

## **Risk Management Planning in a Construction Project**

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**Abstract** – This paper presents an example of a risk management plan for a construction project to be developed in difficult environmental conditions. This Risk Management Plan defines how risks associated with the construction project in a desert zone will be identified, analyzed, and managed. It outlines how risk management activities will be performed, recorded, and monitored throughout the lifecycle of the project and provides templates and practices for recording and prioritizing risks by the Risk Manager. Based on our studies, risk management is an essential part of construction project management and should be always applied using appropriate tools.

**Keywords:** Risk Management, Construction, Plan

### I. INTRODUCTION

This paper is based on a real construction project which was implemented in very difficult conditions being in a desert zone from Africa. Every construction project must have a specific Risk Management Plan and a Risk Manager.

The Risk Manager working with the project team ensures that risks are actively identified, analyzed, and managed throughout the life of the project. Risks shall be identified as early as possible in the project to minimize their impact. The steps for accomplishing this are outlined in the following sections.

The risk management process is presented as a list of coordinated activities [3]:

- “Recognition or identification of risks;
- Ranking or evaluation of risks;
- Responding to significant risks;
- Tolerate and treat;
- Transfer;
- Terminate;
- Resourcing controls;
- Reaction planning;
- Reporting and monitoring risk performance;
- Reviewing the risk management framework”.

ISO 31000 gives a list in order of preference on how to deal with risk:

- a) Avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk;
- b) Accepting or increasing the risk in order to pursue an opportunity;
- c) Removing the risk source;
- d) Changing the likelihood;
- e) Changing the consequences;
- f) Sharing the risk with another party or parties (including contracts and risk financing);
- g) Retaining the risk by informed decision.

There are alternative descriptions of this process, but the components listed above are usually present.

### II. MANAGING RISK IN THE PROJECT

“Risk management requires a reporting and review structure to ensure that risks are effectively identified and assessed, and that appropriate controls and responses are in place” [4].

In order to improve risk management process there will be carried out frequent verifications of specific standard and rules compliance.

Potential changes on the construction site or in the environment must be observed and appropriate changes must be implemented. The monitoring process should prove that the procedures are understood and obeyed.

Any monitoring and review process should also determine whether:

- Measures adopted achieved the intended result;
- Procedures adopted were efficient;
- Enough information was available for the risk assessments;
- Improved knowledge would have helped to reach better decisions;
- Lessons can be learned for future assessments and controls.

According to the standard *ISO 31000 Risk management – Principles and guidelines on implementation* the

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following steps of the risk management process throughout the project gave to be followed. The Risk

Manager uses the following relevant questions to follow the steps presented in Fig. 1.

