RISK MANAGEMENT FOR AFRICAN INFRASTRUCTURE PROJECTS IN PRACTICE:
IDENTIFYING IMPROVEMENT AREAS

Master Thesis
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February 2017 - Bremen
This thesis is the result of my graduation research which is the final part of the master Construction Management and Engineering at Delft University of Technology. The subject of the research is risk management in practice for African infrastructure projects performed by international companies. The research was conducted at Inros Lackner SE who provided data and accommodations to perform the research.

The research has been an academic challenge as well as a personal challenge for me. Fortunately, I was surrounded by people who helped me a lot. First of all, I would like to thank the chair of my graduation committee Hans Bakker for his sharp guidance and specialist knowledge. Jan Anne Annema thank you for the guidance related to the research methods and the motivation you gave me. Erfan Hoseini, thank you for all helpful Skype meetings, discussions, and all feedback. Your positive comments motivated me to go further.

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Last, I would like to thank all my family and friends who supported me these months and gave me the motivation to finish the research well. In particular, Erwin, thank you for listening to me, believing in me and taking care of me when I really needed it.

Although it wasn’t always easy living abroad and graduating at the same time, I am looking back at a great experience that helped me grow academically and mentally.

Enjoy reading,

Lotte van der Kuijp
Hamburg, February 2017
SUMMARY

Africa is rapidly growing, which increases the demand for infrastructure projects. Just like other parts of the world, infrastructure projects are often implemented over budget and with a delay. Better risk management can help to improve the project outcomes. A lot of infrastructure project are executed with the support of international companies. However, it stays unclear how this affects risk management and what should be taken into account.

Objective and method of the research

There is a limited amount of literature available which discusses the performance of risk management for African infrastructure projects by international companies. For this reason, the objective of this research is to provide empirical knowledge about risk management by international companies in African infrastructure projects. Hence, the main research question of this research is:

What improvement areas can be identified relating to risk management for African infrastructure projects executed by international companies?

To identify the improvement areas an ideal situation described by literature is compared with reality found by an empirical study. The literature study focuses on the different risk management methods, risk management process, implementation in the organization, and specifying on the project environment. The last two parts are focused on African infrastructure projects. To identify the performance of risk management in practice, semi-structured interviews are conducted with twelve experts of one consultant engineering company. All experts have extensive experience with African infrastructure projects. The research is written from the perspective of a European engineering company focusing on infrastructure projects, mainly port infrastructure in Africa.

Research results

The ideal situation and risk management in practice are compared to the following topics: risk management process, organizational risk management awareness, and risk management influencing factors (i.e. enabling factors for improved risk management and risk enlargement factors).

Risk management process

The risk management process is advised as a continuous process during the whole project life-cycle: (1) identify risks, (2) risk analysis, (3) plan and implement risk responses, and (4) monitor and control. Although the process is started, it is not continued during the whole project life-cycle. In practice, risk management is performed on an ad-hoc basis.

Organizational risk management awareness

Due to the lack of knowledge and awareness related to infrastructure project and risk management in Africa, it is advised that embed risk management in the organization. The quality should be guaranteed, and a standard procedure should be available. In practice, there is no standard procedure, and the awareness and skills of practitioners vary a lot. This results in different ways and quality levels how risk management is performed.

It is advisable that experiences and results are communicated structurally within the organization and with the African stakeholders. In practice, experiences are shared freely but are hardly documented somewhere. This results in a loss of knowledge for next projects and optimizing the risk management approach. Furthermore, the results of the risk management process are not clearly shared with African stakeholders. This can results in a client that is not able to understand the results and consequence and cannot make well-argued decisions.

Risk management influencing factors
The aim of this category is to understand what factors can help to increase the effectiveness of risk management. Enabling factors for improved risk management are factors that should be taken into account to enhance opportunities and limit the threats. Risk enlargement factors are factors that can cause a treat for the project. The enabling factors and risk enlargement factors in practice are shown in the table below.

The risk enlargement factors are all confirmed by literature. Besides, literature confirms that these factors are not typical for African infrastructure projects, but applicable to most international projects. None of them is structurally taken into account for risk management in practice.

Eight risk enlargement factors are identified for African infrastructure projects, but not structural considered during risk management. Literature confirms that five of the eight factors are typical for African infrastructure projects. Unavailability of service and equipment, poor communication, and a limited amount of data are not seen as typical factors for African infrastructure projects. The available literature states that these factors are related to international projects.

Furthermore, literature states that political and economic instability and technical issues are risk enlargement factors for African infrastructure project. In practice, these factors are not seen as risk enlargement factors.

Table 1: Risk management influencing factors in practice

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<td>Taking into account the local culture helps to understand how this affects effective risk management</td>
<td>Project environment is often in a bad state and poorly maintained</td>
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<td>Experience and know-how are used for effective risk management (knowing what might come up and how to handle)</td>
<td>Necessary service and equipment are often not (directly) available</td>
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<td>Competent local support helps to improve risk management with specific and local knowledge</td>
<td>Unknown and unpredictable (process of) local regulations</td>
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<td>A good relationship with the most important stakeholders helps to improve the effectiveness of risk management</td>
<td>Local clients have little knowledge, experience, and available money</td>
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<td></td>
<td>Communication with the client is difficult</td>
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<td></td>
<td>The decision-making process is slow</td>
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<td></td>
<td>Client is not sure what he wants and is not able to set clear objectives and requirements</td>
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<td></td>
<td>Data is often missing or limited available</td>
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Conclusions and recommendations

Based on the research results the following conclusion can be drawn:

- Risk management is performed in an ad-hoc manner which results in ineffective risk management for African infrastructure projects.
- Risk management is not embedded in the organization. The quality and effectiveness of risk management depend on the awareness and knowledge of the one responsible.
- The results of the risk management process are not shared clearly and systematically. Due to a lack of knowledge, African stakeholders might not understand the results and cannot make well-argued decisions
• The differences in culture should be understood, especially how this affects relationships. Understanding helps to improve the effectiveness of risk management.
• The business project environment differ a lot from the environment of the consultant engineer. This should be considered during risk management.

Based on the literature study and information given during the interviews, several recommendations are drawn for the improvement areas:
• Risk management should be continued during the whole project life-cycle. The results should be updated for important milestones.
• One person should be responsible for performing and facilitating risk management (e.g. risk workshops).
• The client and other stakeholders should be involved in risk workshops. However, the number of persons involved must be limited because of high power distance.
• Risk management needs to be embedded in the organization (and the project) to guide the employees and create awareness and knowledge. This helps to communicate results, so well-argued decisions can be made by all stakeholders.
• To ensure that experiences from one project can be used in the next projects a bottom-up approach is necessary. It is advisable to write down lessons learned and update and use a risk checklist.
• To ensure that the African client understands the results and is aware of the value, it is recommended to use a risk register for structural in clear communication.
• A local company can help to understand the local culture and the effect on risk management.
• The local clients should regularly be contacted
• "Who" is critical in risk management for African infrastructure projects. A comprehensive stakeholders analysis is advised to determine, among others, resources and values.
• "Where" should be included in the risk management approach. Comprehensive site investigation is advisable due to the significant difference between the business culture and project environment of Europe and Africa.

Relevance and limitation of the research
The results of this research add empirical knowledge to the limited amount of literature related to risk management by international companies in Africa. Moreover, the results are a proper basis for further research related to this subject.

However, it might be hard to generalize the results for different purposes. First of all, the research is based on interviews with experts from only one consultant engineering company. The results are influenced by their objectives and thoughts. Secondly, Africa is not homogenous. The continent of Africa is subject to a lot of different cultures, languages, religions, economic and political systems, and so on. It is, therefore, difficult to define one set factors, conclusions, recommendations that are applicable to the whole continent.
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1. **INTRODUCTION**

Africa’s economy is growing and is expected to continue to grow. Nigeria aims to be in the top twenty world economies by 2020 (Gaibi et al., 2010). There are significant economic and geographical differences between the various countries of the continent, but all areas show the eagerness of the continent to grow and make progress.

One of the key factors for economic growth is a good infrastructure system (Osei-Kyei & Chan, 2016) for transport (road, rail, and sea), public services (e.g. electricity, potable water) and telecommunication. Efficient and modern infrastructures improve the quality of life, reduce poverty, enable the possibility of trade over a larger distance, and interconnects commercial centers and people (African Development Bank, 2010; EY, 2015; Mezui & Hundal, 2013). However, Africa is plagued with a great infrastructure gap. The World Bank estimated a necessary annual investment of $93 bn. to fill this gap (Gutman et al., 2015), which cannot be financed by governments solely.

Despite the acknowledgment by governments and institutions of the necessity for investment in infrastructure projects, implementation of infrastructure projects is still lagging behind. It seems that many infrastructure projects struggle to pass the concept stage, becoming attractive for investors, and ready for implementation. Besides, the projects that are implemented are often dealing with late completion and cost overruns (Chileshe & Kikwasi, 2014). Effective risk management, however, can contribute to limiting the change of delays and cost overruns. Risk and in turn risk management are thus weighty factors for project stakeholders (Hillson & Simon, 2007).

1.1. **Definition of the problem**

Although risk management is a continuous process which should be included in all phases of a project, the foundation is laid in the project preparation phase. Comprehensive risk analysis during project preparation gives other parties the opportunity to take risks into account when preparing a bid (Shendy et al., 2011; Marques & Berg, 2011). Another reason that supports the use of effective risk management is the positive influence risk management can have on project outcomes (Chilese & Kikwasi, 2014). Uncertainties with a potentially negative influence on the project outcome are identified and can be avoided or mitigated by choosing a proper strategy.

Risk management is equally important for projects in developed countries as in projects in developing countries. Problems in the implementation of effective risk management can both be seen in projects in developed as in developing countries. Even though the importance of risk management is considered as a vital subject for project management, proper implementation and execution are still lagging behind. Increasing the effectiveness of risk management can make a great difference for African infrastructure. Private parties often stay cautious to invest in African infrastructure projects. Several reasons underpin this problem, but may all be summarized by the high perception of risks. This report focuses on risk management in developing countries. The reason is that implementation of effective risk management for projects in developing countries could help to overcome the high-risk perception and can improve the outcome of the project.

1.2. **Research**

Companies from developed countries have a large market share in developing countries. In the Tanzanian construction market, 62 percent of the market share is owned by foreign companies (Chileshe & Kikwasi, 2014). However, little literature focuses on the risk management approach by foreign companies (international companies) in developing countries. Muriithi & Crawford (2002) focus on project management of international development projects in Africa, but do not specify on risk, nor do they give empirical evidence. A knowledge gap remains on risk management relating to African infrastructure projects by foreign companies (international companies).
For this reason, the objective of the research is to provide empirical knowledge about risk management by international companies in African infrastructure projects. This empirical knowledge will be used to fulfill the aim to improve risk management in practice for this kind of projects. The knowledge can help to identify the areas that should be changed, adjusted, erased, or added. This results in the following research question:

**What improvement areas can be identified relating to risk management for African infrastructure projects executed by international companies?**

To be able to answer the research question, the ideal situation relating to risk management for African infrastructure is sketched in this research, as well as risk management in practice for these projects. A literature study and interviews with experienced managers of African infrastructure projects are performed. Both are compared to find the most important improvement areas.

1.3. **Report outline**

The report is divided into five parts: (1) research design, (2) literature study, (3) empirical study, (4) research results, and (5) literature list & appendices. The different report parts with the corresponding chapter are shown in Figure 1.

![Figure 1: Report outline](image)

The first part of the report, research design (chapter 2, Problem analysis), provides essential background information and determines the project demarcation. Based on this information, the research strategy is discussed in chapter 3.

The next part of this report is the literature study. This part discusses, in chapter 4, the different risk management methods and the essential components of the methods. Chapter 5 explains the risk management process, followed by chapter 6 which focuses on the combination risk management and the organization. Last, chapter 7 explains the risk management and the project environment. The final chapter of this report part is chapter 8, which draws the most important conclusion based on the literature study and answers the first sub-question.

The third part of the report is the empirical study. Chapter 9 first discusses the research methodology for the empirical study. Based on semi-structured interviews risk management by international
companies involved in African infrastructure projects is explained in chapter 10. Chapter 11 compares the information from the literature study with the empirical data discussed in the previous chapter. Chapter 10 and 11 also provide an answer on sub-question two and three.

The research results can be found in the fourth part of the report. Based on the literature and empirical study, chapter 12 draws the main conclusions for this research, by answering the research question. After that, chapter 13 provides recommendations to improve risk management in practice, based on the information from literature- and empirical study. Chapter 14 provides a reflection on research.

The last part of this report, Literature list & appendices, provides the literature list in chapter 15. Thereafter, all appendices can be found.
RESEARCH DESIGN

- Research design
- Empirical study
- Literature list & Appendices
- Literature study
- Research results
2. **Problem Analysis**

The problem analysis discusses the most relevant topics related to the defined problem: necessity of infrastructure in Africa, implementation of infrastructure projects, project risks, and risk management. The information is used to: (1) create a broader understanding of the problem, and (2) to define further focus points for the research.

2.1. **Necessity of Infrastructure in Africa**

The African economy is rapidly growing. To be able to continue to grow, there is an increasing need for infrastructure development. Fast growing areas, such as Asia and Latin America, are quickly implementing infrastructure projects, Africa, however, is lagging behind (EY, 2015).

Infrastructure is usually referred to as interrelated systems which include physical components and societal needs and by Fulmer (2009, p.32) defined as “The physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions.” Because this is a rather broad definition, Fulmer (2009) also identifies primary infrastructure sectors: electric power, oil & gas, sewage systems, transportation, and communications. Besides, the main infrastructure sectors, food and agriculture, chemical, financial, and social infrastructure can also be seen as infrastructure objects, mostly referred to as soft or social infrastructure components. From a functionality point of view, infrastructure facilitates production and distribution of goods and services. The level of infrastructure affects income, employment, international and regional trade, quality of life, and health. Altogether, infrastructure development has a beneficial influence on the economy. On the contrary, lack of infrastructure puts a constraint on economic growth (Oyedele, 2012; EY, 2015). Infrastructure should, therefore, meet the demand in a growing economy and, thus, grow as well, whether in supply level, efficiency or effectiveness.

2.2. **Preparation and implementation of infrastructure projects**

As in most parts of the world, governments in Africa do not have the financial resource to implement the infrastructure project on their own. Lack of knowledge and experience related to the implementing of infrastructure projects is the other problem. The government has to rely on other parties for the preparation and implementation of infrastructure projects (Chaponda et al., 2014). A client can hire a consultant engineer to provide knowledge and take over tasks to ensure quality. During the project life-cycle, the consultant engineer can have one (or more) of these roles: consulting service, design, supervision, and project management.

The implementation of a project, whether in PPP form (public private partnership) or not, is just one of the five steps of the project life-cycle identified by World economic forum (2013): project selection, project preparation, procurement, project construction, and project operation. Project implementation can be seen as the steps after project preparation. Both procurement and implementation are prepared during project preparation.

Project preparation is a critical stage in the life-cycle of a project. The outcome can determine whether or not a project may be interesting for private investors (Shendy et al., 2011). Transparency relating to output requirements, standards, payment terms, and risks ensures that private parties have the right expectation of the project (ICA, 2009). Especially information concerning risks is important. This information gives private parties the opportunity to take all risk into account during the preparation of a bid. Bids offered from a strategic point can be excluded (Shendy et al., 2011; Marques & Berg, 2011).

The selection and preparation of a project are part of an iterative process. Requirements, standards, scope, and outcome of a project should be in line with the possibilities of private parties to deliver this project within the budget. All relevant factors should be taken into account and be tweaked till the right
balance is achieved (e.g. relation between costs and quality). Risk identification and management are important parts of this process.

2.3. Project risks
The previous section underlines the importance of project preparation for the outcome of project procurement and success. Therein, the identification of risks and associated risk management play a major role.

Risk is an often named term, though specific definition varies a lot. ISO (2009) defines risks as “The effect of uncertainty on objective,” so the risk can either have a positive or a negative effect (Hillson, 2003). Schwartz et al. (2014) define it as “the probability of a loss or an unwanted outcome.” Uncertainties about positive effects may not directly be harmful to a project but can create opportunities, in contrast to uncertainties about negative outcomes, which can influence the viability and thus harm a project. The latter is usually referred to as a threat.

Regarding project investments, risks are the most important factor for approval. The greater the risks, the higher the repayment has to be in order to overcome the cost of the risks that materialize (Gatti, 2013; Grimsey & Lewis, 2002). Thus, a number of returns, cash flows generated by the project have to be in proportion to a number of risks. The required amount return must be feasible in order to justify an investment (World Economic Forum, 2015). The amount of risks is, therefore, important for investors.

Not only are risks interesting for investors, but they are also interesting for other private and public parties connected to the project. Since risk is a major factor influencing the outcome of a project, the behavior of different parties within the project is influenced by risks. All parties should emphasize the influence and importance of risks, and it should be part of the project management.

The difficult part is that risks depend on a lot of factors and different risks can be identified for different projects based on the scope, project goals, environment, and stakeholders. Hence it is impossible to give a list of risks that occur in all projects. For instance, each stakeholder may have a different project objectives, so each stakeholder identifies different risks for the same projects. Thus, there is no common view on risks (Waleski & Gibson, 2003).

2.4. Necessity of proper risk management
The fact that risks are always part of a project asks for management to control the risks. Ensuring that the project outcome and a decision-making process that takes risks into account. Risk management defines the plan how risks will be identified, analyzed, monitored, and controlled during the life of the project (Wylie et al., 2014). If the process is followed and executed properly, the impact of the risk level (in this case threats) is reduced, decision making continuously improved, and underperformance of projects is prevented (Kululanga & Kuotcha, 2010, Zwikael & Ahn, 2011).

A prerequisite for a positive effect on the project outcome due to risk management is that risk management is executed effectively. This, in fact, depends on a lot of factors. Risk management is not a one-size-fits-all strategy. It is subject to the project itself, stakeholders, environment, objectives, culture, and human factors. Each different project, therefore, needs an own strategy how to perform proper risk management (National Research Council, 2005; Walewski & Gibson, 2003; ISO 2009). Although the plan and strategy differ per project, a standard procedure can be used (Nicholas & Steyn, 2012).

Knowing that a lot of western companies are involved in infrastructure projects in Africa, the risk management process for these projects are subject to the different environment, objectives, culture, and stakeholders. The risk management process used for projects in developed regions might not be applicable for projects on the African continent. This statement is supported by substantial evidence that
western management concepts are not (directly) implementable in other cultures and might even have different and adverse effects (Muriithi & Crawford, 2003)
3. RESEARCH STRATEGY

This chapter describes the research strategy with the aim to answer the research question. Firstly, the research approach is described. The research question is divided into logical steps, sub-questions. The section also discusses the research relevance and research scope. The second part discusses the research design that will be used.

3.1. Research approach

The aim of this research is to provide empirical knowledge about effective risk management by international companies in African infrastructure projects to enhance the quality of risk management. Therefore, it should be clear what improvement areas, related to risk management performed for African infrastructure projects, can be identified.

For the identification of improvement areas, an ideal situation is compared with reality to see if, and in what way, this deviates. The ideal situation relating to risk management and how to effectively execute risk management is fully described in the literature. The second step is to identify how risk management is executed in practice. And last, to identify the improvement areas, the ideal situation and risk management in practice are compared. This approach is visualized in Figure 2 and written down in the three sub-questions below:

(1) How is risk management described and advised in literature for African infrastructure projects executed by international companies?

