aware employees will handle and respond to risks in a more effective and accurate way than an organization with little interest. Therefore it is important to encourage employees to be active in the project's work with risks. If the employees know what possible actions that can be taken in risk response, then these can be applied in the continuous work with monitoring and control as well. We found that the organizations that had a risk aware culture of thinking in risk management also managed risk better in their everyday work. They felt a bigger engagement towards risk mitigating actions in their work.

New project phase, outdated risks?

Many of the projects we visited did not know what to do with the risk register when the project changed into a new project phase. The most confusing for the projects was going from planning phase to execution phase. So how should a project handle such a transformation? First of all, the risk register should only contain risks that are up-to-date and still essential to the organization. When the project shifts into a new project phase the risk register should be updated thoroughly and risks that are not relevant for the next phase should be removed. Some risks might shift character and of course change the action strategy that is required to handle them.

There are several examples of risks that will shift in character when entering the execution phase. Many of the risks are relatively vague in the planning phase and risk actions often involve planning and preemptive work to reduce the risk of occurrence. As mentioned in the introduction of this report, the best strategy in early phases of a project is usually to reduce threats and enhance opportunities. For example, risk actions related to calculating, collecting additional data, regulations and standards in the planning phase will shift to much more concrete actions in the execution phase where much more focus will be on preventing risks.

In our opinion it is worth to put much effort in reassessing threats and opportunities in shifts from different project phases. In this reassessment it is important to not only reevaluate threats and opportunities but also to evaluate the risk actions, if they still are applicable to the changing situation. Risks that are no longer relevant should be removed and documented so that they are backwards tractable. Risks that are still active should be transferred to the new project phase.

When to delete and how to delete risks

We found that most projects we visited had difficulties to decide when a risk should be removed from the risk register. Many were unsure how to proceed if the risk had occurred or if it no longer was relevant. We argue that the important thing is not how the risk is removed; the important thing is to know why it is removed and to document the reasons. If a risk has occurred the risk is no longer a risk, it is a fact and an event that has impacted the project. However, there may still be parts of the risk that is still active. Therefore it

is important to remember to evaluate if the removal of the risk may result in new risks arising. When removing a risk it is important to document why the risk is removed and adding comments that can be useful for projects in the future for example, how could it have been avoided?

Create traceable risk register

We consider many organizations to discard the previous risk management work that has been done and so to say “reinvent the wheel” every time a new project or project phase is initiated. With the help of a risk register that is backwards tractable the risk management process will be available for coming projects. They will benefit by being able to get information surrounding the risk image from similar projects and how they were assessed. This backwards traceability does not need to be advanced. One way of creating such a risk register could be to save the previous risk assessment meetings with comments in a folder in the organizations intranet so that it will be available for all projects.

7.5 Meetings structure and Communication

We consider that to have effective meetings in the continuous risk management process it is important to have a good structure to follow. There are a number of different ways an organization can structure these meetings, the one that we recommend is illustrated below.

	Risk meeting structure
1	Identify new opportunities and threats
	<ul style="list-style-type: none">○ Begin with identifying opportunities then threats
2	Assess new opportunities and threats
	<ul style="list-style-type: none">○ Log the newly identified opportunities and threats in the risk log○ Assess the newly identified opportunities and threats with probability of occurrence and impact○ Plan response and assign a risk owner
3	Reassess already identified risks
	<ul style="list-style-type: none">○ Begin with high probability opportunities and threats○ Identify new information and update action strategy○ Check if action plan is still valid○ Check if actions are performed by the owner○ Add eventual new actions
4	Update risk register
	<ul style="list-style-type: none">○ Make sure all opportunities and threats has owners○ Communicate changes in register

Figure 18: Recommended structure in risk meetings from Statsbygg.

In many cases, especially in the early phases or in the planning phases of a project, it can be very difficult to assess the risk cost; if this is an issue for the project it is better to focus on assessing the probability and impact in the risk log so the project still will focus on it. We acknowledge it to be problematic to estimate the risks costs without a quantitative data to support the estimation; therefore it can be contra productive to spend too much time on personal estimations in an early stage of the project. We recommend using a rough cost estimate in early planning phase that later on can be adjusted as more information is acquired.