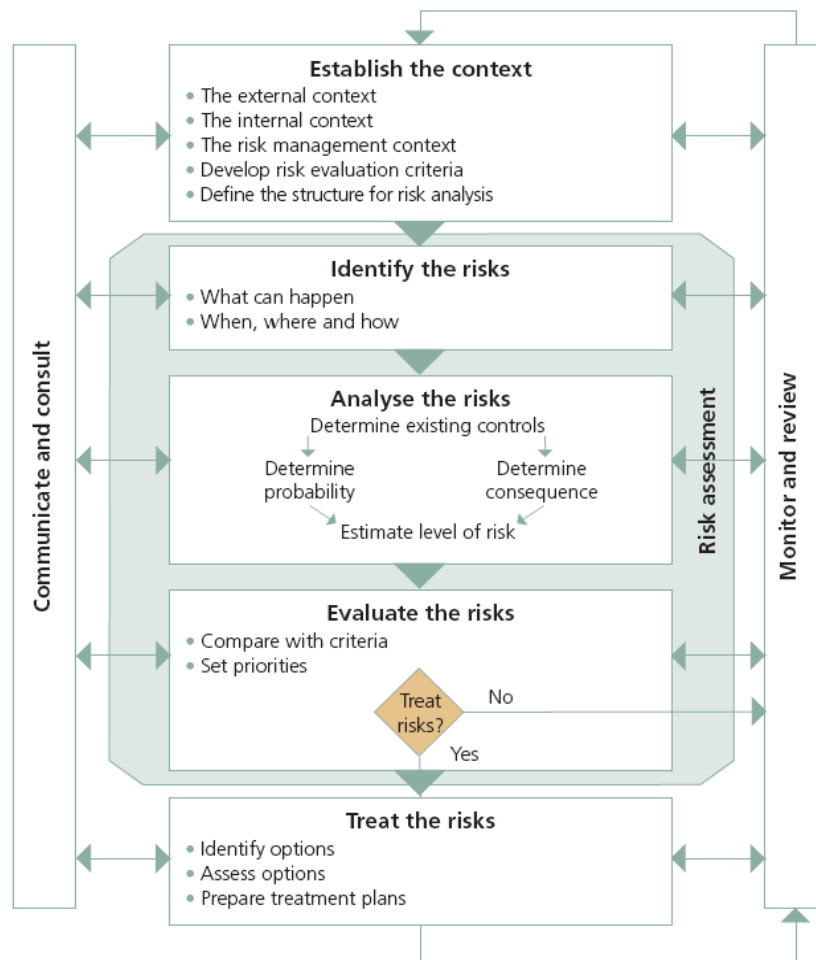


Figure 1. Summary of risk management steps [6]

Table 1 – Specific Risk Management Questions (own contribution)

Risk management process step	Management question
Establish the context	What are we trying to achieve?
Identify the risks	What might happen?
Analyse the risks	What might that mean for the project's key criteria?
Evaluate the risks	What are the most important things?
Treat the risks	What are we going to do about them?
Monitor and review	How do we keep them under control?
Communicate and consult	Who should be involved in the process?

In order to obtain relevant results, the Risk Manager must cooperate with all the key members of the team, permanently.

### III. REPORTING

The Risk Manager will track, monitor and control and report the status and effectiveness of each risk response action to the Project Team.

A "Top 10 Risk List" must be maintained by the Risk Manager and must be reported as a component of the project status reporting process for this project.

All project change requests must be constantly analyzed for their possible impact to the project risks. As risk events occur, the list will be permanently re-prioritized and risk management plan will reflect any and all changes to the risk lists including secondary and residual risks.

Major reviews of the project's risk management framework will be performed every two weeks, and might include, if necessary, evaluation of the risk architecture, strategy and protocols.

In addition to internal communication and reporting, the Risk Manager shall report externally to the Beneficiary, through agreed channels, including to Beneficiary's representatives on site. These external reports are produced in response to mandatory

requirements or international best practices related to risk management and internal control. External risk reporting is assurance that risks have been adequately managed.

External reporting provides useful information to stakeholders on the status of risk management and the actions that are being taken to ensure continuous improvement in performance. [7] The Risk Manager reports to the Beneficiary and other agreed stakeholders on a regular basis, setting out its risk management policies and the effectiveness in achieving its objectives within the project framework. Therefore, the Risk Manager shall:

- Review, reevaluate, and modify the probability and impact for each risk item every two weeks;
- Analyze any new risks that are identified and add these items to the risk list (or risk database);
- Monitor and control risks that have been identified;
- Review and update the top ten risk list as needed, every two weeks;
- Help develop the risk response and risk trigger and carry out the execution of the risk response, if a risk event occurs (all the members of the project team will be involved in identifying adequate solutions);
- Participate in the review, re-evaluation, and modification of the probability and impact for each risk item on a weekly basis;
- Identify and participate in the analysis of any new risks that occur;
- Escalate problems to Beneficiary that:
  - Significantly impact the projects triple constraint or trigger another risk event to occur;
  - Require action prior to the next weekly review;
  - Risk strategy is not effective or productive causing the need to execute the contingency plan. [1], [5].

It is highly important that the Risk Manager must monitor the dynamics of the risks and must report to the superiors or directly to the Beneficiary when urgent decisions are required related to the risk treatment.

#### IV. RISK MANAGEMENT PLAN

The risk assessments are recorded in the following risk register. The risk register is designed to be a dynamic

record of the significant risks faced by the project and will be permanently updated. It should be viewed as a risk action plan that includes details of the current controls and details of any further actions that are planned.