(2) How is risk management carried out by international companies in practice for African infrastructure projects?

(3) What are the differences between the ideal situation described in literature and risk management carried out in practice relating to African infrastructure projects, and what are the causes?

3.1.1. Relevance of the research

The research is relevant in two different ways. This research adds new information to the limited amount of literature relating to risk management for African infrastructure project by international companies and provides a basis for further research. The second contribution is to improve the risk management approach by international companies involved in African infrastructure projects.

3.1.2. Research scope

This research focuses on infrastructure projects, mainly port infrastructure because of the great influence on the development of a region. Demographically this research concentrates on Africa. The research uses one consultant engineering company with great experience in African infrastructure projects, ports (logistics). The company is specialized as a consulting engineer in all phases of the project life-cycle.

3.2. Research approach

Because the research aims to explore, clarify, and understand the current situation, a qualitative research method is most appropriate (Kumer, 2011). For the validity of the data, triangulation is used, which means that findings are checked with different sources of data (Gillham, 2005).

In order to define the improvement areas for risk management in practice, the ideal situation is compared with risk management in practice. The first step is to define ideal risk management related to African infrastructure projects. A literature study forms the basis for the definition of the ideal situation. The second step is to provide empirical data related to risk management in practice. Semi-structured interviews will be conducted with interviewees who have extensive experience with African infrastructure projects. The outcome of the literature study forms the basis for the preparation of the
interviews. The interviews results are analyzed using qualitative content analysis. The next step is to compare the results from the literature study with results from the empirical study. The identified gaps between the ideal situation and risk management in practice make it possible to answer the research question and provide recommendations. The conclusion and recommendation add empirical knowledge to the available literature. Moreover, the recommendation can be used to improve risk management in practice (dashed line). The research approach is summarized in Figure 2.

![Figure 2: Research approach](image-url)
LITERATURE STUDY
4. **DIFFERENT RISK MANAGEMENT METHODS AND COMPONENTS**

Over the years various methods are established to perform risk management. In this chapter, four well-known methods are elaborated to give an understanding of the methods. These methods are: RISMAN, ATOM, PMI, and ISO31000. However, one should realize that there are many more methods available. The understanding of the different methods is used to decide what information is relevant and will be elaborated further to define how risk management is described and advised in literature (first sub-question).

Each method is briefly discussed in the sections below (4.1.-4.4.). The figures that visualize the methods can be found in Appendix E. Comparing the different methods offers some valuable insights which are discussed in section 4.5. The insights help to understand the different components that contribute to an overall risk management approach, which is described in section 4.6.

4.1. **RISMAN risk management method**

This method is established in 1955 by a co-operation between Rijkswaterstaat (Dutch government organization responsible for infrastructures), Railinfrabeheer (Dutch organization responsible for construction and maintenance of the railway), Twynstra Gudde, TU Delft, and the Municipality of Rotterdam. The method was established as a risk analysis method, and later on as a risk management method specialized for infrastructure projects (Well-Stam et al., 2003).

RISMAN can be divided into two main components, the risk analysis part and the risk management part. The first component, risk analysis exists of four successive steps: (1) establish a goal, (2) identify risks, (3) determine what is most important, and (4) establish possible measures. The authors argue that besides these steps, performers of the risks analysis should also determine how to execute and maintain the analysis beforehand. This includes time, money, quality, information, and organization.

The second component, the risk management starts with the risk analysis. Risk management is a dynamic process since risks are not static and risk analysis, as described above, is just an initial view on the risks of a project. Risk management is a continuous cycle which starts with the risk analysis. The second step is choosing appropriate risk measures, after which the measures can be executed. The next step is evaluating the executed risk measures by determining whether the measures are executed and have the desired effect. The evaluation offers the opportunity to update the risk analysis, after which the whole process starts again. The book argues that the transition from one phase to the following phase in the project life-cycle is a perfect moment to update the risk analysis. The two components and the relation between the components are visualized in Figure 9, Appendix E.

Despite the clear set-up of the method, implementation depends on the project and organization. Besides, it is advised to regularly evaluate the method, to potentially make an adjustment to improve the application of the method.

4.2. **ATOM risk management method**

ATOM is developed by Hillson and Simon with the aim to address two issue: (1) the difference between uncertainty and risks, and (2) how to include both threats and opportunities. This explains the name of this method Active Threat and Opportunity Management (ATOM) (Hillson & Simon 2007).

Based on their thoughts, a process of eight steps is composed which both addresses threats and opportunities. The process is visualized in Figure 10, Appendix E. The first step is the initiation step, which aims to define the objectives relating to the project of concern. The next step is the identification step in which the uncertainties might affect the set objectives (from the previous step) in a negative way (a threat) or in a positive way (an opportunity). After that, the identified uncertainties are assessed in the step assessment. By examining each uncertainty, now named as risks, the risks can be filtered, sorted,
and prioritized. The identification and assessment of the risks offer insight into the risk challenge, understanding the exposure. Now appropriate risk responses can be identified in the step response planning. This planning aims to decide on appropriate actions for the threats and opportunities. The decided responses are implemented in the implementation phases. Besides, the decided actions (and later on the results) should be communicated to all relevant stakeholders. The next step is to review the risk assessment, which should be done regularly. The risk assessment includes identification, assessment and response planning. The last step to be taken is the post-project review. Experiences related to minimizing threats and opportunities should be captured in an efficient way to learn from for future projects.

The ATOM method recognizes that projects come in different sizes and complexities. The method is, therefore, scalable regarding number and type of reviews, the optional use of quantitative risk analysis techniques, and the use of different tools and techniques for each step. Furthermore, the book offers an implementation plan and adjusting the method to the organization as well.

4.3. PMI’s risk management method

PMI (Project Management Institute) sees project risk management as one of the twelve knowledge areas of project management, described in PMBoK (Project Management Body of Knowledge). The aim is to increase the effect of positive events and decrease the effect of negative incidents.

PMI describes project risk management in six steps: (1) plan risk management, (2) identify risks, (3) perform qualitative risk analysis, (4) perform quantitative risk analysis, (5) plan risk response, and (6) monitor and control risks. The first process is to define management activities for projects. The second process is the identification and understanding of risks (negative effect on the project) and opportunities (positive effect on the project). Next, the process aims to prioritize the risks based on a qualitative assessment (probability and impact). After the qualitative risk analysis, risks are analyzed in a quantitative manner to assess the effect on the set project objectives. The fifth step aims to determine measures to enhance the opportunities and reduce the threats. During the last step the risk measures are implemented, identified, and residual risks are monitored. New risks are identified and the effectiveness of the risk process during the project is evaluated (PMI, 2008).

PMI’s project risk management method described in PMBoK is one of the twelve knowledge areas and is, therefore, strongly connected to the other areas. Furthermore, The PMI offers the required input and output of each process and lists possible tools and techniques that can be used. The overview of the different processes, inputs, outputs, and tools and techniques per process are presented in Figure 11, Appendix E.

4.4. ISO31000’s risk management method

ISO (International Organization for Standardization) offers principles and guidelines to implement risk management in a systematic, transparent, and credible manner. The principles and guidelines can be applied within any scope and context because each application of risk management is different regarding needs, audiences, perception, and the establishment of the context which is an important part of the process. That is why ISO does not intend to offer a consistent framework but advises to design and implement a risk management plan and framework based on the organization and project. ISO (2009) made a combination between the process, a framework, and principles. Each is explained further and is also illustrated in Figure 12, Appendix E.

The framework offers a management basis to ensure that risk management is embedded in the organization creating an effective risk management process specific for the context of the organization. Moreover, the framework ensures that information about risks is reported and is the basis for decision making. The framework is a continuous process of four main steps: (1) design of a framework for
managing risks, (2) implementing risk management, (3) Monitor and review of the framework, and (4) continual improvement of the framework. Each step is influenced by mandate and commitment, which is the support and dedication of management and organization. The eleven principles are part of the mandate and commitment. Following these steps ensures continual improvement of risk management within the organization.

The last part is the risk management process itself, which consists of six continues main steps: (1) establish the context, (2) risk identification, (3) risk analysis, (4) risk evaluation, (5) risk treatment, and (6) monitor and review. Besides these continuous steps, each step influences, and is influenced by, the step monitor and review. Also, steps 1 to 5 influence, and are influenced by, the step communication and consultation. This means that communication and consultation and monitor and review take place during each step of the risks management process. Step 2, 3, and 4 combined can also be defined as the risk assessment step.

4.5. Insights risk management methods
Four different risk management methods are briefly described which offer several insights. Each method provides a process to identify risks continuously, risk analysis (also called determine risk or risk assessment), plan (determine) and implement risk responses (measures), and review and monitor the risks (evaluate). All methods emphasize the need to continue this process throughout the life-cycle of the project. The risk management process can thus be simplified into four continuous basic steps (see Figure 3):

(1) Identify risks
(2) Risk analysis
(3) Plan and implement risk responses
(4) Monitor and control

All methods define that the input for the risk management process is the environment of the project, the set objectives of the organization, and the project characteristics.

Each method recognizes that risk management should be tailored to the organization and project, there is no one-size-fits-all solution (Chapman & Ward, 2004). The environment, project, and organization define how risk management should best be implemented. The first step is to create risk management which is part of the organization. RISMAN defines the implementation of risk management in the organization as a project, while ISO describes this as a process. However, both do agree that the approach should be monitored and adjusted if necessary to improve the approach within the organization continuously. The second step is the adjustment to the project. All methods recognize that risk management should be scalable based on the objectives of the project, the size of the project, and the environment.

4.6. Risk management components for further research
The section above gives insight into the similarities of the four risk management methods. All methods recognize that risk management is based on three components:

- The process
- The organization
- The project

The first sub-question aims to formulate risk management advised and described in literature. Since the term risk management is rather broad, the three components stated above provide clear guidance for the literature study and further research.

The first part of the risk management approach is the risk management process itself, which is a continuous set of steps to identify, analyze, plan and implement a response, and review and monitor the
risks. The second part, the organization, defines how risk management is implemented, depending on the objectives of the organization, the structure, so it is integrated with the organization processes (ISO, 2009). Thereby, ISO states that the implementation of risk management should regularly be reviewed for continuous improvement of the framework. The framework is thus not the risk management process itself, but how the risk management process interacts with other processes within the organization (policies, structure, processes, and so on). Last part is the project itself for which risk management is performed. The project sets objectives for risk management and also provides input for the risk management process itself, such as the environment of the project, the social and cultural environment, trends in the project environment, and stakeholders (ISO, 2009).

ISO (2009) clearly shows the interaction of the three components, Appendix E figure 12. The following chapter elaborates each risk management component more thoroughly.
5. **RISK MANAGEMENT PROCESS**

This chapter describes the risks management process. First, the risks management steps are briefly shown, after which each step is further explained. Furthermore, this chapter also elaborates available tools and techniques.

5.1. Risk management steps

The previous chapter already sketched different risks management processes. Although each method uses slightly different steps, four main steps are identified, which can be found in (almost) all methods, shown in Figure 3:

1. Identify risks
2. Risk analysis
3. Plan and implement risk responses
4. Monitor and control

The next sections explain each step.

![Figure 3: Basic risk management process (Based on Nicholas & Steyn, 2012)](image)

5.2. Identification of risks

The first step is identification and understanding of risks in the project (Kululanga & Kuotcha, 2010; Hillson, 2003). Identification is usually started in the conception phase, project preparation, and generally first focuses on the high risks which can make it difficult to complete a project successfully. These high risks are usually caused by, but not limited to (Nicholas & Steyn, 2012):

- Different approach than usual
- Use of new technology
- New equipment, system, or approaches
- Unpredictable or changing environment

Risk identification is not only the identification of the risk itself but also the identification of the causes and the potential consequences (ISO, 2009). Although the identification of risks is written down as the second step, it is an iterative process which should be continued during the whole duration of the project (PMI, 2008). Whenever the project and environment changes or new information is obtained, this step should be repeated (National Research Council, 2005). Identification of risks depends on the quality of the analyzed documents and other materials. Therefore, the sources of information should be of high quality as well (i.e. updated, right scope, etcetera) (ISO, 2009). This also applies to other steps, tools, and outputs in the risk management process.
5.2.1. Research scope

Risk categories, such as TECOPS, can first of all help to identify risks in a fast and straightforward way. Secondly, grouping the risks shows whether risks are concentrated in one or more categories or are equally distributed. Last, categorizing risks provides a standard way how to visualize and communicate risks. (Hillson, 2004). Despite the additional value of risk categories, the identification of the risks itself requires much more careful analysis (Steffey & Anatamula, 2010). There is no common way to categorize risks. Hillson (2004) advises that during qualitative risk analysis it is most valuable to categorize risk based on causes / sources, or based on affected areas. Hillson (2004) identifies two ways to categorize risks but does not provide categories itself. Several companies have formed different frameworks how to categorize risks, of which some are listed below:

- PEST (Political, Economic, Social, Technological) / PESTLE (Political, Economic, Social, Technological, Legal, Environment) / PESTLIED (Political, Economic, Social, Technological, Legal, International, Environmental, Demographic)
- TECOP (Technical, Environmental, Commercial, Operational, Political) / TECOPS (Technical, Environmental, Commercial, Operational, Political, Social),
- SPECTRUM (Sociocultural, Political, Economic, Competitive, Technology, Regulatory and legal, Uncertainty, Market)

Steffey and Anantamula (2010) give another option to categorize risks, which is specific for international projects: cultural, political, virtual and regional. The categories are based on the most common problems related to international projects such as geographical barriers (virtual) and differences in culture (culture). Besides this categorization and the risk categories stated above, one can also choose to customize risk categories based on the RBS (risk breakdown structure), which is derived from the WBS (work breakdown structure) (Hillson, 2004).

5.3. Risk analysis

In the second step of the basic risk management process, the identified risks are assessed based on probability and impact. Usually, risks are first assessed in a qualitative manner. The outcome of the qualitative analysis is necessary for project managers to prioritize risks based on the consequences and on which risks they have to focus on (Nicholas & Steyn, 2012). This leads to four kinds of risks: (1) Low impact, low probability, (2) high impact, high probability, (3) low impact, high probability, and (4) high impact, low probability (National Research Council, 2005). In some cases, one can also choose moderate or other values in between (Nicholas & Steyn, 2012). Risks can be prioritized using a risk assessment matrix (RAM), see Figure 4, where the most significant risks (high probability, high impact) are shown in the red (in this figure black part) part, the “hot-spots” (Hillson & Simon, 2007).

![Figure 4: Risk assessment matrix (Hillson & Simon, 2007)](image-url)
In addition, risks can be assessed in a quantitative way, specifying the numerical impact and probability together with the consequence of the risks. Based on the outcome of the qualitative analysis, it can be decided to perform a quantitative analysis for the most important risks. A quantitative analysis offers numerical arguments for decision-making. Different from qualitative risk analysis that tries to assess and prioritize each risk separately, quantitative risk analysis provides the opportunity to analyze combined risks (Hillson, 2004).

Also qualitative and quantitative risk management is dependent on the input. Assumptions made about probability and/or impact influence the output, the risk consequence. However, assumptions are often subject to uncertainties. The risk consequence can, therefore, vary, depending on the assumptions. This fact should be taken into consideration during the analysis and communicated well to relevant stakeholders when making decisions (ISO, 2009).

5.4. Plan and implement risk response

After identifying and analyzing the risks, the third step in the risk management process is to determine how to respond to each risk. Each response influences the risk exposure of the project, with the general aim to enhance the opportunities and threats. The different responses that can be taken are different for threats and opportunities and are further explained in risk response strategy, section 5.4.1.

After deciding the appropriate response, the response needs to be implemented. The implementation of each response can be seen as a little project on its own, defining what needs to be done, who is responsible, in which time frame, and the needed costs and requirements (Hillson & Simon, 2007).

When planning risk management responses, not only the risk itself and risk response possibilities should be taken into account, one should also consider the stakeholders’ values and opinions. The same applies to risks related to risk response and secondary risks. Analysis and monitoring are, therefore, of importance to ensure the right strategy (ISO, 2009). This should be the input for the final step.

5.4.1. Risk response strategies

Different strategies are available for risks compared to opportunities. There are four main strategies how to deal with risks, also known as the four T’s (Kululanga & Kuotcha, 2010; PMI, 2008; Nicholas & Steyn, 2012; Hillson, 2004): terminate (avoid), transfer, treat (mitigate), and take (accept). Considering that an uncertainty can have a positive impact as well (opportunity), four different strategies can be identified (PMI, 2008; Hillson, 2004). As can be seen in Figure 5, the fourth strategy ‘accept’ is used for both opportunities as well as risks: exploit, share, enhance, and accept.

Knowing the different responses, one should be aware which response is appropriate for the each kind of risk. Hillson (2004) identifies an appropriate response for each type of risk based on the probability and the impact (Low, High). The proper response to threats and opportunities are presented in Figure 5.

![Figure 5: Response strategy threats (left) and opportunities (right)](image-url)
5.5. Monitor and control
The last phase of the risk management process focuses on monitoring known risks, identify new risks, reduce or enhance risks, and track the effectiveness of risk response actions (Kululanga & Kuotcha, 2010; PMI, 2008). To be able to respond to the risks and thereby to control them, symptoms should be tracked for already identified risks and possible new risks (Nicholas & Steyn, 2012). This step helps to learn within the project, see which strategies work and which don’t, and gives the option to adjust. This learning process and outcome should also be used in future projects.

Although this step is written down as the last step, the risk management process is a continuous process, this step can thus be seen as the starting point for starting the process again, as can be seen in Figure 3.

5.6. Tools & techniques
Different tools and techniques can be used to support the execution of the risk management process. The list of possibilities is exhaustive, each tool or technique has a slightly different purpose and function. The following options are, for that reason, just a selection of what is available. The listed tools and techniques are based on an extensive list provided by Nicholas & Steyn (2012), Hillson (2004), Hillson & Simon (2007), Smith et al. (2006), and PMI (2008). The list is provided in Appendix F, and most relevant tools & techniques are discussed in this section.

For medium-sized projects, Hillson & Simon (2007) recommend the use of a structured brainstorm, analysis of assumptions and constraints, and a risk checklist in a workshop to identify the first risks. The checklist makes it possible to identify the most common risks that were already identified in previous projects. A structured brainstorm helps to find risks based on requirements and objectives of the project. Diagrams, risk breakdown structures, and risk categories. The last technique is an assumption analysis. An assumption is still an uncertainty and thus needs to be identified as well during the risk identification step. Hillson & Simon (2007) advise to have another workshop, or the same workshop to assess the risks in a qualitative way, prioritize them, and, when required, do a quantitative analysis. It is advised to use a probability impact matrix.

Also for the monitor and control step, a variety of tools and techniques are available. Most important is that changes related to the project are identified, and risks and the effects are tracked. Therefore, Hillson & Simon (2007) advise to have meetings (workshops) regularly for the review of risk management within the project and make changes if necessary.

Despite the great variety of tools and techniques, one should keep in mind that those are only valuable if they are used appropriately with accurate and truthful data. Without meeting these criteria, the output of the techniques can be false. Furthermore, a tradeoff should be made between the usability of the outcome of the tool/technique and the input. The usability of the output should be proportional to the input.
6. Risk Management and the Organization

As earlier described, the organization by whom project risk management is applied is the second component of the literature study. ISO (2009) describes that the organization context contributes in three ways to risk management. The first way is the implementation or procedures and policies that enable risk management within the organization. The second part is the risk management awareness and learning process (continual improvement of the framework), to ensure the effectiveness of risk management. Last, the communication and consultation related to the risk management process.