Assessment of newly identified risks

When new risks has been identified and are about to be logged into the system it is important to give it a specific risk number. A recommendation from Statsbygg is to separate opportunity and threats by using letters for opportunities and numbers for threats. We have developed a new system which both uses letters and numbers to get a structure in the existing risk list. The system uses letter **M** for opportunities and the letter **R** for threats; these letters are followed by a number system X.Y. The first letter X indicates which uncertainty class the opportunity or threat belongs to in accordance to the early cost estimate (Anslag). The second number is a sequential number which indicates the number in the different categories. (In special cases when one risk has been divided into more it is preferable to use the numbering X.Y.Y instead). Other benefits by using such a numbering system could be that the generated risk list will become easier to overview. Below is an example how the risk list can look like with the new identification system:






















			M.2.6	Håmårstad bruer	U2
			M.2.7	Optimalisering av krysset ved Kvam	U2
			M.4.1	Igangsetting av forberedende arbeider for tunnel	U3
			R.10.1	Flom i anleggsperioden	Hendelser
			R.2.1	Reguleringsendring Harpe bru	U2
			R.2.10	80% og 100% leveranse Frya-Vinstra utsettes	U2
			R.2.11	Omlegging av høgspenst (og lavspenst) Frya-Vinstra	U2

Figure 19: An example how the identification in the risk list can be structured. M is opportunities and R is risks.

Furthermore, it is important that the **date is registered** when the risk is registered in the risk log. If this date is missing it will be hard for the project to actively follow up the risk according to the time criticality.

When new threats or opportunities should be placed in the risk matrix it is a good idea to give them deviating colors from the already existing risks in the matrix. The reason is that it is easy for a person not actively involved in the risk process to identify which risks are new for the project. Figure 20 illustrates an example of the risk matrix with newly identified risks, note that the color deviates for the one already existing in the process and the numbering of the risks and opportunities.

Usikkerhets- matrise	Konsekvens							
	Risiko				Mulighet			
	Høykritisk	Kritisk	Alvorlig	Liten	Liten	Middels	Stor	Veldig stor
Sann- synlighet	>100	50-100	15-50	<16	>1	1-5	5-10	>10
Veldig stor 50-100%		R.3.9	R.2.10	R.2.2	M.2.2, M.2.3, M.2.4	M.2.1, M.2.5		
Stor 25-50%			R.9.1	R.2.11, R.2.12, R.2.7, R.2.7		M.2.6	M.2.7	
Middels 5-25%			R.3.8, R.4.5, R.5.1, R.6.2	R.2.4, R.2.8, R.2.9, R.4.2		M.4.1		M.4.2
Liten 1-5%		R.6.3	R.10.1	R.2.1, R.2.3, R.2.5, R.2.6				
Nærmest utenkelig 0-1%	R.7.1			R.4.2				

Figure 20: An illustration showing the new system of risk numbering, new threats and opportunities that deviate in color from already existing risks in the risk matrix.

Reassessment of already existing risks in the matrix.

To be effective in reassessing old risks it is recommended that the matrix is divided into different sections, see below. The reassessment should start with number 1 and 2; these are the threats and opportunities with the biggest impact and importance for the project. For the risks in 1 and 2 it is very important for the project to develop responses that will help to enhance or decrease the possibility of occurrence. These should be followed by number 3 and 4 with a medium impact on the project and in the end of the reassessment should risks in number 5 be reassessed.

Usikkerhets- matrise	Konsekvens							
	Risiko				Mulighet			
	Høykritisk	Kritisk	Alvorlig	Liten	Liten	Middels	Stor	Veldig stor
Sann- synlighet	>100	50-100	15-50	<16	>1	1-5	5-10	>10
Veldig stor 50-100%	2	R.2.10	R.2.2	M.2.2, M.2.3, M.2.4	M.2.1, M.2.5	3	M.2.7	1
Stor 25-50%			R.9.1	R.2.11, R.2.12, R.2.7, R.2.7	M.2.6			
Middels 5-25%	4	R.3.8, R.4.5, R.5.1, R.6.2	R.2.4, R.2.8, R.2.9, R.4.3	M.4.1	5	R.7.1	R.6.3	R.10.1
Liten 1-5%		R.2.1, R.2.3, R.2.5, R.2.6	R.4.2					
Nærmest utenkelig 0-10%	R.7.1							

Figure 21: Illustration showing how the risk matrix could be divided for reassessment.

Other examples that can be used to make the process more effective is to have the assessment either on a flip-sheet, whiteboard, or if the project have access to an interactive whiteboard. The benefit by using, for instance, an interactive whiteboard instead of the Excel based risk sheet is that the responsible for the risk meeting can concentrate on having an effective meeting. Further benefits are that; it is easy to communicate which threats or opportunities that have moved during the reassessment, or which risks that have expired. This method is especially beneficial when communicating with people that not actively involved in the risk process, for instance with project personnel or the project owner.

Figure 22 illustrates an example how the risk matrix can be used for illustrating which risks that have moved or expired during reassessment.