These further actions should be written as auditable actions that must be completed within a defined timescale by identified individuals. This will enable the internal audit function to monitor the existing controls and monitor the implementation of any necessary additional controls. The resources required to implement the risk management policy will be clearly established at each level of management and within each business unit involved in the project. Risk management is embedded within the operational planning and budget processes for the project.

In order to update the risk assessment at regular intervals, major reviews shall take place every two weeks.

After each major review, the Risk Manager shall provide the Beneficiary a Full Risk Report with the following generic structure:

- Executive summary;
- Scope and objectives of report;
- Project status summary;
- Overall risk status;
- Top risks and actions;
- Detailed risk assessment;
- Conclusions and recommendations;
- Appendices:
  - Updated Risk Register;
  - Prioritized Risk List, and other documents as required.

The Beneficiary shall express his opinion on the risk information but must make important decision after discussing with the specialists involved in the construction project.

#### V. RISK REGISTER

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Table 2 Risk Register own contribution inspired by [2]

Element	Risk	Existing controls	C	L	Agreed priority	Action sheet
Location Risks	<p><b>Cause:</b> Severe weather conditions that could jeopardize the construction works (dust storms, torrential rain with or without flooding)</p> <p><b>Impact:</b> Failure in meeting the undertaken deadlines for completing the execution works.</p>	The key deadlines will be accurately established considering the float for each activity.	5	3	(15)	<p><b>Mitigation:</b> The impact of the delays will be mitigated. The critical path will be redefined. The Gantt chart will be rescheduled when needed in order to meet the undertaken deadlines.</p>
Location Risks	<p><b>Cause:</b> Archaeological discoveries</p> <p><b>Impact:</b> Halting execution for an indefinite period depending on the nature of the discoveries.</p>	Although the area has no identified historical or archaeological resources, the Project Manager is carefully following the Beneficiary's policy that there should be continued recognition of potential for discovery of such resources.	5	1	(5)	<p><b>Retention</b> In case of discovery of any historic, prehistoric, archaeological, cultural, or paleontological residue or evidence during site investigation or construction, work shall cease immediately, and the Project Manager will immediately inform the Beneficiary; the site shall not be further disturbed until authorized in writing by the Beneficiary.</p>
Location Risks	<p><b>Cause:</b> Terrorist attacks. (kidnapping, destruction of parts of the construction, destruction of the site, block / destruction / seizure of construction materials or vehicles on access roads to and from the objective, personal injury or homicide)</p> <p><b>Impact:</b> Failure/ delay in continuing the construction works.</p>	<p>The cooperation with the military authorities that provide security in the perimeter in which the construction site is located.</p> <p>The cooperation with the regional military authorities for movements in the area, including transport.</p>	5	2	(10)	<p><b>Prevention:</b> Establishment of cooperation with the military authorities that provide security in the perimeter in which the construction site is located. Establishment of cooperation with the regional military authorities for movements in the area, including transport.</p>
Contractual Risks	<p><b>Cause:</b> Purchase of materials, equipment and facilities that do not comply with the beneficiary's requirements</p> <p><b>Impact:</b> Delays in execution works.</p>	Validated datasheets for the products. Validation process for suppliers.	3	1	(3)	<p><b>Prevention:</b> Before signing the contracts with the suppliers, all datasheets for the products will be presented to the Project Manager and beneficiary for validation.</p>