6.1. Risk management procedures and policies

Implementation of effective risk management is more than only implementing processes and procedures (Chileshe & Kikwasi, 2014). A general prerequisite for effective risk management is the support of management: Supporting risk management (motivation and awareness), setting procedures and policies that guarantee regulatory compliance, assigning accountability and responsibility, providing the resources, and establishing the framework in the organization (ISO, 2009; Smith et al., 2006; Well-stam et al., 2003; Agyakwa-Baah & Chileshe, 2010). Furthermore, necessities should be made available, such as skills, experience, training programs, tools and techniques, and documents and formats. The latter is further discussed in the last section of this chapter (ISO, 2009).

Especially for African infrastructure projects, the management style is important. A study by Agyakwa-Baah & Chileshe (2010) revealed that the management style (i.e. concerns and time involvement) and goals and objectives of the organization are the most important success factors for implementing effective risk management for construction projects in Ghana, to create awareness. Besides, effective implementation (i.e. engagement by organization and management) enhances the awareness of risk managing which is seen as one of the barriers for effectively performing risk management if not done correctly (Chileshe & Kikwasi, 2014).

6.2. Risk management awareness and learning process

Introducing effectiveness risk management for projects in the organization does not happen overnight (Smith et al., 2006). Also, organizations change, so does the context of the organization. This might result that the risk management framework needs to be adjusted to ensure effectiveness. It is, therefore, advisable to regularly review the risk management framework and do adjust and improvements if necessary. (Chapman & Ward, 2004; Roeschmann, 2014; and Zwika & Ahn, 2011; ISO, 2009).

Besides the organizational risk management framework, Smith et al. (2006) mention that successful risk management is, for the most part, depending on the attention, motivation, competence, and knowledge and understanding of the employees. Besides, Hillson & Simon (2007) state that a critical success factor for effective risk management is the competence of people, and therefore the training of staff is an essential element. Chileshe & Kikwasi (2014) identified the lack of experience as a barrier to implementing risk management for African projects, from the client’s side and the side of the consultant engineer.

6.3. Communication and consultation

Communication and consultation (internal and external) are not only identified by ISO (2009) as an essential part of risk management, lack of information and communication between stakeholders is a barrier for effective risk management for African project (Chileshe & Kikwasi, 2014). Without sharing information and communication risk management cannot be fit for purpose. Furthermore, communication and consultation between the different stakeholders help to understand why certain decision are made. Besides, stakeholders can make well-sustained decisions themselves based on the communicated results of risk management. Concluding communication and consultation is important for the quality of the risk management process, understanding of external stakeholders, decision making...
of internal stakeholders, and the improvement of the risk management framework (ISO, 2009; Smith et al., 2006). Communication of results should be understandable for everyone (Smit et al., 2006). Serpella (2014) highlights this need by stating that the way knowledge and information are used, is often a failure factor to achieve effective risk management. Moreover, the lack of coordinated communication between stakeholders in African projects prevents effective risk management (Chileshe & Kikwasi, 2014).

Reporting can enable effective communication and consultation. Main results and conclusions are documented, stakeholders are easily informed about the status of a project, and stakeholder can base decision-making of the right information. Hillson & Simon (2007) advise to define the reporting in a risk management plan or project communication plan and use a risk register. A risk register documents all identified risks, by briefly describing the risk, the risk owner (responsible person), impact, probability, response, and current status.

Besides the reporting between each step of risk management process, a post-project review is essential. Hillson & Simon (2007, p. 130) define the purpose of such a review as follows: "To capture and record risk-related knowledge and experience from a completed project in a form that can be used for future similar projects." Information / lessons learned / experience from one project can be used for the next project, so information will not get lost. It can help to improve the risk management framework. The output can be a risk checklist and a document for capturing lessons learned.
7. **RISK MANAGEMENT AND THE PROJECT ENVIRONMENT**

Project risk management is risk management specific to a project. A project is initiated to fulfill a pre-defined need, the objective. The project, however, is influenced by external factors, the project environment, and so is project risk management (Smith et al., 2006). Well-Stam et al. (2003) point out the objectives of a project. Hillson & Simon (2007) argue that the project size matters. ISO (2009) emphasizes the external context, including the stakeholders and social and cultural aspects. This chapter discusses the relation between the project (environment) characteristics and risk management. Furthermore, this chapter describes the characteristics of risk management international African infrastructure projects.

7.1. **Relation risk management and project environment**

It is important to determine the characteristics of a project to tailor the risk management approach. This can be shown by making a distinction between a public and a private client in a project. A private client’s most important goal is to make a profit, while the public client is also concerned how the project fits within the public needs (Smith et al., 2006). The kind of client (values, vision, resources) influences what kind of risks and opportunities are identified, how they are assessed (in terms of impact and consequences), and what tools and techniques are effective.

Scholars have listed several project characteristics that should be taken into account for risk management. ISO (2009) argues that stakeholders and objectives related to a project influence the set risk criteria and decision-making. Chapman & Ward (2004) are more specific, by stating that this depends on the six w’s (who, why, what, which way, wherewithal, when) and the project life-cycle:

- **Who**: Often seen as the most important project characteristic. Refers to the stakeholders, their relation to each other and the project, perception, values, and resources (ISO, 2009; Chapman & Ward, 2004; Smith et al., 2006).
- **Why**: Refers to the objectives and criteria of the project. Not only the set objectives but also the prioritization of the objectives, for the whole project or per project phases influences risks management. Different risks might be identified, and differently analyzed (ISO, 2009; Chapman & Ward, 2004).
- **What**: Related to the project design, whether the design will be the right solutions, does it fulfill the needs? In other words, does the project create benefit? Related to risks management, one should be carefully when the designs create benefits or not.
- **Which way**: Defines how the project will be executed, the activities that are related to the project, often project stages. Risk can be associated with the whole project, but also to each activity and the relation between the different activities (Chapman & Ward, 2004).
- **Wherewithal**: Refers to the resources necessary for the project. This includes materials, machinery, labor, knowledge, or money. Related to risks managing, what happens if one or more resources are not available, how can this be resolved, and how it relates to the technical complexity of a project.
- **When**: Focuses on the timeframe of the project. The critical point is the planning, between different activities (see which way), should be emphasized, because these might influence the project objectives.
- **Project life-cycle**: Refers to the stages of the project. Objectives, activities, stakeholders, etcetera, differ per project stage and thus influence risk management (Chapman & Ward, 2004).

7.2. **African infrastructure projects**

The previous section discusses what project characteristics should be taken into account for risk management, but the characteristics are quite general and do not highlight the characteristics of African infrastructure project that are relevant to risk management. This section elaborates on literature that
focuses on project characteristics of infrastructure projects in general and project characteristics for projects located in Africa.

7.2.1. **Infrastructure projects**

Investment in infrastructure projects all over the world is growing, especially those done by private investors. Infrastructure projects are expected to offer good and stable returns. The downside of infrastructure projects is the vulnerability of the projects. During the operational phase, the projects are extremely vulnerable to changes that affect the returns, since the use determines the return on investment (Miller & Lessard, 2000). Infrastructure projects are often long-term projects, which means that during and after project implementation the environment of the project changes, not only political but also in, among others, demand and technical solutions (Jong et al., 2013). Infrastructure projects are therefore especially vulnerable to political choices. Millar & Lessard (2000) consequently state that risks are crucial related to engineering projects and risk management should be part of decision-making. Many scholars support this statement. Jong et al. (2013) who performed a literature review on the reduction of problems related to the implementation of large transport infrastructure projects found that risk containment measures are one of the main factors to enhance project performance (Jong et al., 2013).

7.2.2. **International projects located in Africa**

Regarding international projects, the project environment is often a lot different than the national environment (of the international organization). Liu et al. (2015) mention that because of this context, new risks related to the different environment, can be identified in international projects. Besides the additional risks, the project may also know different risks due to the combination of different cultures. Various authors have tried to identify the most important external factors relating to risk management. Liu et al. (2015) emphasize cultural aspects, not only the national culture of the projects but also the organizational culture. The culture of the organization is mostly leading above the culture of the project when applying risk management. However, the research states that risk management and risk-taking is perceived differently (e.g. value, importance) in different cultures. Risk management from the perspective of the organizational culture may therefore not be applicable to the local culture of the project. The difference in culture between organization and project in international projects makes effective risk management difficult because values and perception are different. International projects are subject to a multifaceted risk environment, but risk managers working with these international projects are often unprepared to deal with the different cultural, political, and environmental issues that appear (Steffey & Anantatmul, 2011; Zwikael & Ahn, 2011; Bière et al., 2015).

Project characteristics (such as local culture) might differ between Europe and Africa. They can also be different between the various countries and regions in Africa. Although this section discusses project characteristics related to Africa that should be taken into account for effective risk management, one should consider that African countries are not homogenous in terms of, inter alia, religion, social, economic and cultural aspects (Muriithi & Crawford, 2003).

Culture in Africa is characterized by the importance of social relations. Decisions are, compared to most Western culture, usually based on social benefits instead of economic benefits. Most employees of African organizations / companies are therefore committed to organizational goals to the extent that it also contributes to social ties and objectives (e.g. communities, family). Furthermore, African states are relatively young, which makes political institutions often weak and unstable. These institutions and organizations are often large and use patronage systems, which can be explained by both the high power distance and moderate to high uncertainty avoidance (Muriithi & Crawford, 2003). This results in difficulties with fraud and corruption, lacking knowledge and information from the side of the
government, and bureaucratic and biased political influence (Maseko, 2014). Communication with and between different governmental ministries can, therefore, be difficult (Komendantova et al., 2012).

Another cultural characteristic is the general poor maintenance attitude in Africa. During the operational phase of a project, the level of maintenance is low. The culture toward maintenance is one reason, but the lack of knowledge, money, and skilled personnel are other causes (Yogo & Verdier-Chouchane, 2015; Enakire & Onyenania, 2007; Ika & Hodgson, 2014).

World Bank Group (2017a) ranked (all most all) countries based on the ease of doing business. Figure 6 shows that countries on the African continent score low in the world ranking on the ease of doing business (moderate and dark blue), especially compared to Europe (bright yellow). The continent of Africa counts the most countries with the lowest ranking. Focusing on the efficiency and quality of regulations related to doing business, Sub-Saharan Africa scores the lowest of all regions taken into account (World Bank Group, 2017b). Komendantova et al. (2012) argue that regulations (this time related to energy projects) in North Africa frequently lacking transparency and are bureaucratic, which makes it difficult to rely on existing regulations. Also in South Africa, lack of transparency and bureaucracy is a hurdle related to PPP project regulations in South Africa (Maseko, 2014). The difference in ease of doing business shows that international organization should emphasize the difference in the economic and political situation, regulations, and cultural for effective risk management.

![Figure 6: Ease of doing business worldwide (World Bank Group, 2017a)](image_url)
8. **Ideal Risks Management & Answering Sub-question 1**

The previous chapters of the literature study capture the essence of project risk management and relation with African infrastructure project. Hence, based on this information the first sub-question can be answered.

1. **How is risk management described and advised in literature for African infrastructure projects executed by international companies?**

Ideally, risk management is tailored for the project and organization, using a systematic process. This indicates the three elements that should be discussed with ideal risk management related to African infrastructure projects: the process, the organization, and the project.

The risk management process consists of four iterative steps: Identify risks, risk analysis, plan and implement risk responses, and monitor & control. For each step several tools and techniques are available, the choice of the tool or technique should be proportional to the required outcome of each step. Another criterion is the quality of the data as input for the tool or technique.

Risk management should be tailored to the organization and supported by management. Management should create motivation and awareness, setting procedures and policies and providing resources. After implementation, effective risk management is for the largest part depending on the responsible employees. Experience and training are, therefore, essential. Due to the limited knowledge and experience with risk management in Africa, the support of management and availability of training is even more important. The last important part of the organization that affects risk management is communication and consultation. Communication and consultation are essential for the quality of the risk management process, the understanding of external stakeholders, decision making of internal stakeholders, and the improvement of the risk management framework. For a project in Africa communication is the most important part to ensure risk management is fit for purpose. It is therefore advised to define the communication in a risk- or project communication plan, use a risk register that is updated after each step of the process, and held pros-project reviews to capture risk-related knowledge.

How risk management should be executed for the project depends on the project itself and its environment. To define this, it is advisable to keep the six w’s (who, why, what, which way, wherewithal, when) and the project life-cycle in mind. Risk management for infrastructure project should emphasize the vulnerability to regulatory changes during the operational phase, which affects the viability of the project. Although the countries on the African continent differ a lot, some characteristics should be taken into account. Especially the difference in culture is important. Compared with the culture of most Western regions, social relations and ties are crucial and are often the primal reasoning for commitment and choices. Most nations are young which makes the economic and political situation unstable. Fraud, corruption, lacking knowledge, and communication are well-known problems. Due to the high power distance and uncertainty avoidance institutions are large and use patronage systems. Furthermore, the maintenance culture is often poor. For international companies, it can be difficult to do business due to the large difference in the economic and political situation, regulations, and cultural aspects. Regulations are non-transparent and bureaucratic.
EMPIRICAL STUDY

Research design

Empirical study

Literature list & Appendices

Literature study

Research results
9. Methodology empirical study

This chapter discusses the different methods used for the empirical study. Empirically refers to “Conclusions drawn based upon hard evidence gathered from information collected from real-life experience or observations” (Kumar, 2011, P.29). First, the interview methodology is further explained. After that, the next section focuses on the qualitative content analysis which is used to analyze the results. Last, the validation of the results is discussed.

9.1. Interview methodology

To gain insight into risk management in practice interviews are conducted with experienced project managers. Interviewing is a preferred method for collecting in-depth data within complex situations. Furthermore, interviews (semi-structured / unstructured) give the possibility to explain questions or answers further to prevent misunderstandings. A disadvantage of conducting interviews is that the quality of the data depends highly on the skills and experience of the interviewer (Kumar, 2011).

The prepared interviews are semi-structured which means that topics and questions are predetermined in an interview protocol to ensure comparable data and uniform information among the respondents. However, the wording of questions can be different in each interview. Moreover, semi-structured interviews give the possibility to ask extra questions depending on the content of the interviews (e.g. extra explanation, interesting topics) (Kumar, 2011).

Based on the literature study an interview protocol is formed to ensure all relevant topics are discussed during each interview. The interview is based on the critical decision method which is specially developed to elicit knowledge gained by experience from experts during non-routine cases (Klein et al., 1989). The method is particularly helpful to discuss knowledge related to risk management and risk management related decisions in practice (Taylor, 2003). The preparation of the interviews and the interview protocol are further described in Appendix A.

9.1.1. Selecting interviewees

Twelve interviews are conducted to get insight in risk management in practice in Africa (information about the employees can be found in Appendix A.4. The respondents are selected employees of the consultant engineering company Inros Lackner SE, based on the following criteria:

- Based in an international department in Western Europe,
- Extensive (several years) experience with African infrastructure projects
- Involved in the preparation and or managing of the project (familiar with the topics risk management, project management, and project outcome)
- Motivated to speak honestly and freely

9.1.2. Conducting and transcribing the interviews

After the selection of the interviewees, the respondents are contacted. The aim of the interview is explained and a suitable timeslot is found to conduct the interview. Each interview is recorded with permission of interviewee to transcribe the interviews. The interviews last between 40 minutes and one hour and are based on an interview protocol. The transcripts of the interviews are sent back to interviewees for final adjustment to ensure the respondents agreed with the transcripts. The transcription of the interviews can be found in Appendix B.

9.2. Comparing the interview results – Qualitative content analysis

All interview results are compared using qualitative content analysis (QCA). Due to the open-ended questions of the interview, the information is difficult to compare (Kumar, 2011). QCA helps to reduce the information from all transcripts until only relevant and usable data remains. The remaining data is categorized based on a coded frame. Using the coded data enables the researcher to compare the data
of all transcripts (Schreier, 2012). The preparation of the qualitative content analysis is fully described in Appendix C. The results of the QCA can be found in Appendix D.

9.2.1. **Categorization and coding**

The literature study discusses three main subjects: the risk management process, risk management and the organization, and risk management and the project. These three subjects are used as the basis for the coding frame under the following names: risk management process, organizational risk management awareness, and risk management influencing factors.

Because the main categories are still rather broad, several sub-categories for each main category are defined based on the literature study and the information given during the interviews. Information of the transcript is categorized per main category and sub-category. The last step is coding the information per sub-category, which defines the direction of the information related to the sub-categories. This quickly shows what has been said about the sub-category. Coding the information enables the researcher to easily compare the information per main category and sub-category (Schreier, 2012).

The risk management process is defined with the aim to get more knowledge about the risk management process used in practice. Four relevant sub-categories are selected: time of identification, technique, and tools used for identification, time of reassessment, and measures that can be taken by the consultant engineer. The second main category is the organizational risk management awareness. The objective is to identify the opinion of the employees (awareness and knowledge) and the structure of the organization that enables risk management. Organizational risk management awareness is split into two sub-categories: added value (how employees feel about the value of risk management) and exchange of knowledge.

The last identified main category is risk management influencing factors. The aim is to understand what factors can help to increase the effectiveness of risk management for African infrastructure projects. The second objective is to identify factors that can lead to risky events in African infrastructure projects. The two selected sub-categories are: enabling factors for improved risk management and risk enlargement factors. The purpose of the first sub-category, from now on abbreviated as enabling factors, is to find what factors can help to improve the effectiveness of risk management for African infrastructure projects (enhancing the opportunities and limiting the threats). The latter sub-category aims to find factors (project characteristics) related to African infrastructure projects that can cause risks. These factors should be taken into account during risk management. Being aware of the first and latter sub-categories can help to minimize the threats, enhance the opportunities, and improve effective risk management. The two sub-categories are further divided into typical factors and general factors. A typical factor classifies the factor as typical for African infrastructure projects. Factors that are not identified as typical, or if the respondents did not have an opinion about the typicality, are considered as general factors. Typical factors can also be applicable to projects in a different environment but are in this research identified as most applicable to African infrastructure projects.

9.3. **Validation**

The results of the interviews are validated using expert judgment. Two experts of African infrastructure projects are asked to review the results. One of the experts is mainly involved as project manager in large African projects. The other expert is mainly involved in the management of the international project department.
The initial results are translated into clear statements to structure the validation process. The statements can be found in the validation protocol shown in Appendix H. The experts are asked to assess the statements based on the following subjects:

- Agreement with the statement (and reasoning)
- How the statement affects risk management
- Recommendation for improvement
10. Risk management in practice

This chapter presents the results of the interviews. The results are described based on the following categories (used by the qualitative content analysis): risk management process, organizational risk management awareness, enabling factors for improved risk management, and risk enlargement factors. The presented results are supported with quotes from the interviews, shown in the green boxes. The last section of this chapter draws the conclusions and answers to the second sub-question.

10.1. Validation

Based on the interviews the main information related to the risk management process is related to used tools and techniques, time of identification, time of reassessment, and the measures that could be taken by the engineer.

"I think in any project it is necessary to focus on the aim of the project and then see where the risks are, then it is useful to have the experiences of other projects. Every project is different." – Respondent 2

Three respondents mention that brainstorming is regularly used by the respondents to identify risks with colleagues. Sometimes a brainstorm can have a formal character especially organized to identify risks, but usually, it is an informal discussion between the respondent and colleagues about the challenges that might come up.