Usikkerhets- matrise	Konsekvens							
	Risiko				Mulighet			
	Høykritisk	Kritisk	Alvorlig	Liten	Liten	Middels	Stor	Veldig stor
Sann- synlighet	>100	50-100	15-50	<16	>1	1-5	5-10	>10
Veldig stor 50-100%		R.3.9	R.2.10	R.2.2	M.2.2, M.2.3, (M.2.4)	M.2.1, M.2.5		(M.2.4)
Stor 25-50%	(R.6.3)		R.9.1	R.2.11, R.2.12, R.2.7, R.3.7		M.2.6	M.2.7	
Middels 5-25%			R.3.8, R.4.5, R.5.1, R.6.2	R.2.4, R.2.8, R.2.9, R.4.3		M.4.1		M.4.2
Liten 1-5%		(R.6.3)	R.10.1	R.2.1, R.2.3, R.2.5, R.2.6				
Nærmest utenkelig 0-1%	R.7.1			R.4.2				

Figure 22: An example how the risk matrix can be used for illustration of which risks that have moved or expired from the previous meeting. Crossed over risk has expired during the reassessment and arrows illustrates risks that has moved.

Risks that have moved shall be inside a bracket and an arrow shall display how the risk has moved from its previous to its new position. If a risk has expired during the risk assessment is shall be crossed over, in the next risk meeting this risk shall be removed from the matrix.

Project meetings:

During project meetings the project manager has a good opportunity to involve the entire project personnel in the risk image, for instance by communicate the projects top ten risks. Statsbygg recommends that the focus should be to discuss challenges or specific areas of interest instead of just reporting on progress.

Moreover, if possible, these meetings can be used to identify new risks. One good example how this can be done comes from Statoil. In Statoil they starts all their project meetings with discussions about which opportunities and threats the personnel sees in connection to the project and their own work until the next meeting. They always start by identifying and discussing opportunities before moving on to threats.

8. Improvement in NPRA and reflections

All the recommendations given in the chapter above are valuable for project organizations in NPRA region east. However, there are more issues we found interesting to discuss further for the organization. Some of the recommendations are specific to the project office E6: Biri – Otta that we currently are working in, but we hope that other projects in NPRA could find these recommendations both useful and inspiring. We arranged our recommendations as key factors we found useful from other organizations followed by specific areas in NPRA's risk management process that we found interesting to discuss.

Key factors to become successful in risk management:

In the course of our visits in the different organizations we have discussed what they see as key factors for an organization to become successful in risk management. Some of the most common factors that have been brought up are listed below as well as our own thoughts and recommendations:

- **Strong commitment from leaders within the organization**
The leaders need to show and communicate with the organization that they believe in risk management; what the organization will win by actively working with risk management and how will it help the project. This commitment should not only come from leaders that are actively working in the project but it should also come from the project owner.
- **Project owner**
If the project owner shows an interest for the projects work in risk management besides the ten most important risks for the project will create risk awareness in the project. Beside this, it will also create an understanding of how important the work with risk management is for the project.
- **Encourage an open culture and attitude towards risk**
This is achieved by actively informing about the risk image, for instance through project meetings or to encourage the use of the risk board. Furthermore, by engaging personnel in risk responses will help to foster a risk aware culture.
- **Risk register and action list is alive**
It is important to remember that the risk register and action list is a snapshot from the last risk assessment. These are always in change and by actively monitor risks the project will control them better.
- **Active visualization of the result**
By actively visualize the result from the risk process will create an interest and awareness in the organization. This can be done, beside information in project meeting, by having a risk board in the department. Employees can use this board to get an understanding how the risk image for the project are developing.
- **Perseverance**
To develop a functional risk management process and culture takes time. To be able to reach the project goal with risk management takes perseverance from it leaders.
- **Sharing of knowledge (both internal as well as external the project)**
Actively sharing knowledge with others will help the project to develop their current risk management process. A good example how this can be done comes from Statoil where they organize lunch-

meetings once a month for persons that works with quality and risk management. This approach can also be implemented in NPRA region east.

Split bigger projects

Major projects that involve many threats and opportunities might gain by dividing the major parts into separate risk logs. For example the project E6: Biri – Otta contains of a subproject E6: Frya – Sjoa. The Frya – Sjoa project in its turn consist of two contracts, Frya – Vinstra and Vinstra – Sjoa. Our recommendation is that each of the two contracts should develop a risk register when they entering the construction phase. They should operate separate risk management processes and report once a month of the ten most critical risks to risk manager in the Frya – Sjoa project. By dividing the projects in to subprojects an running simultaneous risk processes the main project will always be reported the most important risks and can manage them more effectively.