Contractual Risks	<p><b>Cause:</b> Failure in meeting the planned deadlines for the execution phases.</p> <p><b>Impact:</b> Delays in the general execution graphic and therefore, postponing the completion term for the project.</p>	Contractual terms of enterprise monitoring and penalty for failure in following the execution graphic. (excepting the force majeure)	4	2	(8)	<p><b>Prevention:</b> Ensuring contractual terms of enterprise monitoring and penalty for failure in following the execution graphic. (excepting the force majeure)</p>
Contractual Risks	<p><b>Cause:</b> Defects in equipment used.</p> <p><b>Impact:</b> Delays in execution works.</p>	Cooperation with other suppliers to conclude contracts with them when needed.	3	3	(9)	<p><b>Prevention:</b> Cooperation with other suppliers to conclude contracts with them when needed.</p>
Contractual Risks	<p><b>Cause:</b> Failure to comply with contractual obligations by local suppliers.</p> <p><b>Impact:</b> Jeopardize the construction works. Occurrence of delays and additional expenses.</p>	Cooperation with other suppliers to conclude contracts with them when needed.	3	3	(9)	<p><b>Prevention:</b> Cooperation with other suppliers to conclude contracts with them when needed.</p>
Contractual Risks	<p><b>Cause:</b> The Beneficiary withdraw from the project or introduction of important changes / new elements in the project.</p> <p><b>Impact:</b> Delay in project. Project Management Team forced to commit more resources. Financial loss for the management company</p>	Contractual terms – including Notification of changes apply	5	2	(10)	<p><b>Prevention:</b> Ensuring compliance with contractual terms to avoid this kind of situations.</p> <p><b>Mitigation:</b> Permanent contact with the Beneficiary will be maintained. Following such a notice from either party, a cost breakdown of the additional costs to be incurred by the Constructor if he would implement the change/deviation and the related impacts on the terms and conditions.</p>
Economic Risks	<p><b>Cause:</b> Boost of prices for gas and other materials.</p> <p><b>Impact:</b> Financial loss.</p>	Reserves in the budget for expenses classified as contingencies.	3	3	(9)	<p><b>Prevention:</b> Establishment of reserves in the budget for expenses classified as contingencies.</p>
Communication Risks	<p><b>Cause:</b> Poor communication between Project Manager's team members.</p> <p><b>Impact:</b> Dissemination of distorted information or lack of necessary information in the execution works.</p>	Multiple communication means available on site	1	1	(1)	<p><b>Prevention:</b> Permanent information of the personnel regarding the technical and administrative issues and decisions</p>

Construction Risks	<p><b>Cause:</b> Not following the general principles of design.</p> <p><b>Impact:</b> Design and execution errors; delays in ensuring the working area</p>	Financial and technical evaluation of the project. Contractual penalties for the persons responsible with following and verifying the execution works, who do not inform the project team about occurrence of design and execution errors.	4	2	(8)	<p><b>Prevention:</b> Necessary resources will be assigned. The Technical Project (Basic Design) will be closely followed. The project will be evaluated. There will be included contractual penalties for the persons responsible with following and verifying the execution works, who do not inform the project team about occurrence of design and execution errors.</p>
Construction Risks	<p><b>Cause:</b> Cadastral boundaries overlap, resulting in wrong location, probability of enclosure and penetration of neighboring properties.</p> <p><b>Impact:</b> Additional administrative costs. Additional costs caused by paying the neighboring land occupied.</p>	Accurate establishment of the ownership limits.	5	1	(5)	<p><b>Prevention:</b> Checking ownership limits before starting work.</p>
Construction Risks	<p><b>Cause:</b> Suspension of the execution work by the public authorities.</p> <p><b>Impact:</b> Delays in the execution graphic. Financial loss.</p>	Necessary permits following the local conditions and regulations	1	2	(2)	<p><b>Prevention:</b> Obtaining all the necessary permits following the local conditions and regulations.</p>
Politic / Security Risks	<p><b>Cause:</b> Occurrence of substantial changes in the constitutional order, political regime, economic, security, social movement in the host country</p> <p><b>Impact:</b> Project delays. Financial loss.</p>	-	4	3	(12)	Retention
Personnel Risks	<p><b>Cause:</b> Impossibility of locally contracted employees to work within project framework and imposed standards.</p> <p><b>Impact:</b> Delays in execution.</p>	Cooperation on contractual bases with specialized local recruitment agencies and other contacts.	3	3	(9)	<p><b>Mitigation:</b> Extend cooperation with other recruitment agencies to find appropriate human / working resources. Extend recruitment regionally.</p>