Almost all respondents use their experience from former projects to identify risk, thereby experience from colleagues is also used because respondents feel that information is shared freely. Two respondents mention that they are in favor of a systematic approach, looking at the requirements and identify possible challenges and risks. Besides, some respondents mention more formal techniques like probability analysis and scenario analysis related to technical, financial, and economic assessment.

Nearly all respondents identify risks during project preparation (proposal, inception, and feasibility study). Some are more precise about the time in project preparation than others. The feasibility study and inception stage are two typical moments mentioned by several respondents. Other respondents mention that there is not one typical moment to identify risks, but that this is done during the whole project life-cycle whenever necessary or when clear risks come up.

"You should identify the technical risks when writing the proposal, but it is difficult to identify all risk at this stage" – Respondent 1

Most respondents are not clear about a formal moment to reassess the identified risks. The most typical moment identified by the respondents is whenever there is a project or a process meeting, or a report needs to be delivered. Respondents mention that there is always a chapter or agenda item related to risks. However, respondents do add to this statement that only risks relevant for that moment or project phase are discussed (e.g. what is an obvious threat at that moment). Two respondents state that whenever new information comes up the risks are reassessed. These respondents also mention that only the risks that are directly influenced by this new information are reassessed.

Nearly all respondents argue that the actions that the consultant engineer can take based on the risk identification and (re)assessment are limited. Most respondents mention that the information was used to inform and make the client aware, so the client can take the appropriate actions. Besides informing and making the client aware, the consultant engineer can advise the client to take certain risk mitigation measures.
Respondents also state that the consultant engineer can make an assumption in the case of lacking information. This action is most appropriate as a measure when critical information is missing and otherwise causes a delay. The assumptions can be used for advising the client. Respondents are very clear about the fact that all of this (assumption, advises, and deliverables) should be put in writing as evidence that the consultant engineer informed the client about the decision and the client did agree.


Respondents also discuss the measure that can be taken in case the risks exist that the client might not pay, which are perceived to be high in Africa. One of the actions mentioned by the respondents is to ask the client for a high advance payment, so a part is already paid before the start of the project. The second option given by the respondents is to limit the amount of work till the first payment comes in. In case the client does not pay, the amount of lost work is limited. Both measures can be combined. One of the respondents elaborates the consequences of the first and latter option. Especially the first option which is asking for a high advance payment may end up in negotiation since the client has to agree as well. The issue of not getting paid is mainly related to new clients because it is not clear whether the client is trustworthy regarding the payments. If a well-established financing institute is involved, this risk is very small.

10.2. Organizational risk management awareness

Information regarding organizational risk management awareness is discussed based on added value and the exchange of knowledge.

Most respondents recognize the added value of risk management because it influences the success of the project. Some respondents mention that it is their duty as an engineer to advise the client and thus identify risks. Some respondents, however, see it only as mandatory if the clients ask for it or if it is required by the financing institute. Respondents find risk management difficult, especially at the beginning of the project, since not all risk can be identified at that stage.

The current project management system of the company is valued differently among the respondents. The system requests the project manager to assess the project on several points. If all lights are green, all requirements are met, the project can be continued. The system ensures that all contracts are signed before the start of the project for example. One respondent mentions that this system is most valuable for inexperienced project managers, by gaining more experience one thinks about the issues themselves. Another respondent also had the opinion that this system may not be realistic because one cannot expect a project manager to assess the project in a negative way, even if this would be the case. Furthermore, respondents mention that formal procedures can be seen as a lot of work, which does not immediately create an added value for the project. Respondents also mention that this system is intended to inform the board and thus is only an added value for them.

“The risk can be at the side of the engineering company, if you make assumptions without approval of the client. This is the law, if you are protected by the approval of the client you are safe.” – Respondent 10

“You always negotiate yes. It depends how hungry you are, how bad you want the project. It also depends on how much confidence you have in the client” – Respondent 12

“It is different for projects which are financed by World Bank or other donor institutions, as generally we do not expect any payment issues” – Respondent 1

“It is our duty to flag it up, to warn.” – Respondent 12
Several respondents state that information about risks that could be used for other projects is spread in an informal way. One talks a lot with each other and important information is spread orally. Respondents also use experience from former projects to gain knowledge. On the other hand, other respondents mention that exchange of knowledge about risks is difficult because the challenges in a project are different each time and not comparable. Only one respondent documents all risks in a risk register, the risk register is used for next projects.

10.3. **Enabling factors for improved risk management**

Risk management for African infrastructure projects can be improved by taking several factors into account. All factors are visualized in Figure 7. The length of the bar shows how respondents mention the factor during the interview. Some bars are partly light and dark-green colored, which indicates by how many respondents the factor is classified as typical for African infrastructure projects (dark green), or is seen as a factor that improves risk management in general (light green).

Based on the length of the bar five factors stand out: experience / understanding of the local culture; using the same and / or international standards; experience / know-how; competent local support; and good relationship with the client (and client’s staff). Based on the distinction between typical and general three extra factors are interesting: being aware of the local regulations; good relationship with financing institute; and effective / transparent communication with the client. Being aware of the local regulations is discussed as a risk enlargement factor, in section 11.4, see Figure 8. The same applies to the factor effective / transparent communication with the client. The other six factors are further elaborated below (good relationship with financing instituted is discussed together with a good relationship with the client).

![Figure 7: Enhancing risk management effectiveness factors, typical or general](image)

**10.3.1. Experience / Understanding of the local culture**

This factor is described as the knowledge about the local culture and understanding how this affects the project, so it can be taken into account managing the project.
Respondents often mention that understanding the local culture has a positive effect on the outcome of the project and can improve risk management, so it is fit for the project environment. The local culture of the engineering company can differ from the local culture of the client (and the local culture of the project) which can affect the project and risk management in different ways. Respondents state that the working culture in Africa is different. It is mentioned that common working days can be different from the working days of the engineering company. Thereby it is said that personal relations are more important than contracts and contracts have a different value. Another respondent argues that understanding the local culture and the differences help to understand each other better (the local party). One can (more easily) empathize with the other party. The cultural differences bring different risks and different perspectives on risk and risk management. Understanding the local culture, and thus the differences, help to perform risk management that is effective for the local culture.

Respondents did not identify this factor as typical for risk management for African infrastructure projects. Most respondents felt that this is important for effective risk management in all international projects. Nevertheless, respondents state that understanding and having experience with the local culture is an important success factor for, among others, African infrastructure projects.

10.3.2. Using the same and/or international standards
This factor refers to the standards used in the project regarding, amongst others, technical, safety, health, and environmental impact. Companies involved in the project use the same standards which are most of the time international standards.

Respondents mention that the use of the same standards has a positive influence on the project. Especially during the project design and implementation phase, it is helpful to use the same standards. Using the same standards guarantees a common understanding of, inter alia, the safety on site, quality of the design, and environmental impact. On the other side, respondents feel that despite a common understanding of the used standards, this does not immediately mean that all stakeholders comply with the standards in practice.

Respondents did not classify this factor as typical for African infrastructure projects. This factor is applicable to risk management for all international projects. Respondents state that it should always be taken into account for international projects. It has been said that whenever working with only European companies no problems are expected. This might be different, however, for cooperation with companies outside Europe. The factor is thus not a typical factor for risk management for African infrastructure projects but should be taken into account executing international projects.

10.3.3. Experience/know-how
This factor refers to the overall experience and know-how of employees of an engineering company learned in former projects, which can be applied in following projects.
Respondents mention that experience of one projects is used in the next project, for both international and national projects. This can be seen as learning by doing. Respondents say that experience helps to foresee what might come up and how to deal best with it.

Respondents value experience for different reasons. The most important reason is to make well-considered decisions and assumptions based on experience. An example given by one of the respondents is the availability of equipment at or near the site that is necessary for the implementation of the project (e.g. machinery, administrative necessities). Another example is making a well-considered assumption whenever valuable information is missing to continue a design. Know-how and having experience from former projects help to know what to expect and what issues might come up. This helps to identify and assess risk easier which are typical for the project environment, characteristics, and stakeholders.

Respondents did not classify experience as a typical factor for African infrastructure projects. It is argued that experience is an important factor in all projects, national, international, and located in African.

### 10.3.4. Competent local support

This factor refers to the support and usefulness of a local company and or staff working in partnership with or as sub-contractor for the engineer. In this case, the local support should be contributing to the success of the project and be based in the country / region of the project.

> “When I have a project in another country, Africa or Asia, or Middle East, I need to have a local counter party, a local consultant. Not only for support, but providing office space, administrative services, to be the interface to the client but also to delegate certain part of the project to their engineers at low costs.” – Respondent 2

As the quote above illustrates, respondents value the availability of local support for different reasons, amongst others, office space, and supporting facilities. Other respondents value a competent local partner as an interface with the local stakeholders (for instance the client). The last benefit is the knowledge of the local partner related to culture, local regulations, and other differences, which the local partner can help with these issues. The previously named benefits can help to improve the effectiveness of risk management since the local partner can help to specify risks management to the local environment.

On the other side, many respondents argue that a local partner is only additional value if it is doing its job. A local partner who is not willing to cooperate or not doing its job properly (i.e. in time, right quality) may only be a burden for the foreign engineer.

> “In ... they never felt responsible for the project. I think with a better local partner, it could have been faster.” – Respondent 6

Most respondents do not classify this factor as typical for risk management for African infrastructure projects, with the argument that a competent local partner is necessary for all international projects. nevertheless, it shows the importance of the factor for international projects.

### 10.3.5. Good relationship with the client (and client’s staff)

This success factor refers to the quality of the relation between the engineer and client. They cooperate and trust each other in such a way that this contributes to the success of the project.
Respondents frequently state that a good relationship is valuable for several reasons. First reason named by the respondents is the cooperation of the client to complete the project successfully. This is especially important when the project is not initiated by the local client, but for instance by a financing institute. The second reason is that a good relationship motivates the client to make important data available for the engineer. The last argument given by respondents is that a client can ensure the support of other governmental parties in the project providing better availability of data and support with local regulations. A good relationship with the client helps the consultant engineer to base risk management on all data that is available and to be honest and transparent about the risk. Thereby, a good relationship ensures that the client complies with the recommended risk mitigation measures by the consultant engineer.

Only a small percentage of the respondents feel that this is a typical factor that can improve risk management for African infrastructure projects. Most respondents argue that a good relationship with the client is important in all sort of projects. On the other hand, some respondents also state that a personal relation in the African culture is more important than in the European culture.

Most respondents feel that not only a good relationship with the client is important, but also with the financing institute. This is most related to the fact that the consultant engineer (especially in the role of site supervisor) has little enforcement power. Good relationships might help to get things done and implement risk mitigation measures. The same applies to the relationship with other stakeholders such as the contractor.

Transparent and good communication is also mentioned as a separate enabling factor to enhance the relationship between the client and engineer. Respondents mention that the consultant engineer should ensure that client can make a well-argued decision on its own. This should be done based on the information offered by the consultant engineer. However, respondents state that the consultant engineer should realize that the client does not have the same technical knowledge but still needs to understand the effect of a decision.

A good relationship with the financing institute is only identified as a typical factor for risk management for African infrastructure projects by a small percentage of respondents. Respondents give the same argument as for a good relationship with the client that it is important for all kinds of projects. The same applies to the communication with the client.

10.4. Risk enlargement factors
This section discusses the factors related to African infrastructure projects that cause more risk to the project. The factors mentioned by respondents are visualized in Figure 8. The length of the bar shows how many respondents mention the factor. Some bars are partly light- and dark-green colored, which indicates the number of respondents that classified the factors as typical for African infrastructure projects (dark-green) or is seen as general (light green), thus applicable to all kinds of infrastructure projects.

Based on the length of the bar three factors stand out: unpredictable / not knowing the process of the local regulations; client is not sure what he wants; and no or limited data available. Taking into account the percentage of respondents classifying a factor as typical, five other factors are of interest: bad state
/ maintenance of the environment; service and equipment not available; client does not have experience and money; conflicting interest between client and financer; and slow decision-making process (no experience / understanding of the local culture is already discussed as success factor). The sections below discuss the factors further.

### 10.4.1. Bad state / maintenance of the environment

This factor refers to the status of the environment such as buildings and nature. The status of the environment is in a poor or not what it should be. This should be taken into account during the project although the environment itself is not directly part of the project.

"A risk is the condition of the existing quay wall" – Respondent 10

Respondents feel that the environment of the project is sometimes in a poor state due to the limited amount of maintenance. This can influence the current project because the implementation can influence the environment that is in a poor state. Respondents state that this should be taken into account while designing the project, implementing the project, and for the operation and maintenance phase. Extra risks should be considered than in other projects.

All respondents classified this factor as a typical for African infrastructure projects. The maintenance is poor and the state of the environment is worse than projects in another location. Proper site investigation beforehand can help to take the state of the environment into account at an early stage.

### 10.4.2. Service and equipment not available

This factor refers to the availability of all kind of services (e.g. utilities) and equipment (e.g. concrete, machines) that are necessary for all phases of the project, which are often absent.

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Figure 8: Risky project characteristics, typical or general

<table>
<thead>
<tr>
<th>Factor</th>
<th>Typical</th>
<th>General</th>
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<tr>
<td>Too many assumptions</td>
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<tr>
<td>Incompetent local partner</td>
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<tr>
<td>Using different standards</td>
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<tr>
<td>Long time between project preparation and implementation</td>
<td></td>
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<tr>
<td>Not clear / right risk allocation - client contractor</td>
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<tr>
<td>Geographical barrier</td>
<td></td>
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<tr>
<td>Engineer has no decision power</td>
<td></td>
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<tr>
<td>Nobody wants to make decisions</td>
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<tr>
<td>Unclear if finance is in place</td>
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<tr>
<td>Bad state / maintenance of the environment</td>
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<tr>
<td>Service and equipment not available</td>
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<tr>
<td>No experience / understanding of local culture</td>
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<td>Unpredictable / not knowing the process of local...</td>
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<tr>
<td>Client does not have the experience and money</td>
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<td>Poor communication with the client</td>
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<tr>
<td>Conflicting interest between client and financer (direct...</td>
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<tr>
<td>Slow decision-making process</td>
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<tr>
<td>Client is not sure what he wants</td>
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</tr>
<tr>
<td>No or limited data available</td>
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Several respondents mention the lack of service and equipment necessary for projects on site. One respondent mentions the availability of utilities and fuel. Another respondent states that sometimes sophisticated equipment for, for instance, a bathymetry study, is missing. Although a solution is always possible, this should be taken into account when preparing a project since it can cause delay and affect the quality. The unavailability of service and equipment is an extra risk that should be taken into account during the risk management process to ensure necessary activities can be completed (on time and within budget).

All respondents classified this factor as typical for African infrastructure projects. Although it is not related to all projects in Africa, and the unavailability of services and equipment can be different for each project, it is a common factor causing risks and should be taken into account during project preparation.

10.4.3. Unpredictable / not knowing the process of local regulations

This factor refers to the knowledge of the consultant engineer about local regulations and the process affecting the project. In this case, the engineer has little knowledge about local regulations or cannot predict the process that should be taken into account.

Respondents mention that local regulation is not always clearly stated. Even if the regulations are known, the enforcement and process of the regulation are still unpredictable. Two important examples given by respondents are work permits and tax exemptions. It is vital to have knowledge of these two regulations for the (risk) management of international projects. Even if consultant engineer knows the regulation regarding these issues, the procedure in practice might differ. This affects time, costs, and other project requirements. Due to the unpredictable process, it is difficult to prepare. The unpredictability of local regulations makes it hard to decide what risk to take into account and how to assess them. Determining effective measures can also be problematic. Respondents advise the use of a competent local partner to help with the (unpredictable) local regulations.

Most respondents classified this as a typical factor causing risk in African infrastructure projects because even if the regulation itself might be clear, the process of the regulation is often unpredictable.

10.4.4. Client does not have the experience and money

This factor refers to the experience level and knowledge about infrastructure projects, relating issues to this projects, and the available money. Due to lacking experience and money, the client is not able to meet certain agreements and standards relating to the project.

Respondents mention that the local client often has little knowledge and experience relating to an infrastructure project. The role of the consultant engineer is in that case to bring knowledge and advice. However, it also affects the work of the consultant engineer. It is stated that the local client cannot always keep agreements since there is no money or knowledge. Besides, it slows down the decision-making process because everybody is afraid to make the wrong decision. It should be noted that respondents feel that this is already improving and differs per governmental organization and area. The inexperienced client puts an extra risk on the project.

Because of the lack of experience, the client might not be aware of the value of risk management and how to use this. The consultant engineer should take this into account by clearly communicating outcomes and recommendations of the risk management process.
Even though the knowledge and expertise of the local clients differ and is generally improving, respondents classified this as a typical factor causing risks in African infrastructure projects. Since it affects the work of the consultant engineer, this should be taken into account.

10.4.5. Poor communication with the client
This factor refers to the quality and amount of communication between engineer and client. Here the amount and quality are of such a level that one is not able to fully understand each other which negatively affects the success of the project.

“What I found difficult when I work for Africa is the communication. We all speak a different language, but we try to understand each other. But sometimes this doesn’t work, just because of barriers, because you can’t sit in a meeting room” – Respondent 12

Poor communication with the client affects the relationship between client and the consultant engineer. As the quote above illustrates, communication can be very difficult due to geographical barriers. Another reason mentioned by a respondent is cultural differences. People might think differently. This enhances the fact that one should understand the local culture to be able to empathize with each other and understand each other. Poor communication can result in the client failing to understand the need and the outcome of risk management. The client can, therefore, not make a well-considered decision or does not enforce necessary measures that put extra risks on the project.

Respondents identified poor communication as a typical factor causing risks in African infrastructure projects. The reason is the geographical distance and different culture. The factor is, therefore, related to the most international project. However, the importance of personal relation in the African culture is the reason this factor is classified as typical.

10.4.6. Conflicting interest between client and financer (direct investment)
This factor refers to projects with conflicting interests of the financer, client, and contractor. Project financed by the client are direct investment projects. Because the client and financer (often also the contractor) are strongly related, this can result in an unequal relationship between project stakeholders and the authority of the engineer (in the case of site supervision). The unequal relation can result in non-effective choices by the client, which negatively affect the quality (mostly regarding the environment) of the project.

“If it is an outside fund than we have more authority … But they are coming with the money. Then our position, the supervision of the work, is very difficult” – Respondent 4

Respondents state that indirectly financed projects places the consultant engineer in the place as a moderator between different project stakeholders, while directly financed projects result in less bargaining power for the consultant engineer. In this case, the engineer is paid directly by the client which makes the role as a moderator difficult. Respondents felt that due to this situation the client (and often the contractor) might not use the outcome of the risk management process and recommendations drawn by the consultant engineer, or decides to do something different. The wrong decision or lacking decision can put an extra risk on the project. Although this usually does not have financial consequences for the consultant engineer, wrong decisions can affect the image of the company. An example given by one of the respondents is recommendations that were advised to mitigate environmental risks. The advices given were not taken into account, and because of the direct investment, the financing party was encouraged to any actions either, which resulted in environmental issues.

Direct investments are not typical for African infrastructure projects since it does not depend on the location or type of the project. Respondents mention that direct investment is becoming more usual in Africa, especially since large financing institutes are cutting the budget. The factors should, therefore,
be taken into account by the consultant engineer. Because the factor does not cause extra risk in African projects, it is not further discussed in this report.

10.4.7. Slow decision-making process
This factor refers to the rapidity of the decision-making process from the client’s side. In this case, the rapidity of the decision making is slow and negatively affects the progress of the project.