More accurate description of risk actions

We found that many of the risk actions in the project could be further explained and with more detail. The project feared that this would make the risk actions to an activity list but we do not consider this to necessarily be a negative thing. By describing the actions better the risk owner will be able to handle them easier. The action list will also be easier to monitor if the actions are performed within the given time frame. The risk owner will feel more encouraged to work with the risks if the action does not feel overwhelming. By achieving smaller risk actions and targets followed by “ticking off” milestones in his/hers risk action work they will feel more stimulated to continue their risk work.

Identification date

It is very hard to relate to the time criticality in the current Excel sheet if there is no date of identification. The model in NPRA lacks a field where the date of the identified risks can be noted. By ignoring the time criticality the risk management process will lack some of its sense of being an urgent matter that needs to be dealt with.

Risk costs

To estimate threats and opportunity cost is perceived as one of the most difficult part of the risk management process, and perhaps the step that makes the whole process hard to handle. When focusing too much on detailed estimations of risks the important part of focusing on handling the risk can be lost. We recommend that the risk and opportunity cost should be rough estimates in initial phases of the risk management process. The estimate should reflect the event, however, we perceived the project to underestimate the risk cost and put a lower value than the appropriate risk cost. By doing this the criticality of the risk is downgraded and the importance of handling it decreases. We recommend that the risk cost is downgraded when more information about the risk is acquired. Focus more on the risk actions to increase the knowledge of the risk and to reduce its impact or probability. The important thing is not to have an exact number when it comes to costs; it is to handle risks and opportunities by concrete actions.

Effects of risk actions

As with the risk costs the economic gain from risk actions is in many cases very hard to estimate. This creates questions during the risk meetings where too much time and focus is on the economic gain of risk actions. These numbers are usually fair guesses, however, it does not create an additional value to the risk management process in our opinion. If the economic gain is not very straightforward or based on something concrete we consider it better to leave it out. Focus on promoting the importance of working with the risk actions instead.

Specify and clarify the risk and opportunities

To get a convenient overview in both the risk and focus list generated by the PUS-model it can be beneficial for the project to develop a naming convention that can be implemented in the risk log. An example that can be used that separates risk and opportunities are described in chapter 7 under "Assessment of newly identified risks". Moreover, this can also help to make reviews in the follow-up meetings more efficient.

Lunch meetings and continuous improvements

We consider that the organizations we visited where the importance of the risk management was communicated, and where there was an open dialog concerning risks were the organizations that seem to manage risks best. By creating a forum where an open dialog can be held but also questions and thoughts can be ventilated surrounding risks and the process of managing them; will develop both the process and personnel. We recommend lunch meetings as a good opportunity because it feels more relaxed than ordinary meetings. Moreover, we consider it important to point out that risk management is not something that only should be managed at risk meetings. Instead, the optimal way must be to implement it as part of the daily work, it is first then the project will reach continuous improvements in risk management.

Later Project phases

In the execution phase of a project it is important with follow up activities of risks and opportunities compared to the initially identified and assessed risks. All additions and changes to the contracts that implements costs or cost reductions for the project should be assessed and logged. NPRA's project E6: Trondheim – Stjordal has developed a model that is used where all the changes to the contract is logged and explained. This model is a very useful tool to keep track of historical changes. We believe that the Excel sheet that they have developed is a good addition to the already existing PUS-model and G-prog in the execution phase. This since it gives a good overview of additional costs in contracts but also that it specifies in what part of the project it is impacting. It might be an idea to use similar definitions and numbers for identification as in the PUS-model to make the two excel sheets correspond.

Identification by Scenario techniques

When the project aims to identify new risks and opportunities a helpful method could be to use scenario techniques. Scenario techniques can be performed both as qualitative exercises in meetings but also as a quantitative technique. If it is done with a qualitative approach one of the managers takes on the role as a process leader who describes a scenario for the rest of the participants. For example, during the executional phase of the project there is a huge flooding. What threats or opportunities can be identified in that situation? If this technique should be efficient the manager must come prepared with relevant and well worked through scenarios. Quantitative scenario techniques are usually performed to describe how the project can manage changes in one or more of its objectives, usually cost and time. For instance, this technique can be used to model what will happen if the price for material will increase with 5-30.

9. Reflections

During the process of writing this report the authors have gained valuable knowledge in how different projects work with Risk Management in practice. Furthermore, an increased view has been developed in which areas a projects have to focus on to be successful in their work with Risk Management. The opportunity to visit different projects and to see how the risk image shifts from different stages in a projects life cycle has been a valuable and appreciated knowledge for the authors.

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