“In general the problem is that many parties are involved in the project and consequently the decision making process is time consuming as everybody has to agree” – Respondent 1

Respondents feel that the decision-making process is often slow. This slows down the project because the local client is the one who has to make the decision in the end. Respondents name several reasons for the slow decision-making process. Often many different parties are involved who all have their own interests. The second reason is the lack of knowledge which makes it hard to make well-argued decisions. In this case, the consultant engineer should guide the local client. Last, people are afraid to make a decision in case they are held responsible when making the wrong decision. A slow decision-making process can cause extra risks for African infrastructure projects causing delay and financial consequences.

Respondents also state some solutions which should encourage the speed of the decision-making process. First, the consultant engineer needs to guide the local client, inform him about the consequence of each choice. Risk management is then important to explain decisions. The other option is to set a deadline for decision making. This latter option might safeguard the progress, but a local client will not be content with this deadline. The factor highlights the importance of communication and understanding the local culture.

Respondents did classify this factor as typical for African infrastructure projects which can have great influence on the progress of a project. It should, therefore, be taken into account.

10.4.8. Client is not sure what he wants
This factor refers to the initiated project by the client. The demarcation, requirements, and wishes are not clear stated by the client. This influences the engineer’s ability to execute the project meeting the client’s wishes.

“On the other hand the client was not sure what he wanted” – Respondent 10

Respondents stated that the client should demarcate the project by setting the objectives and requirements. Based on this information the consultant engineer can deliver work that meets these objectives and requirement. If the client is not sure what he wants or what use the project will have in the future, it is difficult for the engineer to define, for instance, a design that meets all requirements (the requirements are not set). The consultant engineer needs to make assumptions and set a demarcation on its own to ensure progress and quality of the project. The lack of demarcation and requirement also affects the quality, progress, and budget of the project, and it is, therefore, important to take into account.

Respondent classified this factors as typical for African infrastructure projects. Because this factor affects the set objectives and requirement of the projects, it should be taken into account.

10.4.9. No or limited data available
This factor refers to the amount of information that is available at the start of a project. In this case, the amount of data is not sufficient to successfully execute the project.
Respondents state that enough and relevant data is necessary to design a project that is right for the environment. For instance the wave frequency, soil condition, and weather information, which influence (the design of) the project. Without this information, it is hard to make a design that meets all requirements and causes extra uncertainties related to the project. Besides, the necessary information is also important for the tender documents so contractors can base their prices on a fair amount of data. Missing data makes it difficult to calculate an accurate price which in the end negatively influences the outcome of the project. The outcome may differ a lot from the estimated price. Furthermore, enough information and data are necessary for effective risk management.

Respondents give several reasons for a limited amount of available data. The information might be (partially) missing, the information was never there, the data is outdated, or the information is there, but nobody knows where to find it.

Respondents classify this factor as typical for African infrastructure projects. Although opinions vary whether or not this is also related to infrastructure projects in other parts of the world, it happens very often in Africa. This factor should, therefore, be taken into account.

10.5. Validation of the interview results
Both experts did agree with most of the statements. This section discusses the answers that (partly) deviated from the results described above and interesting comments (e.g. recommendations) that should be taken into account.

One of the experts mentions that the value of risk management depends on the client, whether he takes it into consideration and uses it to make well-argued decisions. Formal procedures will, therefore, not always be helpful and might even cause a lot of extra work. It should be done in such a way that it benefits the project and its client. Furthermore, both experts agreed that experience is of great value for risk management. However, important insights are easily forgotten because of the lacking procedures.

One of the experts mentions the importance of knowing the stakeholders for improving risk management, especially in a different environment. Knowing the stakeholders helps to understand what might come up and how to deal with it. Besides this, a good relationship with the client is seen by both experts as very important. Being transparent and straightforward from the beginning on is recommended. On the other hand, using the same standards is not seen as a factor that will make a difference in improving risk management. One expert mentions that it is more related to the design phase of a project and it is just a matter of agreeing on those standards. This factor will therefore further not be taken into account.

Relating the factors that can cause risks, both experts mention that communication with the client is important for all kinds of projects. However, one of the expert mentions that it can be difficult to reach the client and that this is the real factor that can cause risks. Patience and commitment are necessary. The lack of information is by both experts not seen as typical for projects located in Africa, it is a problem in all projects. Usually discussing what extra information is necessary helps to overcome the problem. However, in Africa this might be difficult due to the lack of experience and money. Furthermore, both experts mention the difficult situation of direct investment but also state that it does not necessarily cause risks. It is important to document evidence of advice given and the decisions that are made. The experts confirm that this factor does not need to be taken into account.
10.6. Conclusion risk management in practice & answering sub-question 2

The chapter describes risk management practice for African infrastructure projects. With this information, the second sub-question is answered.

2. How is risk management carried out by international companies in practice for African infrastructure projects?

During the preparation of a project, risks are identified using (informal) brainstorm sessions and based on experience. Experience is also used to assess the risk. Based on the expertise of the employees and requirements set by the client or financing institute more sophisticated techniques are used for assessment, such as scenario analysis. Risks are only (partly) reassessed when critical new information comes up. The consultant engineer has difficulties with taking effective actions based on the risk assessment. Making the client aware and providing recommendation are the most important actions that the consultant engineer can take. Still, the client is the one who takes the final decision. Motivation and awareness about risk management differ between employees due to a lack of standard procedures and knowledge.

Respondents identified five factors that enable improved risk management for African infrastructure projects. The respondents also identified eight typical factors of African infrastructure projects that cause risks. The factors are summed up in Table 2.

It can be concluded that risk management is executed on an ad-hoc basis. The process is started, but often not continued. Organization’s management supports risk management, but it is not embedded in the organization. This means that there is no standard procedure for the risk management process in order to continuously improve the risk management framework or establish clear communication and consultation. Following the risk management maturity model, the process is “Novice.” Factors that can help to improve risks management and factors related to African infrastructure project that can cause risk could easily be identified but were not always taken into account during managing of the project.

*Table 2: General success factors, typical failure factors, and typical risks identified by the respondents*

<table>
<thead>
<tr>
<th>Enabling factors for improved risk management</th>
<th>Risk enlargement factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taking into account the local culture helps to understand how this affects effective risk management</td>
<td>Project environment is often in a bad state and poorly maintained</td>
</tr>
<tr>
<td>Experience and know-how are used for effective risk management (knowing what might come up and how to handle)</td>
<td>Necessary service and equipment are often not (directly) available</td>
</tr>
<tr>
<td>Competent local support helps to improve risk management with specific and local knowledge</td>
<td>Unknown and unpredictable (process of) local regulations</td>
</tr>
<tr>
<td>A good relationship with the most important stakeholders helps to improve the effectiveness of risk management</td>
<td>Local clients have little knowledge, experience, and available money</td>
</tr>
<tr>
<td>Communication with the client is difficult</td>
<td>The decision-making process is slow</td>
</tr>
<tr>
<td>The decision-making process is slow</td>
<td>Client is not sure what he wants and is not able to set clear objectives and requirements</td>
</tr>
<tr>
<td>Client is not sure what he wants and is not able to set clear objectives and requirements</td>
<td>Data is often missing or limited available</td>
</tr>
</tbody>
</table>
11. COMPARING EMPIRICAL STUDY WITH LITERATURE

To identify similarities and differences between practice and theory, risk management in practice for African infrastructure projects is compared with the available literature on risk management. Literature and empirical data are compared to the following topics: risk management process (section 11.1), organizational risk management awareness (section 11.2), enabling risk management for improved risk management (section 11.3), and risk enlargement factors (section 11.4). The last section (section 11.5) of this chapter draws the conclusions and answers the third, and last, sub-question.

11.1. Comparison risk management process in practice with literature

Nicholas & Steyn (2012) advise an iterative risk management process which includes risk identification, risk analysis, plan and implement risk response, and monitor and control. Some parts of the process are clearly executed in practice, while other parts are left out. Chapman & Ward (2004) emphasize the importance of starting the risks management process at an early stage in the project. Risks are identified at the beginning of the project, during project preparation. More specific, during the inception stage and feasibility study.

The risks management process should also be continued during the whole project lifecycle, which is not always the case in practice. After the identification, risks are only reassessed when important new information is found or during project reports and project meetings. The latter focuses on critical risks that are obvious at that moment and can be seen as ad-hoc risks management. Chapman & Ward (2004) mention that whenever new information comes up, all risks should be reassessed, thus not only the risks that seem obvious at the moment. Well-Stam et al. (2003) argue that this should happen (at least) at the end of a project phase or milestones to ensure it is done on a regular basis, which is not always the case in practice.

Tools and methods used to identify risks are basic but helpful. Experience is an important source to identify risks, just as discussions with experts is. But without writing down specific information relating to risks in each project, there is a chance that important known risks are forgotten. Smith et al. (2006) see this risk identification process as informal. Preferable knowledge relating to risk and risk management should be documented so employees can use this in upcoming projects (Serpella et al., 2014).

The most difficult part for a consultant engineer is the actions one can take after identifying risks in practice. The engineer has little decision power and mostly advises the client, who in the end takes the decisions. Although the decision power is limited, the consultant engineer is still affected by the decisions taken by the client and the outcome of the project. This difficult position highlights the benefit for a consultant engineer to understand the project risks, and to be able to explain them to other stakeholders, in order to make the best decisions. Hillson & Simon (2007) explain that also for making the client aware and advising, structured documentation would be helpful to explain risks and mitigation measures.

11.2. Comparing organizational risk management awareness in practice with literature

In practice, management has extensive knowledge about risk management and supports the use of it. There is, however, no a clear risk management framework available, there are no specific guidelines to follow, neither templates that can be used. In other words, risk management is not embedded in the organization. This is contradicting to the advice given by literature. A prerequisite for effective risk management is not only the support of management, but also setting procedures, policies, providing resources, and embedding this in the organization (Smith et al., 2006).
Because risk management is not embedded in the organization, the way risk management is executed can be different each time. Besides, the quality of risk management depends on the experience, knowledge, and motivation of the employee in charge of the project. The opposite is advised by literature, which not only recommends a structured approach but also recommends to train employees. The quality of risk management mostly depends on skills of the employees (Hillson & Simon, 2007). Due to lack of knowledge about infrastructure projects and risk management in Africa, competent employees are essential. Employees should be aware of the added value and be skilled to effectively perform risk management for African infrastructure projects (Chileshe & Kikwasi, 2014; Agyakwa-Baah & Chileshe, 2010).

The lagging awareness and risk management framework in practice leads to lagging communication and exchange of knowledge. Although information and experiences are shared freely within the organization, this is not done in a structured and effective way. Neither is the information related to risk management shared with stakeholders in a structured way. According to ISO (2009) structurally sharing information is necessary to improve risk management (so it is fit-for-purpose). Moreover, structural and clear communication is essential to create understanding (Smith et al., 2006). Especially in Africa due to the lacking knowledge and experience (Chileshe & Kikwasi, 2014). This highlights the need to use post-project reviews, risk checklists, and risk registers.

Based on the comparison in this section, the risk management maturity level can be defined using the risk maturity model provided by Hillson (2004). This maturity model assesses the maturity/capability of the organization regarding project risk management. The maturity level is defined based on culture, process, experience, and application (Hillson & Simon, 2007). The risk maturity model can be found in Appendix G, Table 13. According to the maturity model, the used risk management practice can be rated as two out of four, “Novice.” A “Novice organization” is still doubtful about the added value of risks management. Risk management itself is informal and ad-hoc based on the experience of a few individuals. Moreover, there is no consistent approach available.

11.3. Comparing enabling factors for improved risk management with literature
Based on the interviews five enabling factors for improved risk management identified. Although all are important, none of them are typical for risk management for African infrastructure projects. The enabling factors are (the ranking of the factors does not say anything about the importance):

(1) Experience / understanding of the local culture
(2) Experience / know-how
(3) Competent local support
(4) Good relation with the financing institute
(5) Good relation with the client (and client’s staff)

Despite the fact that there is a wide range of success factors related to project management, specific literature on enhancing the effectiveness of international infrastructure projects is limited. In addition, literature that focuses on projects located in Africa is scarce. Therefore, it is difficult to compare the enabling factors in practice with literature. The literature used in this section does not focus on African infrastructure projects but mostly focusses on projects in other regions of the word or international projects in general.

1.3.1 Comparing the factor: experience / understanding of the local culture
To enable risk management improvement for African infrastructure projects, it is important to understand (having experience with) the local culture. This enabling factor is widely recognized by different scholars. Steffey & Antatmula (2011) argue that understanding the different context in international projects is an important success factor for effective risk management. Anantatmula & Thomas (2010) state that understanding of the local culture is the basis for good communication, which
in the end influences the stakeholder and customer satisfaction. Ika & Hodgson (2014) also confirm that local practices, language, resources, and laws should be adapted, which shows the need for understanding the local culture. Besides, Ling & Hoi (2006) argue that difference in culture is problematic and advises that companies should have an understanding of the local culture and how it affects business.

1.3.2 Comparing the factor: experience / know-how
General experience, in other words, know-how, is identified as a factor that enables improvement of risk management in practice. Literature confirms the added value of this factors. Gunhan & Arditi (2005) argue that specialist expertise improves company’s image and provides know-how, which contributes to the successfullness of a project and in the end the effectiveness of risk management. Furthermore as already stated in section 1.2, the quality of risk management depends on the skills of the employee responsible, especially if the project environment differs from the organizational environment.

1.3.3 Comparing the factor: competent local support
Competent local support is identified as enabling factor for different reasons. One of them is that a local company can help to specify risk management for the local needs and wishes (culture, regulations, stakeholders, and etcetera). There is not a lot of literature that recommends the cooperation with a local partner. Gunhan & Arditi (2005) states that a local company can offer support with equipment and labor that contributes to the success of an international project. However, the authors do not specify this for the success of risk management.

1.3.4 Comparing the factors: good relation with financing institute, client, and client’s staff
The last two enabling factors identified in practice (good relationship with financing institute and client) are both supported by literature. As already mentioned, Anantamula & Thomas (2010) see (good) communication as an important contributing factor to the stakeholder satisfaction, especially for a project with cultural differences. A good relationship with the important stakeholder ensures that risk management can be specified to the stakeholders’ wishes and values and helps to create awareness.

11.4. Comparing risk enlargement factors with literature
Based on the interview results eight risk enlargement factors are identified, typical for African infrastructure projects:

(1) Bad state / maintenance of the environment
(2) Service and equipment not available
(3) Unpredictable / not knowing the process of the local regulations
(4) Client does not have the experience and money
(5) Poor communication with the client
(6) Slow decision-making process
(7) Client is not sure what he wants
(8) No or limited data available

Since only limited research is specified on risk enlargement factors for African infrastructure projects, it is difficult to compare the identified factors with the available literature.

1.4.1 Comparing the factor: bad state / maintenance of the environment
The poor state of maintenance of the project environment is not only identified as a threat by respondents, but it is also a problem that is often discussed in literature over the last years. Enakrire & Onyenanja (2007) state that maintenance of projects is usually poor, which influence the effectiveness of projects because it can results in underperformance. Yogo & Verdier-Chouchane (2015) even argue that the poor maintenance culture influences the competitiveness of the region.

1.4.2 Comparing the factor: service and equipment not available
Literature confirms that the unavailability of necessary service and equipment can be a threat to the project. Especially projects executed overseas have to take this into account. The unavailability can cause a lot of extra cost and delay. (Gunham & Arditi, 2005). However, this treat is connected to international projects and not to the continent of Africa.

1.4.3 Comparing the factor: unpredictable / not knowing the process of the local regulations
The unpredictable and non-transparent regulation is an often identified factor causing risks related to projects located in Africa. The unpredictability of regulation does not only affect the viability of infrastructure projects (Miller & Lessard, 2000). Also, the preparation and implementation are influenced. Maseko (2014), who identified challenges and opportunities for infrastructure projects in South Africa, confirms that regulation, the procedure for the regulations, and enforcement are unclear and takes too long. World Bank Group (2017a) even identified that (Sub-Saharan) Africa is the region that ranks lowest relating to efficiency and quality of regulations. This is also confirmed by a research related to energy project in North Africa (Komendantova et al., 2012).

1.4.4 Comparing the factor: poor communication with the client
Difficult communication is identified as a threat typical for African infrastructure projects. Komendantova et al. (2012) states that this is the result of bureaucratic and biased political influences. Another reason for difficulties in communication related to international projects is the distance and cultural differences between the parties (Anatatmul & Thomas, 2010). It remains unclear whether difficulties with communication is typical for African project or related to all international projects.

1.4.5 Comparing the factors: client does not have the experience and money, slow decision-making process, and client is not sure what he wants
The lack of experience and money from the client’s side is identified as a typical threat. This is confirmed by Maseko (2014). The author mentions that African governmental organizations usually have little knowledge and budget. The lack of experience can cause problems related to preparation and execution of a project. Besides, the lack of knowledge can cause a slow decision-making process and problems with clearly stating the requirement and wishes for the project. Especially the latter is seen as a problem because it also causes a slow decision-making process, which delays the project. The lack of knowledge also causes the client’s problem with clearly stating the objectives and expectation related to the project. However, the lack of demarcation can also be triggered by the biased political influences (Maseko, 2014).

1.4.6 Comparing the factor: no or limited data available
The last identified risk enlargement factor in practice is the limited amount of data. Ling & Hoi (2006) confirm the possible negative influence that this factor can have on projects. Anantatmula (2010) also argues that this is a critical factor, but adds that this is mostly related to the difference in culture. The author suggests that knowing what incentives (monetary and non-monetary) can be used to improve data sharing is helpful. Trust, communication, and a systematic structure to capture knowledge can be used for improvement as well. It is doubtful whether this factor is typical for the African context or related to most international projects.

1.4.7 Remaining risk enlargement factors
It might be surprising that an unstable political and economic environment is only named once by the respondents, while literature highlights the importance of this factor. Muriithi & Crawford (2003) mention the weak political institution due to the fact that Africa states are relatively young (compared to most European countries). On the other hand, Maseko (2014) mentions that political instability is not a problem in South Africa. The economy and political situation are rather stable in that county. Furthermore, a respondent mentioned that projects are not executing in unsafe and / or unstable environments. This might be the reason that this is not a noteworthy factor during the project life-cycle because it is already taken into before starting the project.
Another striking result is that almost no technical issues are shared. Regarding infrastructure projects, the technique is an import part of the, for instance, design and implementation. The reason for the limited amount of technical issues is that only well-known techniques are used. Another reason, engineers might be more known and experienced with technical issues. Because of the knowledge and experience, the issue can easily be controlled and is not worthwhile to mention.

11.5. Conclusion comparing empirical study and literature & answering sub-question 3

In the previous sections, a comparison is made between results of the interviews and available literature relating to the risk management. The risk management process, organizational risk management awareness, enabling factors for improved risk management, and risk enlargement factors are compared with the available literature. Based on the insights gained by the comparison the third research question can be answered.

3. What are the differences between the ideal situation described in literature and risk management carried out in practice relating to African infrastructure projects, and what are the causes?

As described in literature, risk management should be tailored to the project, which is also the case for African infrastructure projects.

Although risk management, the identification of risks, is done at an early stage, it is not continued during the whole project life-cycle. The further risk management process is executed in an ad-hoc manner. Whenever a risk becomes critical or new information comes up, the process is continued, but there is no standard moment to monitor and reassess risks, although it is advised to do so.

There are several causes for the ad-hoc practice of risk management. First, although risk management is supported by management, it is not embedded in the organization. There is no standard procedure that can be followed, there is no learning process, and communication and consolation is not established. The second reason is the awareness of the employees. Not all employees recognize the added value of fully executing risk management, neither are all employees skilled and experience for risk management.

Improving the knowledge and awareness of employees along with structuring the risk management process by applying procedure will increase the use and usefulness of risk management. Especially for African infrastructure project due to the lack of knowledge related to infrastructure project and risk management in by stakeholders in Africa. One should keep in mind that this is a learning process. Thereby, implementing too many procedures only increases the bureaucratic level of a company and limits the usefulness. Therefore, the risks management procedures should be adjusted to project and organization (taking into account the enabling factors and the risk enlargement factors).

Five enabling factors for improved risk management are identified (see Table 2). Literature confirms the relevance of these factors, but also shows that none of them are typical for African infrastructure projects. The enabling factors can be used for the improvement of risk management for most international projects. The factors are not structurally taken into account in practice. A reason can be that the absence of a risk management framework (procedures, policies, formats), the lack of awareness and, and the limited skills of employees to effectively perform risk management.

Moreover, eight risk enlargement factors are identified typical for African infrastructure projects (see Table 2). Most of these factors are confirmed by literature. The unavailability of service and equipment, poor communication with the client, and a limited amount of data are mentioned by literature. Instead of associated those factors with projects located in Africa, the factors are related to international projects. Also, the risk enlargement factors are not consequently taken into account for effective risk management in practice. The absence of a structural approach (e.g. in sharing information) causes that
not all stakeholders are aware of the factors. The factors are thus not considered during risk management.

Political and economic instability was not mentioned by respondents, although literature does recognize this as an important factor to consider. The reason for this difference is that the organization does not do business in such areas, where the safety is jeopardized. Also, technical issues were not commonly shared, although this was expected. The reason might be that consultant engineers are extra focused on the technical issues, and those can, therefore, easily be managed.
RESEARCH RESULTS

Research design

Empirical study

Literature study

Research results

Literature list & Appendices
12. Research conclusion

The objective of this research is to provide empirical data about risk management by international companies in African infrastructure projects to improve the risk management in practice. Interviews with experienced project managers gave insight about current risk management approaches in practice. Moreover, comparing current practices with the ideal situation, made it possible to identify the gaps, and thus, the areas of improvement for risk management in practice by international companies in African.

The research question of this research is:

What improvement areas can be identified relating to risk management for African infrastructure projects executed by international companies?

The improvement areas can be identified related to the risk management process, implementation in the organization, and tailoring to the project characteristics. These three components form the basis for tailored risk management approach which is specific for to the organization and / or project in African infrastructure.

The backbone of risk management is the risk management process, which is a continuous process of four steps: (1) identify risks, (2) risk analysis, (3) plan and implement risk responses, and (4) monitor and control. The process should be started as soon as possible and continued during the whole life-cycle of the project. Different tools and techniques can be used in each of these risk process steps, which should be specified based on the project characteristics. Besides, the quality of the input data is another important factor determining the effectiveness and reliability of the tool / technique. Without reliable input, the output is not reliable either. It is advised to use risk categories throughout the risk process for identification of risks, grouping of risks, and easy communication. Based on the interviews, risk management starts early in the project life-cycle but is not continued throughout the whole project. Literature clearly states that risk management should not only start early in the project but should be continued in throughout the project. Usually, risks are identified and assessed based on brainstorms and experience. Sometimes, when necessary, more advanced techniques are used, such as scenario- and probability analysis. Literature advises to regular have meetings in the form of workshops to identify, assess, and monitor the risks. This can be expanded with quantitative assessment techniques.

Conclusion 1: Although the different steps are taken, and the use of tools and techniques seems sufficient following literature, the process is not continued during the project life-cycle. This means that the risks management documents are not regularly updated. Risk management is performed on an ad-hoc basis. This can result that the risk management is not effective.

To ensure that risk management is effective for the organization (quality), the risk management framework should be embedded in the organization’s procedures, culture, processes, and objectives. The interviews with management staff show that they have sufficient knowledge and supports the use of risks management, though risk management is not embedded in the organization. This means that there are no standard procedures, and objectives. Besides, the implementation of the risk management within the organization is a continuous process. The internal and external environment of the organization can change, and the risk management framework should be adjusted if necessary. The same applies to the knowledge of employees. Employees should have enough knowledge how to perform risk management and understand the necessity. It might be clear that if risk management is not embedded in the organization, it is not continuously improved either. Communication and consultation should be in place for this learning process. Without communication, the risk management framework cannot be improved. Besides, the information is used as input for the risk management process, explanation of
decision-making, recommendation to people in the organization and external stakeholders (such as the client). The interviews clearly showed that there is a lot of communication between employees and information is easily shared, but not on a structural basis. Moreover, outcomes of the risk management process are shared with stakeholders, internally and externally, although not always in a logical format, such as a risk register. The communication and relation is for African clients critical for the successful risk management. Therefore communication about risk and recommendations should be understandable. If the client understand the risks, consequence and recommendations, it is more likely that it is taken into account.

**Conclusion 2:** Despite the knowledge and support of management, risk management is not embedded in the organization and not continuously improved. The lack of procedures results in a lack of uniformity in performing and the quality of risk management. Performance and quality dependent on the knowledge and motivation of the employees and the standards and procedures.

**Conclusion 3:** The results of the risks management process are not shared in a systematic and understandable way so everyone understands the results and can be used for decision-making (internally and externally).

Risk management should be tailored based on project characteristics. To define what characteristics should be taken into account, one can use the six w’s approach (who, why, which way, wherewithal, when) and the project life-cycle. The available literature that discusses what factors enable improved risk management for African infrastructure is scarce. All enabling factors focus on the understanding the local culture, stakeholders, and the use of former experience. Literature and experts both acknowledge those factors, but the factors are not consequently applied in practice. The same applies to the risk enlargement factors. These are not structurally taken into consideration for effective risk management, while experts and the available literature confirms the importance of the factor. Most risk enlargement factors are related to the project environment and the ease of doing business in Africa.

**Conclusion 4:** The effect of the difference in culture, especially in terms of relationship, should be better understood and used to improve risk management for African infrastructure projects.

**Conclusion 5:** The business and project environment are a lot different for international companies. The threats to the project should be well understood so it can be taken into considerations during risk management. Comprehensive stakeholder analysis and site investigation can help to do so.
13. RECOMMENDATIONS

The previous chapter answers the research question by identifying the areas of improvement for risk management in practice. Based on the information described in the literature and empirical study, recommendations can be drawn for improving these areas in practice. Recommendations are described per conclusion (the number of recommendation corresponds with the number of the associated conclusion), section 13.1. Moreover, this chapter discusses recommendations for further research, section 13.2.

13.1. Recommendations to improve risk management in practice

Recommendation 1a: It is recommended that the risk management process is performed on a regular basis. When the process is not yet routine for employees, this can be difficult. What steps to take, how, and when is not defined (see next recommendations). It is therefore recommended to continuously go through the risk management process and update the risk management documents. Milestones or start and finish of a project phase are suitable moments to do so. The milestones of a project are usually the transitions from one project stage. The risk profile of the project can dramatically change due to these transitions (Well-stam et al., 2003).

Recommendation 1b: One person has to be responsible for performing and facilitating risk management in the project to guarantee responsibility. The person responsible is the one who has to communicate the results with internal stakeholders and external stakeholders. This does not mean that others cannot help or should not be involved. The opposite is advised by literature, internal and external stakeholders should be involved in the risk management process. More specific, regular use of risk workshops is recommended. Hillson & Simon (2007) call the one responsible for performing and facilitating the risk champion. For African stakeholders the communication is important, so they fully understand the result and consequences of the risk management process.

Recommendation 1c: It is recommended to include external stakeholders (the client) in the risk management process (the different workshops). However, too many parties involved slows down the process. Moreover, due to the high power distance (typical for the African culture), people won’t speak freely (Muriithi & Crawford, 2003).

Recommendation 2a: It is recommended to embed risk management in the organization. Most important is the existence of procedures and knowledge to guarantee the quality of risk management. Risk management in the organization depends on the characteristics of the organization. It is, therefore, recommended to see the implementation as a project on its own. ISO (2009) extensively discusses the implementation of a risk management framework and prerequisites (principles) of effective risk management. The method is highly recommended by scholars because of its adjustable character to seek for continuous improvement. Following the principles, replaces the need to adopt a standard method (Olechowski et al., 2016). The approach can be seen in Appendix E, Figure 12.

Recommendation 2b: The quality of risk management is highly dependent on the motivation and knowledge of the employees who perform risk management. It is therefore recommended to offer training for the employees that creates awareness and knowledge. This is not only helpful for the quality of the risk management but also to overcome the lacking knowledge in Africa related to risk management and infrastructure projects. Awareness and knowledge help to explain important results and issues. Employees who already have extensive knowledge about risk management can help other employees (internal training), or external companies can offer extra knowledge and explanation.

Recommendation 3a: It is recommended to use post-project reviews. Although this is already partly done, risk and risk management should be included. The current risk management framework should be reviewed as well as the performance of risk management. Lessons learned can be identified for the risk management framework, as well as for the improvement of risk management in Africa (what approach...
work, typical risk, and etcetera) (Kululanga & Kuotcha, 2008). The lessons learned can be translated into a risk checklist, which is helpful at the start of each project. A bottom-up approach is necessary to improve risk management, instead of a top-down.

**Recommendation 3b:** It is recommended to use a risk register. A risk register helps to structurally and clearly communicate the results of the risk management process. The clear communication results in understanding and awareness (Hillson & Simon, 2007; Muriithi & Crawford, 2003).

**Recommendation 4a:** A culture determines one’s values, objectives, manners, and more. Understanding of the local culture is, therefore, an important benefit for risk management. The support of a local company can help with to minimize the effects of the difference in culture.

**Recommendation 4b:** Because communication and relationship are very important in the African culture, it is advisable to contact the client regularly (preferably the same person each time). This can be either by telephone, video call, or in person. The last option is preferred.

**Recommendation 5a:** To specify risk management for projects located in Africa, “who” is very important. It is recommended to perform a comprehensive stakeholder analysis. The knowledge, values, and resource are different for each stakeholder and are highly dependent on the culture. A stakeholder analysis gives insight in the stakeholders, how to approach, the values, and the usable resources.

**Recommendation 5b:** Besides the stakeholder analysis, it is recommended to investigate (site investigation) the project environment, the location, its characteristics, the culture, and the regulations. Although it is not always possible to overcome possible threats, it can be taken into account. For example, it is difficult to make unpredictable regulations predictable. However, knowing that regulations are unpredictable help to limit the consequences, one comes prepared. Although “where” is not part of the six “w’s” of Smith et al. (2006), it should be included because “where” is very important for African infrastructure projects.

### 13.2. Recommendations for further research

During the research, several openings for further research are identified. Each is briefly discussed below.

- First of all, based on the conclusion and recommendations a research can be performed focusing on the creation of a risk management plan for international companies involved in African infrastructure projects. Thereby, this plan can be validated to implement the recommendations and review the results.
- This research focuses on infrastructure projects located in Africa from the viewpoint of the consultant engineer. It might be interesting to see what the differences are with other locations, other projects, or from a different viewpoint (like the contractor, client, or financing institute). The research contributes to risk management in practice for this different kind of projects, stakeholders, and or areas. Besides, it would be interesting to compare the outcomes of these studies and see what characteristics have a significant influence.
- During the research, it became clear that the difference in culture affects the project- and risk management. In this research, the influence of culture on communication and relationships was found most important, but there are many other cultural differences that can affect project- and risks management. These are not identified or further elaborated in this research. Doing research into all cultural differences can help to understand all stakeholders better and enhance the quality of project- and risk management. For instance, the dimensions described by Hofstede (2010) can be used: power distance, individualism, masculinity, uncertainty avoidance, long-term orientation, and indulgence.
- Last, during the research, it became clear that the consultant engineer often feels that the amount actions he can take regarding risk management are limited. Because the consultant engineer depends on the outcome of the project (image and financially), research might help
to investigate how the consultant engineer can enlarge the enforcement power, or take actions that can create more value (in terms of image and financially).
14. **Reflection**

The quality, usability, and relevance of the research depend on a lot of factors. Research and the research scope does not stand alone. For the interpretation and usage of the results and data, it is important to understand these factors. This section discusses the research objective, limitations of the results, the generalizability, and the scientific contribution.

The initial objective of the research was to find factors that influence risk management, in what way, and how this can be improved. During the research, it became clear that this objective was not feasible. A reason is the limited time available, but the most important reason is that it depends on to a very large extent on the project characteristics. Each project is different and knows its own challenges. African countries are not homogenous in terms of economy, landscape, culture, religion, language, and more. It is therefore very difficult to define influencing factors that are generally important and influence risk management.

The first limitation of this research is the used method. Interviews are very helpful to get more insight into the experience, thoughts, and reasoning of experts. Initially, this seemed like an efficient method to find factors that influence the risk management process. However, the quality of the method depends on three factors, the preparation of the interview, the skills of the interviewer and the understanding and cooperation of the interviewee. Although all the interviews are well prepared, it focused too much on project management (general issues related to the project) instead of risk management. The second factor is the skills of the interviewer to be able to extract the predefined information. Sometimes the interviewer did not stick to the protocol. This resulted that not all transcripts fully cover the same topics. Last, the understanding and cooperation of the interviewee. All respondent were willing to cooperate and share their thoughts. However, not all respondents were fully familiar with the topic risk management or interpreted it differently. This is also a reason that not all transcript cover the same topics.

Secondly, the interviews are based on the critical decision method. This method is used for understanding, clarifying, and the decision related to risk management before. The method gives the respondent the opportunity to choose a relevant project and situation. This, however, leads to interviews that are difficult to guide. As a beginning interviewer it became clear that it is very difficult to structure the interviews, so the interviews could be compared.

The third limitation of the research is a lack of consistency between the transcripts. Because not all transcripts cover the same topics, it was hard to compare the topics. The researcher was forced to make some interpretations. Although the researcher tried to do this in an objective manner, interpretations are still affected by subjectivity to some extent.

Although the results of the research are validated, the experts are two of the interviewees. Great care is taken to choice these experts objectively who have a critical opinion and are involved in different parts of a project. Though this is not ideal for validating the results.

Reflecting on the used research method, for further research it is advisable to combine interviews with case studies. The case studies would give more structure to interviews and make easier to find factors influencing the risk management. The cause-effect relation is better visible.

Furthermore, the research uses the data provided by only one company. Although this company has a lot of experience for many years with African infrastructure projects, the results only represent the thoughts and experience of this company. When using the results of this research, on should keep in
mind that the results are focused on just one company. It should be first analyzed whether the However, it is expected that the conclusions and recommendations are (partly) generalizable because literature confirmed most results.

Last part to discuss is the scientific contribution of this research. During the research, it became clear that there is just a limited amount of literature available that focuses on risk management related to African infrastructure projects. Regarding African infrastructure projects, most literature focuses on the barriers and success factors related to project management in general. Besides, most available literature is not written from the perspective of the consultant engineer. This research sheds light on risk management from the perspective of the consultant engineer related to African infrastructure projects. The research might not substantially contribute to the general literature related to risk management, but provides a basis for risk management related to consultant engineers, African infrastructure projects, and international projects.
LITERATURE LIST & APPENDICES

Research design

Empirical study

Literature study

Research results

Literature list & Appendices


Jacob, S.A. & Furgerson, S.P. (2012). Writing interview protocols and conducting interviews: tips for students new to the field of qualitative research. The qualitative report 17, article 6: p. 1-10


Master Thesis – L.S. van der Kuijp – February 2017


APPENDIX A: PREPARATION OF THE INTERVIEWS

This appendix describes the steps that are taken to prepare and conduct the semi-structured interviews. First step is to further elaborate the methods used, critical decision method in the form of semi-structures interviews in A.1. Thereafter, A.2 determines the focus of the interview and what data should be gained from the interview. In section A.3, the focus areas will be translated into an interview structure, interview questions and an interview protocol. A pilot interview gives insight in the quality of the interview and will show some areas for improvement. The outcome of the pilot is not described but immediately implemented in the interview protocol. The next section, A.4 describes the criteria for relevant interviewees and gives a brief introduction of the candidates. Last, A.5 gives some insight in how to conduct the interviews.

A.1 Critical decision method and semi-structured interviews
The critical decision method is specialized to elicit knowledge gained by experience from experts during non-routine cases. Typical cases, brought up by the interviewee, are used to discuss further elaborate the case and incidents, strategies and the nature of a decision. During the interview, semi-structured probing is used which creates a dialogue format to extract the data but still maintains cooperation and interest of the interviewee (Klein et al., 1989). The main strength of the method relating to this research is the ability to put difficult to communicate knowledge (such as, contextual knowledge) into words (Taylor, 2003). Relating to this research, the focus will be on decisions relating to risks and risk management.

A.2 Interview focus
During the literature study, different subjects are collected, which will also be used during the interviews:
- Process and tools
- Organizational awareness
- Project characteristics

The critical decision method helps the respondent to communicate non-routine case where decision making is based on experience and less on procedures. The three topics, above are found by specifying on or several specific incident or challenge (Taylor, 2003).

A.3 Interview structure, questions and protocol
The interview consist of four phases: Introduction, interviewee’s background, risk management, and wrap up. Each phase is discussed below. The corresponding question for each phase can be find in the interview protocol, which is visualized Figure 4.

- Introduction: Meeting of the interviewer and interviewee. The purpose of the interview will be explained, as well as making an agreement regarding to the publicity of the transcript.
- Interviewee’s background: Especially the experience level of the interviewee is of interest, which can be translated into the numbers of years worked in the company, and in total. Also the roles he / she had in projects and what company he / she is related to.
- Risk management: This phase is the core of the interview. Information about a specific project will be asked, as well as the risk management process, elicitation of specific incidents, and the exploration of typicality.
  - Choice of a specific project: The interviewee will be asked to think of a specific project which was risky or challenging to manage. This project will be further used for the other questions.
Risk management process: Not only the formal risk management process is of interest, but also if it is used. Furthermore it is of interest to see if the interviewee uses his own process.

Elicitation of specific risks: Specific risk or issues will be addressed, as well as how the interview did deal with each risks.

Exploration of typicality: The last part is to see whether the named risk and or challenges are typical and occur more often.

- Wrap-up: During the last part of the interview the interviewees should have option to ask questions or to add information. Moreover, the interviewee should be thanked for his time.

Because of the semi-structured character of the interview, the interview protocol does not consist any question that ask for further explanation. Moreover, wording of the question can be different for each interview.

A.4 selecting interviewees

The right interviewees need to be selected for the interviews to get insight in the experience in implementation and execution of risk management in African infrastructure projects. Because the research question focuses on international companies working on African infrastructure projects, interviewees should be working in a company stationed in west Europe. Moreover, these European interviewees should have relevant experience with African infrastructure projects. This means that topic of risk, risk management, and project outcome should be familiar subjects. Last, the interviewee should feel free to speak about the subject.

Interviewees are initially selected from employees working for the company Inros Lackner SE. This company executes infrastructure project in Africa for many years and established a good reputation regarding to these projects, which ensure experiences and quality. Information about the selected in interviewees is shown in Table 3.

Table 3: Information selected interviewees

A.5 conducting the interviews

The selected interviewees will be approached and the purpose of the interview will be explained. If the interviewees agree to cooperate with the interview, the interview is planned. Before the interview, the purpose of the interview is explained again, as well as agreeing on the anonymity and recording the interview. All interviews will transcribed afterwards based on the recording and the interview notes. The transcript will be sent to the respondent for final adjustments so both parties agree on the transcript.
<table>
<thead>
<tr>
<th>Introduction</th>
<th>Welcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thank you for being here. I really appreciate the fact that you are making time for this interview and I am sure it will be of great help for my research.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Introduction interviewer</th>
</tr>
</thead>
<tbody>
<tr>
<td>My name is Lotte van der Kuijp. I am a master student construction management and engineering at the TU Delft. I am particularly interested in risk management, by what it is influenced and how it can influence a project. Therefore I am writing my master thesis at Inros Lackner SE focusing on risk management in practice for African infrastructure projects.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Introduction interview topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>During the research I would like see the risk management (process) that is practiced in reality regarding to African infrastructure projects. I would like to know what you do, why you do it that way, instead of what you should do. There is thus no right or wrong answer. Also it doesn’t matter if there is no formal protocol, I am looking to hear your experiences.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interview process</th>
</tr>
</thead>
<tbody>
<tr>
<td>We will first focus on a project that may be interesting, from there, we will discuss the projects and the risks further.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Publicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>To be able to make a transcript I will record this interview. I will send you the transcript, so you can read it. After us both agreeing with the transcript I will use the document for my analysis to draw conclusions for the report. The transcript will be anonymized in the private report, the public report will not contain any transcripts.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interviewees background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company and role</td>
</tr>
<tr>
<td>For which company do you work?</td>
</tr>
<tr>
<td>What is your role in this company?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>For how long have you been working with infrastructure project in Africa?</td>
</tr>
<tr>
<td>What is usually your role/task within these projects?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Choice of specific project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a recent project that you felt was challenging or risky?</td>
</tr>
<tr>
<td>Can you give me a general description of this project?</td>
</tr>
<tr>
<td>• What was the main goal of the project?</td>
</tr>
<tr>
<td>• Who was the client and where there any partners?</td>
</tr>
<tr>
<td>• What was the budget of the project</td>
</tr>
<tr>
<td>• When was the project implemented and how much time did it take?</td>
</tr>
<tr>
<td>• Was the project a success (time, price, quality)?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk management process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a formal process that can be used for risk management?</td>
</tr>
<tr>
<td>If yes, can you explain the process?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Elicitation of specific incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus on a specific risk during the project that you felt was challenging, how have you dealt with this incident?</td>
</tr>
<tr>
<td>This doesn’t have to be a risk that actually occurred, but should something were you had to deal with during the project.</td>
</tr>
<tr>
<td>Can you describe the situation?</td>
</tr>
<tr>
<td>Can you give more information about:</td>
</tr>
<tr>
<td>• What happened leading up to the situation? (Context, environment)</td>
</tr>
<tr>
<td>• Can you describe the time of the incident in the project life-cycle?</td>
</tr>
<tr>
<td>• How and when did you identify the risk?</td>
</tr>
</tbody>
</table>
### What do you think were the causes / triggers of the incident? And how did you find out?

### Relating to the incident what were the specific goals on this point (mitigate, eliminate, transfer, or accept)?

### How did you decide what to do to meet this goal (tools, knowledge, and efficiency)?

### Did the actions had the effect you had in mind (effectiveness)? If not, why do you think that was? If so, what might have caused it not to work?

### Did you review the actions that were taken?

### Can you name anything that have helped (positive or negative) to the achieved result relating to the risk?

### Can you think of another situation where you would have done things differently?

### Exploration of typicality

- Do you experience it in other projects as well?
- What are similarities?
- What are the differences?
- Depending on which factors?

### Questions

**Do you have any questions, additional information, or comments?**

### Thank you

Thank you for your time. It was a very informative and interesting to hear your experiences. I will send you the transcript as soon as possible. If you have in the meantime (or afterwards) anything that would help my research, you are more than welcome to contact me. For instance, you might know somebody that is an interesting interview candidate as well?
APPENDIX B: TRANSCRIPT INTERVIEWS

This appendix contains the transcripts of the conducted interviews. The table below, Table 5, gives an overview of the interview transcript per section.

By writing down the record of an interview in a transcript, six basic rules of Gillham (2005) are taken into account to effective transcription of the right quality:

- Do not let tapes accumulate
- Transcript as soon as possible after the interview
- Ideally transcribe the day after the interview
- Be realistic about the time transcription will take
- Don’t spend more than an hour at time on transcription
- Clearly identify tapes and transcripts

Transcriptions can vary in amount of detail, thus it is important to establish the amount of detail on forehand to make sure each transcript has the same level of detail. Gillham (2005) recommends to include questions stated by the interviewer as well as the answers given by the interviewee visualized in different font. Material that cannot be recorded should also be visualized in the transcript, by a clear indication. Last, paragraphing and punctuation should be applied following the recorded interview, and not following grammatical rules. This means that the transcript may not meet grammatical rules, but does visualize meaning of words, sentences, or paragraphs. On the other hand, the transcripts will not include paralinguistic features, unless this has great influence on the meaning of the interview. Speech hesitation and repetitive words (e.g. repetition of “you know” after each sentence), that do not influence the meaning of what is said, are also not included in transcript. It can be summarized that everything that is said, which is meaningful or clarifies is included in the transcript.

B.1 Oversight interviews and transcript

In Table 5 the information about the conducted interview is written down, together with the place of the transcript.

Table 5: Information interviews and transcripts

<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
<th>Date Interview</th>
<th>Virtual / face</th>
<th>Transcript place</th>
</tr>
</thead>
<tbody>
<tr>
<td>INT1</td>
<td>Inros Lackner</td>
<td>27-9-2016</td>
<td>Face-to-face</td>
<td>B.2</td>
</tr>
<tr>
<td>INT2</td>
<td>Inros Lackner</td>
<td>4-10-2016</td>
<td>Face-to-face</td>
<td>B.3</td>
</tr>
<tr>
<td>INT3</td>
<td>Inros Lackner</td>
<td>6-10-2016</td>
<td>Face-to-face</td>
<td>B.4</td>
</tr>
<tr>
<td>INT4</td>
<td>Inros Lackner</td>
<td>6-10-2016</td>
<td>Face-to-face</td>
<td>B.5</td>
</tr>
<tr>
<td>INT5</td>
<td>Inros Lackner</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>INT6</td>
<td>Inros Lackner</td>
<td>26-10-2016</td>
<td>Face-to-face</td>
<td>B.6</td>
</tr>
<tr>
<td>INT7</td>
<td>Inros Lackner</td>
<td>25-6-2016</td>
<td>Face-to-face</td>
<td>B.7</td>
</tr>
<tr>
<td>INT8</td>
<td>Inros Lackner</td>
<td>27-9-2016</td>
<td>Face-to-face</td>
<td>B.8</td>
</tr>
<tr>
<td>INT9</td>
<td>Inros Lackner</td>
<td>21-11-2016</td>
<td>Face-to-face</td>
<td>B.9</td>
</tr>
<tr>
<td>INT10</td>
<td>Inros Lackner</td>
<td>21-11-2016</td>
<td>Face-to-face</td>
<td>B.10</td>
</tr>
<tr>
<td>INT11</td>
<td>Inros Lackner</td>
<td>15-11-2016</td>
<td>Face-to-face</td>
<td>B.11</td>
</tr>
<tr>
<td>INT12</td>
<td>Inros Lackner</td>
<td>10-11-2016</td>
<td>Face-to-face</td>
<td>B.12</td>
</tr>
<tr>
<td>INT13</td>
<td>Inros Lackner</td>
<td>15-11-2016</td>
<td>Face-to-face</td>
<td>B.13</td>
</tr>
</tbody>
</table>

B.2 – B.13 – Interview transcripts
**APPENDIX C: PREPARATION QUALITATIVE CONTENT ANALYSES**

The content of each transcript should be analyzed to be able to make a good comparison between all the experience and opinions of the interviewees, which should be done based on qualitative content analysis. Schreier (2012, p.1) described qualitative content analysis as follows: “QCA is a method for systematically describing the meaning of qualitative material. It is done by classifying material as instance of the categories of a coding frame.” The coding frame is therefore the cornerstone of the analysis.

First the method will is further explained (C.1), thereafter the code frame will be explained (C.2).

This appendix will further describe the method and the identification of the code scheme. The results of the qualitative analysis is provided in Appendix D.

**C.1 Description of the method**

Qualitative content analysis can be used for different kind of data, in this case it will be used to analyze transcripts of interviews. The method reduces a transcript consisting of useful and irrelevant data into information that that is of meaning for the research. To do so, eight steps are advised (Schreier, 2012):

1. Deciding on you research question
2. Selecting your material
3. Building a coding frame
4. Dividing your material into units of coding
5. Trying out your coding frame
6. Evaluating and modifying your coding frame
7. Main analysis
8. Interpreting and presenting your findings

The first two steps are already accomplished in previous steps in the research. The other steps will be elaborated in the next sections. The selected material are the transcript of the conducted interviews, and the research question is:

*What improvement areas can be identified relating to risk management for African infrastructure projects executed by international companies?*

A coding frame makes it possible to select relevant data from the transcript to use for the research. A code frame consists of main categories / dimensions and sub-categories. The main categories are the aspects the research focus on, while the sub-categories specify what has been said about the main-category (e.g. a meaning) (Schreier, 2012).

There are two main ways to decide the main categories, sub-categories and codes. The first way is concept driven, based on already known information, the coding frame is build. The second possibility is data drive, which means is that the coding frame is based on the new information of the analysis. A combination of the two is also possible, which is the case is this research.

**C.2 Explanation of the main categories and sub-categories**

Based on the research question and the available information described in the literature study three main categories can be distinguished: Risk management process, organizational risk management awareness, influencing project factors. Each main categories consist of at least two sub-categories, which give direction to the main category, as explained above. The sub-categories are based on the already known information and on the information from the transcripts (data that was provided).

Based on the literature study the risk management process turned out to be the backbone of risk management. Risk management process can be applied in all sorts of project and is not (that much)
influenced by contextual factors. Despite that the risk management practice is extensively described in literature, literature also described that the process is often not fully or in the right way applied. This results in the identification of the first main category: risk management process. This main category is further divided into technique and tools used for identification, time of identification, time of reassessment, and measures to take by the engineer.

The application of a risk management process is depending on the thought, motivation and knowledge of employees and procedures set by the organization. For that reason, the organizational risk management awareness is the second main category. The organizational awareness is further split up in added value, the opinion of the employees about the usefulness of risk management, and exchange of knowledge, how employees use (each other’s) experience in the process.

The last identified main category is risk management influencing factors. The aim is to understand what factors can help to increase the effectiveness of risk management for African infrastructure projects. The second objective is to identify factors that can lead to risky events in African infrastructure projects. The two selected sub-categories are: enabling factors for improved risk management and risk enlargement factors. The purpose of the first sub-category, from now on abbreviated as enabling factors, is to find what factors can help to improve the effectiveness of risk management for African infrastructure projects (enhancing the opportunities and limiting the threats). The latter sub-category aims to find factors (project characteristics) related to African infrastructure projects that can cause risks. These factors should be taken into account during risk management. Being aware of the first and latter sub-categories can help to minimize the threats, enhance the opportunities, and improve effective risk management. The two sub-categories are further divided into typical factors and general factors. A typical factor classifies the factor as typical for African infrastructure projects. Factors that are not identified as typical, or if the respondents did not have an opinion about the typicality, are considered as general factors. Typical factors can also be applicable to projects in a different environment but are in this research identified as most applicable to African infrastructure projects.

C.3 Used Codes
The information given in the transcripts, divided into main and corresponding sub-categories can be coded to generalize the information, this benefits the comparable of the information, statements of each interviewee. A code is formed when a certain statement was stated more than once. If this was the case, a general code was formed. The codes related the risk management process Table 6, the codes related to risk management awareness are given in Table 7, and codes related to risk management influencing factors are show in Table 8.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience former projects</td>
<td>The experience gained in former project is used to identify risk in a new / current project.</td>
</tr>
<tr>
<td>Looking from the requirements down</td>
<td>To identify risks the requirements (goals) of the project are taken in mind, and from that point of view risks are identified.</td>
</tr>
<tr>
<td>Brainstorming</td>
<td>During a brainstorm session with several employees risks are identified. This can be both a formal as an informal session.</td>
</tr>
<tr>
<td>Project preparation</td>
<td>Risk are identified before project implementation, during the preparation of the project. The exact moment during preparation is not clear. Usually the outcome of the project preparation is a feasibility study.</td>
</tr>
<tr>
<td>Along the project</td>
<td>There is no specific time for the identification of risks, this is done throughout the duration of the project.</td>
</tr>
<tr>
<td>Feasibility study</td>
<td>During the feasibility study the risks are identified. Usually this includes the risks related to different options for the project, and not especially the risks the engineer is exposed to.</td>
</tr>
<tr>
<td>Inception report</td>
<td>During the inception report the risks are identified. Usually this includes the risks related to the project, and not especially the risks bared by the engineer.</td>
</tr>
<tr>
<td>Project/process meetings and reports</td>
<td>During the preparation of the project meeting and reports the risk can be reassessed, this is more related to issues that came up and how to handle those issues.</td>
</tr>
<tr>
<td>Every time new information comes</td>
<td>When new information is available the risks are reassessed. Usually this happens in an informal way.</td>
</tr>
<tr>
<td>Aware and inform the client</td>
<td>Engineers makes the client aware of the possible problems or current issue, gives the client the opportunity to find possible measure in time.</td>
</tr>
<tr>
<td>Put everything in writing</td>
<td>Engineer has to put all decision that are made, such as assumptions, in writing.</td>
</tr>
<tr>
<td>High advanced payment</td>
<td>The engineer can ask a higher payment in advance, usually when one expects that payment will be an issue.</td>
</tr>
<tr>
<td>Recommend risk measures</td>
<td>Engineer recommends certain risk measures that could be taken by the client. Can also refer to common effort to find measures.</td>
</tr>
<tr>
<td>Not taking too much risk at the start of the project</td>
<td>Engineers tries to minimize own risks at the start of the project. This can include not doing more than supposed till first payment is received.</td>
</tr>
<tr>
<td>Making assumption</td>
<td>Engineers will make assumptions to be able to continue. This mostly is applied when there is a limited amount of data.</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Very important it is your duty</td>
<td>Engineer feels that it is his duty to advise the client, and risk management is an important part of that.</td>
</tr>
<tr>
<td>If the client asks for it</td>
<td>A formal risks management process is only of value when the client ask for advice regarding to risks and risk measures.</td>
</tr>
<tr>
<td>Can be helpful for the success of the project</td>
<td>Risk management is seen as helpful and can have a positive impact on the outcome of the project. However, it is not seen as a duty.</td>
</tr>
<tr>
<td>Obligated because of financing institute</td>
<td>It is not especially seen as an added value, but more as a duty because it is required by the financing institute.</td>
</tr>
<tr>
<td>Not able to identify risk at the beginning</td>
<td>Engineer admits that it is not possible to identify the all risks at the beginning of the project, which can influence the value of risk management in a negative way.</td>
</tr>
<tr>
<td>Using former project</td>
<td>Engineers are able to use former project to gain knowledge and to exchange knowledge.</td>
</tr>
<tr>
<td>Informal spread of experience</td>
<td>Informal ways are used to exchange knowledge. This can includes just talking to each other and mentioning important issues.</td>
</tr>
<tr>
<td>Challenges are different each time</td>
<td>Refers to the difficulty to exchange reasonable knowledge regarding to risk management and projects, since all project have their own challenges best solutions which makes it hard to compare</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Effective / transparent communication with the client</td>
<td>Refers to the quality and amount of communication between engineer and client. In this case the communication is good.</td>
</tr>
<tr>
<td>Good relationship with client (and client’s staff)</td>
<td>Refers to the quality of the relation between the engineer and client. Quality means if the both cooperate and trust each other.</td>
</tr>
<tr>
<td>Good relationship with financing institution</td>
<td>Refers to the quality of the relation between the engineer and financing institution. Quality means if the both parties cooperate and trust each other.</td>
</tr>
<tr>
<td>Competent local support</td>
<td>Refers to the support and usefulness of a local company and or staff working in a partnership with or as sub-contractor for the engineer.</td>
</tr>
<tr>
<td>Being aware of local regulations</td>
<td>Refers to the knowledge and productiveness of local regulations affecting the project by the engineer. In this case the engineer knows which local regulations should be taken into account.</td>
</tr>
<tr>
<td>Experience / know-how</td>
<td>Refers to the overall experience and know-how of engineer’s employees learned in former projects which can be applied in following projects.</td>
</tr>
<tr>
<td>Competent own staff</td>
<td>Refers to support and useful engineer’s employees that contribute to the success of the project. This does not apply to the knowledge and / or experience but to use commitment and ability of applying the skills in such a way that this contributes to the success of the project (i.e. not only having the know-how but be able to apply this).</td>
</tr>
<tr>
<td>Enough information at an early stage</td>
<td>Refers to the amount of information that is available at the start of a project. The amount should be sufficient to successfully start and execute the project. This information can refers to subsoil information, traffic amount, anything that influences the project.</td>
</tr>
<tr>
<td>Using same and or international standards</td>
<td>Refers to the standards used in the project regarding to technical safety, health, environment, etcetera. Companies involved in the project use the same standards, which are most of the time international standards.</td>
</tr>
<tr>
<td>Tender document include all necessary information</td>
<td>Refers to information given in the tender document to find a contractor. The information should be sufficient for the contractor to make a realistic offer, and thus prevent strategic behavior. This is information that influence the execution and price of the project.</td>
</tr>
<tr>
<td>Working with indirect investors</td>
<td>Indirect investment refers to a separate investor (form the contractor or client). This ensures a fair relationship between client, investor, contractor, and engineer, taking into account all agreements made in advance.</td>
</tr>
<tr>
<td>Experience / understanding local culture</td>
<td>Refers to the knowledge about the local culture and understanding how this affect the project. Because this is expected and taken into account this will not negatively affect the outcome of the project.</td>
</tr>
<tr>
<td>No or limited data available</td>
<td>Refers to the amount of information that is available at the start of a project. In this case the amount of data is not sufficient to successfully execute the project or take into account for risk management</td>
</tr>
<tr>
<td>Client is not sure what he wants</td>
<td>Refers to the initiated project by the client. The demarcation, requirements and needs are not clear.</td>
</tr>
<tr>
<td>Slow decision making process</td>
<td>Refers to the rapidity of the decision making process on the client’s side.</td>
</tr>
<tr>
<td>Conflicting interest between client and financer (direct investment)</td>
<td>Refers to not having a separate investor for the project, but investor is linked to the contractor or client. This cause an unequal relationship between project parties, and engineer authority (in case of site supervision).</td>
</tr>
<tr>
<td>Poor communication with the client</td>
<td>Refers to how easy communication is, the quality, and the amount of communication between engineer and client.</td>
</tr>
<tr>
<td>Client does not have experience and money</td>
<td>Refers to the experience level and knowledge regarding to infrastructure projects, relating issues, and the available money.</td>
</tr>
<tr>
<td>Unpredictable / not knowing process of the local regulation</td>
<td>Refers to the knowledge and productiveness of local regulations affecting the project by the engineer. In this case the engineer has little knowledge about local regulations or cannot predict the process that should be taken into account.</td>
</tr>
<tr>
<td>No experience / understanding of the local culture</td>
<td>Refers to the knowledge about the local culture and understanding how this affect the project. In this case the engineer has little experience with the local culture.</td>
</tr>
<tr>
<td>Service and equipment not available</td>
<td>Refers to the availability of all kind of services (e.g. utilities) and equipment (e.g. concrete, machines) that are necessary in all phase of the project. In this case the service and equipment are unavailable at or near the project site.</td>
</tr>
<tr>
<td>Bad state / maintenance of the environment</td>
<td>Refers to status of the environment, like building and nature. The status of the environment in is poor and this should be taken into account during risk management.</td>
</tr>
<tr>
<td>Unclear if finance is in place</td>
<td>Refers to the trustfulness and knowledge if the client has enough money to execute and pay for the project.</td>
</tr>
<tr>
<td>Nobody wants to make decision</td>
<td>Refers to the fact that nobody likes to make decision, being afraid making the wrong decision and held responsible.</td>
</tr>
<tr>
<td>Engineer has no decision power</td>
<td>Engineer has not power to make decisions and can only strongly advise client and contractor.</td>
</tr>
<tr>
<td>Geographical barrier</td>
<td>There is a large distance between the important stakeholders, which creates a barrier regarding to the communication and relation between the parties.</td>
</tr>
<tr>
<td>Not clear / right allocation of risks – client contractor</td>
<td>The allocation of identified risks in the contract between client and contractor is not done clear or the right way, causing that there is no clear risk ownership or one parties bares risks he should not be baring.</td>
</tr>
<tr>
<td>Long time between project preparation and implementation</td>
<td>Time between project preparation and implementation is of such extent that the environment and context of the project is changed in such a way that the project may not fully fit for purpose.</td>
</tr>
<tr>
<td>Using different standards</td>
<td>Refers to the standards used in the project regarding to technical safety, health, environment, etcetera. Companies involved in the project use different standards, which cause ambiguity regarding to the right standards.</td>
</tr>
<tr>
<td>Incompetent local partner</td>
<td>Refers to the support and usefulness of a local company and or staff working in a partnership with or as sub-contractor for the engineer. In this case the local support is not of any help.</td>
</tr>
<tr>
<td>Too many assumptions</td>
<td>Too many assumptions have to be made, which negatively affect the quality of the company.</td>
</tr>
</tbody>
</table>
APPENDIX D: RESULTS QUALITATIVE CONTENT ANALYSIS

As explained in Appendix C, codes are used per main and sub category to analyze the data from the interviews. Per main category, each code has a corresponding color, to get a better overview of the data. The codes per main category risk management process are shown in Table 9, organizational risk management awareness is shown in Table 10, and Table 11 shows the codes for the risk management influencing factors.
Table 9: Content analysis risk management process

Table 10: Content analysis organizational risks management awareness

Table 11: Content analysis risk management influencing factors
APPENDIX E: RISK MANAGEMENT METHODS

This visualizes four risk management methods: RISMAN in Figure 9, ATOM in Figure 10, PMI in Figure 11, and ISO31000 in Figure 12.

Figure 9 Risk management by RISMAN method (Well-Stam et al., 2003):
Figure 10: ATOM risk management process (Hillson & Simon, 2007)
Figure 11: Project risk management overview (PMI, 2008)
Figure 12: Risk management principles, framework, and process (ISO, 2009)
**APPENDIX F: TOOLS & TECHNIQUES**

The table below lists the most important tools and techniques that can be used in each step of the risk management process.

*Table 12: Techniques and tools per step of the risk management process*

<table>
<thead>
<tr>
<th>Step</th>
<th>Tool / Technique</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information gathering</td>
<td>Brainstorming</td>
<td>During a brainstorm a comprehensive list of risk can be obtained. A brainstorm group consist of a variety group of experts who are part and outsiders of the project team. Different tools can be used, such as categories of risk, and risk breakdown structure (Hillson, 2003; Nicholas &amp; Steyn, 2012; PMI, 2008).</td>
</tr>
<tr>
<td></td>
<td>Delphi technique</td>
<td>This technique aims to reach consensus of experts relating to risk for a specific project. (Nicholas &amp; Steyn, 2012; PMI, 2008).</td>
</tr>
<tr>
<td></td>
<td>Interviewing</td>
<td>This includes interviewing experienced project participants, stakeholders, or subject related experts with the aim to identify risks (PMI, 2008; Hillson, 2003)</td>
</tr>
<tr>
<td></td>
<td>Checklist analysis</td>
<td>A checklist is developed based on historical information and knowledge gathered during previous projects. The checklist can be helpful to quickly and simple identify risks. One should be aware that a checklist is never complete. The checklist should, for that reason, always be reviewed after each project or available new information (PMI, 2008; Nicholas &amp; Steyn, 2012; Hillson, 2003)</td>
</tr>
<tr>
<td>Assumption analysis</td>
<td></td>
<td>Projects are based on assumptions, hypotheses, and scenarios. The validity of all should be explored, which will results is possible risks relating to inaccuracy, inconsistency, or incompleteness (PMI, 2008; Hillson, 2003).</td>
</tr>
<tr>
<td>Diagramming techniques</td>
<td>Cause and effect diagram</td>
<td>This tool is also known as the fishbone diagram, is frequently used during brainstorms with the aim to find the casus of a risk. Useful to identify causes of risks (Nicholas &amp; Steyn, 2012; PMI, 2008).</td>
</tr>
<tr>
<td></td>
<td>System or process flow-chart</td>
<td>Gives insight in elements of a system interrelate (Nicholas &amp; Steyn, 2012; PMI, 2008).</td>
</tr>
<tr>
<td></td>
<td>Influence diagram</td>
<td>A graphical representation of a situation. Causal influence, time ordering and relationship can be identified (Nicholas &amp; Steyn, 2012; PMI, 2008).</td>
</tr>
<tr>
<td>SWOT analysis</td>
<td></td>
<td>Examines the strength, weaknesses, opportunities, and threats. Not only is this a good way to identify internal and external risks (positive or negative), but it gives also the opportunity to see how to overcome or enhance the risks (PMI, 2008; Hillson, 2003).</td>
</tr>
<tr>
<td>Expert judgement</td>
<td></td>
<td>Experts can give their vision relating to risks (PMI, 2008; Nicholas &amp; Steyn, 2012).</td>
</tr>
<tr>
<td>Risk categorization</td>
<td>Risk can be categorized based on the source of the risk, using a risk breakdown structure (RBS), the affected area, using a work breakdown structure (WBS), or other categories (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Risk analysis</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Risk responsibilities and impact assessment</td>
<td>Investigation of the likelihood and impact or each risk in a qualitative way. Can be done during interviews or meetings (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Probability and impact matrix</td>
<td>The probability and impact assessment can be used as input for a probability and impact matrix. The matrix offers an overview in the classification of risks, to be able to quickly respond. This matrix can be developed for a specific objects or for the overall objective or the project (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Risk data quality assessment</td>
<td>Performing qualitative risk analysis, data should be accurate and unbiased, which should be assessed. Only if the data is acceptable, it can be used for qualitative risk analysis (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Risk urgency assessment</td>
<td>Some risk may be more urgent than others, because of the risk might occur sooner than others. In that case, symptoms, responses, and warning signs should be in place for that risk (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Expert judgement</td>
<td>During qualitative risks analysis experts can give their opinion on the qualitative probability an impact of risks (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Investigation of the likelihood and impact or each risk in a qualitative way</td>
<td>Investigation of the likelihood and impact or each risk in a qualitative way. Can be done during interviews or meetings (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Probability and impact matrix</td>
<td>The probability and impact assessment can be used as input for a probability and impact matrix. The matrix offers an overview in the classification of risks, to be able to quickly respond. This matrix can be developed for a specific objects or for the overall objective or the project (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Risk data quality assessment</td>
<td>Performing qualitative risk analysis, data should be accurate and unbiased, which should be assessed. Only if the data is acceptable, it can be used for qualitative risk analysis (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Risk urgency assessment</td>
<td>Some risk may be more urgent than others, because of the risk might occur sooner than others. In that case, symptoms, responses, and warning signs should be in place for that risk (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Expert judgement</td>
<td>During qualitative risks analysis experts can give their opinion on the qualitative probability an impact of risks (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Data gathering and representation</td>
<td>Interviewing To quantify the probability and impact of certain risks, interviews can extract experience and historical data.</td>
<td></td>
</tr>
<tr>
<td>Probability distribution</td>
<td>Using this technique a probability distribution is assigned to specific risks to look for the impact of a specific parameter. The result is a frequency distribution of the expected outcome, which is based on several distributions. This technique requires sufficient information to support a truthful distribution (PMI, 2008; Nicholas &amp; Steyn, 2012; Smith et al., 2006).</td>
<td></td>
</tr>
<tr>
<td>Sensitivity analysis</td>
<td>This techniques helps to see which risk have the most potential impact. Each element is assessed separately while freezing the other elements. Critical areas of the project can be found (PMI, 2008; Hillson, 2003; Smith et al., 2006).</td>
<td></td>
</tr>
<tr>
<td>Expected monetary value (EMV)</td>
<td>This is a statistical concept that tries to calculate the average outcome depending on different scenarios. An EMV can be made for the opportunities, as well as for the threats. An overall EMV for a project is calculated by multiplying the value and each outcome with the probability. Decision three analysis is a common form of EMV (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Modelling simulation (Monte Carlo technique)</td>
<td>A model is made that included all uncertainties with the associated probability and impact on the objectives (PMI, 2008). Monte Carlo Technique: Most computer programs use this technique. The data is developed by a random number generator from probability distribution, because there is no predictable pattern. Each value should correspondent with probability of occurrence. To use this technique, this should be known (Hillson, 2008).</td>
<td></td>
</tr>
<tr>
<td>Risk assessment</td>
<td>Risk should be reassessed to identify new risks, closing risk that are outdated, and analysis of the current risks (qualitative, quantitative, risk response). This should regularly be done (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Risk audits</td>
<td>This includes examine and document the effectiveness of risk responses and risk management process. Should be done frequently (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Variance and trend analysis</td>
<td>Planned results are compared with actual results (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Technical performance measurement</td>
<td>Comparison of the technical accomplishments during project execution with the project management plan. Technical performance measures should be available. It can include weight, transaction times, number of delivered defects, storage capacity and so on. The measurement can help to forecast the success and the degree of technical risks faced by the project (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Reserve analysis</td>
<td>During the project, risk can occur that influence the contingency reserves (schedule and costs). The remaining contingency reserves is compared with to the amount of risk remaining at a certain time to determine if the remaining contingency reserve is adequate (PMI, 2008).</td>
<td></td>
</tr>
<tr>
<td>Status meeting</td>
<td>Project risk management should be part of periodic status meetings, because frequent discussion about risks makes it more likely that risk (threats and opportunities will be identified. This becomes easier as it is frequently applied (PMI, 2008).</td>
<td></td>
</tr>
</tbody>
</table>
**APPENDIX G: RISK MATURITY MODEL**

Table 13: Risk maturity model (Hillson, 2004)

<table>
<thead>
<tr>
<th>Definition</th>
<th>Level 1 - Naive</th>
<th>Level 2 - Novice</th>
<th>Level 3 – Normalized</th>
<th>Level 4 – Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unaware for he need for management of risk</td>
<td>Experiment with risk management, through a small number of individuals</td>
<td>Management of risk built into routine business processes</td>
<td>Risk-ware culture, with proactive approach to risk management</td>
<td></td>
</tr>
<tr>
<td>No structured approach to dealing with uncertainty</td>
<td>No generic structured approach in place</td>
<td>Risk management implemented on most or all projects</td>
<td>Active use of risk information to improve business processes and gain competitive advantages</td>
<td></td>
</tr>
<tr>
<td>Repetitive and reactive management processes</td>
<td>Aware of potential benefits of managing risk, but ineffective implementation, not gaining full benefits</td>
<td>Formalized generic risk processes</td>
<td>Emphasis on opportunity management (“positive risk”)</td>
<td></td>
</tr>
<tr>
<td>Little or no attempt to learn from past or to prepare for future</td>
<td>Repetitive and reactive management processes</td>
<td>Benefits understood at all levels of the organization, although not always consistently achieved</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Culture</th>
<th>Level 1 - Naive</th>
<th>Level 2 - Novice</th>
<th>Level 3 – Normalized</th>
<th>Level 4 – Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>No risk awareness</td>
<td>Risk process may be viewed as additional overhead with variable benefits</td>
<td>Accepted policy for risk management</td>
<td>Top-down commitment to risk management, with leadership by example</td>
<td></td>
</tr>
<tr>
<td>Resistant/reluctant to change</td>
<td>Risk management used only on selected projects</td>
<td>Benefits recognized and expected</td>
<td>Proactive risk management encouraged and rewarded</td>
<td></td>
</tr>
<tr>
<td>Tendency to continue with existing processes</td>
<td></td>
<td>Prepared to commit resources to reap gains</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process</th>
<th>Level 1 - Naive</th>
<th>Level 2 - Novice</th>
<th>Level 3 – Normalized</th>
<th>Level 4 – Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal process</td>
<td>No generic formal processes although some specific formal methods may be in use</td>
<td>Generic processes applied to most projects</td>
<td>Risk-based business processes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Process effectiveness depends heavily on the skills of the in-house risk team and availability of external support</td>
<td>Formal processes, incorporated into quality system</td>
<td>“Total Risk Management” permeating entire business</td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td>No understand of risk principles or language</td>
<td>Limited to individuals who may have had little or no formal training</td>
<td>In-house core of expertise, formally trained in basic skills</td>
<td>All staff risk-aware and using basic skills</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Development of specific processes and tools</td>
<td>Learning from experience as part of the process</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Regular external training to enhance skills</td>
</tr>
<tr>
<td>Application</td>
<td>No structure application</td>
<td>Inconsistent application</td>
<td>Routine and consistent application to all projects</td>
<td>Second-nature, applied to all activities</td>
</tr>
<tr>
<td></td>
<td>No dedicated resources</td>
<td>Variable availability of staff</td>
<td>Committed resources</td>
<td>Risk-based reporting and decision-making</td>
</tr>
<tr>
<td></td>
<td>No risk tools</td>
<td>Ad hoc collection of tools and methods</td>
<td>Integrated set of tools and methods</td>
<td>State-of-the-art tools and methods</td>
</tr>
</tbody>
</table>

Active allocation and management of risk budgets at all levels
Limitation need for external support

Regular refreshing and updating of processes
Routine risk metrics with constant feedback for improvement
**APPENDIX H: VALIDATION**

The results of the interviews are validated using expert judgment. Two experts of African infrastructure projects are asked to review the results. One of the experts is mainly involved as project manager in large African projects. The other expert is mainly involved in the management of the international project department.

The initial results are translated into clear statements to structure the validation process. The validation protocol is shown in Table 14.

*Table 14: Validation protocol*

<table>
<thead>
<tr>
<th>Validation protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name:</strong></td>
</tr>
<tr>
<td><strong>Date:</strong></td>
</tr>
<tr>
<td><strong>Risk management process</strong></td>
</tr>
<tr>
<td>Brainstorms / informal discussions are used to identify risks</td>
</tr>
<tr>
<td>Experience is the most important source to identify risks</td>
</tr>
<tr>
<td>Sometimes more formal techniques are used (probability analysis)</td>
</tr>
<tr>
<td>Risk management is started in the project preparation (not one typical moment)</td>
</tr>
<tr>
<td>Continued for process or project meetings (only most important issues for that moment are taken into account)</td>
</tr>
<tr>
<td>Engineer has limited action available and can only recommend or make the client (and financing institute) aware.</td>
</tr>
<tr>
<td>Everything, especially assumptions, should be put into writing as evidence</td>
</tr>
<tr>
<td>Consultant engineer should take into account that payment can be an issue</td>
</tr>
<tr>
<td>Brainstorms / informal discussions are used to identify risks</td>
</tr>
<tr>
<td><strong>Organizational risk management awareness</strong></td>
</tr>
<tr>
<td>Effective risk management has a positive effect on project success</td>
</tr>
<tr>
<td>It is the duty of the engineer to perform risk management</td>
</tr>
<tr>
<td>Risk management is only mandatory if the client ask for it</td>
</tr>
<tr>
<td>Formal procedures related to risk management are a lot of extra work and does not create an added value</td>
</tr>
<tr>
<td>Information and experiences is spread freely among the employees</td>
</tr>
<tr>
<td>Experience from one project cannot always be used for other projects, each project is different</td>
</tr>
<tr>
<td>There are no risk management tools or methods used (e.g. checklists, risk register)</td>
</tr>
<tr>
<td><strong>Enabling factors for improved risk management</strong></td>
</tr>
<tr>
<td>Knowing the local culture and the difference with organizational culture helps to perform risk management effectively and has a positive effect on project outcome</td>
</tr>
<tr>
<td>General success factor for all international projects</td>
</tr>
<tr>
<td>If all project stakeholders use the same standards (technical, safety, health, and environment) everyone has the same perspective on risk and risk management, which makes it more effective.</td>
</tr>
<tr>
<td>General success factor for all international projects</td>
</tr>
<tr>
<td>Having experience / know-how with many African infrastructure projects helps to effectively perform risk management (knowing what might come up, challenges)</td>
</tr>
<tr>
<td>General success factor for all projects</td>
</tr>
<tr>
<td>Cooperation with a competent local partner helps to effectively perform risk management, because they have specific knowledge about, inter alia, local regulation and culture.</td>
</tr>
<tr>
<td>General success factor for all international projects</td>
</tr>
<tr>
<td>For effective risk management a good relation with the client is essential. Knowing their perspective and wishes is essential, as well as their cooperation.</td>
</tr>
<tr>
<td>General success factor for all projects</td>
</tr>
<tr>
<td>Risk enlargement factors</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>The bad state / maintenance of the environment of African infrastructure projects should be taken into account for effective risk management</td>
</tr>
<tr>
<td>o Typical for infrastructure projects in Africa</td>
</tr>
<tr>
<td>For effective risk management one should take into account that services and equipment necessary for the project might not be available</td>
</tr>
<tr>
<td>o Typical for infrastructure projects in Africa</td>
</tr>
<tr>
<td>Local regulations are often not transparent (unpredictable) or not known which makes it difficult to perform effective risk management</td>
</tr>
<tr>
<td>o Typical for infrastructure projects in Africa</td>
</tr>
<tr>
<td>Clients often do not have a lot experience with infrastructure projects, nor do they have the money. Effective risk management is therefore difficult because enforcement (by the client) is difficult.</td>
</tr>
<tr>
<td>o Typical for infrastructure projects in Africa</td>
</tr>
<tr>
<td>Non transparent, lack of communication with the client makes effective risk management difficult (identify risk, enforce risk measures).</td>
</tr>
<tr>
<td>o Typical for infrastructure projects in Africa</td>
</tr>
<tr>
<td>Direct investment (conflicting interest between financer and client) makes it difficult to perform risk management effectively, because client might not listen, does not show interest (enforcement of risk measures).</td>
</tr>
<tr>
<td>o Typical for infrastructure projects in Africa</td>
</tr>
<tr>
<td>A slow decision-making process does have a negative effect on the effective risk management (enforcement of risk measures).</td>
</tr>
<tr>
<td>o Typical for infrastructure projects in Africa</td>
</tr>
<tr>
<td>The client is often not sure what he wants (lack of demarcation and requirements), which makes it difficult to identify specific risks beforehand (based on the requirements).</td>
</tr>
<tr>
<td>o Typical for infrastructure projects in Africa</td>
</tr>
<tr>
<td>A lack of data or information makes it difficult to effectively identify and assess risks, thus effective risk management is difficult.</td>
</tr>
<tr>
<td>o Typical for infrastructure projects in Africa</td>
</tr>
</tbody>
</table>