Personnel Risks	<p><b>Cause:</b> The impossibility of the Project Management Team personnel to work.</p> <p><b>Impact:</b> Delays in execution.</p>	Contingency planning already in place to change any person in the Project Management team structure for the project	2	2	(4)	<p><b>Mitigation:</b> Apply contingency planning. Bring the assigned persons with the equivalent qualifications and competence. Repatriate the persons who cannot work. Complete the project team with new members.</p>
Personnel Risks	<p><b>Cause:</b> Work accidents. Possibility assessed due to differences in working culture and procedures, also differences in working experience.</p> <p><b>Impact:</b> Delays in execution works.</p>	Contractual terms of enterprise monitoring and penalty for failure in following the health and security conditions at work. The contracts will include the obligation to ensure conditions of safety and security at work in according to the current legislation.	4	3	(12)	<p><b>Prevention:</b> Ensuring contractual terms of enterprise monitoring and penalty for failure in following the health and security conditions at work. The contracts will include the obligation to ensure conditions of safety and security at work in according to the current legislation. Permanent instructions and trainings will be performed on site to avoid such problems. Cooperation and communication with the closest medical facility to evacuate wounded persons. On-site trained personnel in medical first aid.</p>

Risk Register columns and their content description are presented below:

- Element - A risk category;
- Risk - A brief description of the risk, its causes and its impacts;
- Existing controls - A brief description of the controls that are currently in place for the risk. At an early stage in the life of a project, the controls may be those that are expected to be in place if normal project management processes are followed;
- C - The consequence rating for the risk, with the controls in place, using scales;
- L - The likelihood rating of the risk, using scales like;
- Agreed priority - The agreed priority for the risk, based on an initial priority determined from a matrix, adjusted to reflect the views of the project team in the risk assessment workshop;
- Action sheet - A cross-reference to the action summary for the risk.

The following risk matrix has been used as the basis for the scoring of risks. After identifying the risks and scoring their likelihood and consequences, the Risk Manager must propose multiple ways of treating them to the Project Team and the Team must approve some solutions to risk treatment.

## VI. RISK TREATMENT

1. One high risk concerns severe weather conditions that could jeopardize the construction works. This risk cannot be avoided, and the mitigation process must minimize the consequence; the critical path will be redefined, the Gantt chart will be rescheduled.
2. A major risk is represented by work accidents. In order to prevent work accidents, contractual terms and permanent *on-site* instructions will be provided, as well as performs to ensure conditions of safety and security at work according to the current legislation and best practices. Permanent instructions and trainings will be performed on site to avoid such events. Cooperation, communication and a contingency planning with the closest medical facility to evacuate wounded persons. On-site trained personnel in medical first aid.
3. A risk that cannot be avoided or transferred (the costs of doing so being high) is the occurrence of substantial changes in the constitutional order, political regime, demographical movement in the host country. In these circumstances, the organization must retain the risks, permanently assess the risk factors adapting contingency planning to the current situational changes.

C O N S E Q U E N C E	LIKELIHOOD					
		RARE (1)	UNLIKELY (2)	POSSIBLE (3)	LIKELY (4)	ALMOST CERTAIN (5)
	INSIGNIFICANT (1)	LOW RISK (1)	LOW RISK (2)	LOW RISK (3)	LOW RISK (4)	MODERATE RISK (5)
	MINOR (2)	LOW RISK (2)	LOW RISK (3)	MODERATE RISK (6)	MODERATE RISK (8)	MODERATE RISK (10)
	MODERATE (3)	LOW RISK (3)	MODERATE RISK (6)	MODERATE RISK (9)	HIGH RISK (12)	HIGH RISK (15)
	MAJOR (4)	LOW RISK (4)	MODERATE RISK (8)	HIGH RISK (12)	EXTREME RISK (16)	EXTREME RISK (20)
CRITICAL (5)	MODERATE RISK (5)	MODERATE RISK (10)	HIGH RISK (15)	EXTREME RISK (20)	EXTREME RISK (25)	

Figure 2. Risk Scoring Matrix  
(Source: [https://healthandsafety.curtin.edu.au/emergency\\_management/risk-analysis-matrix.cfm](https://healthandsafety.curtin.edu.au/emergency_management/risk-analysis-matrix.cfm))

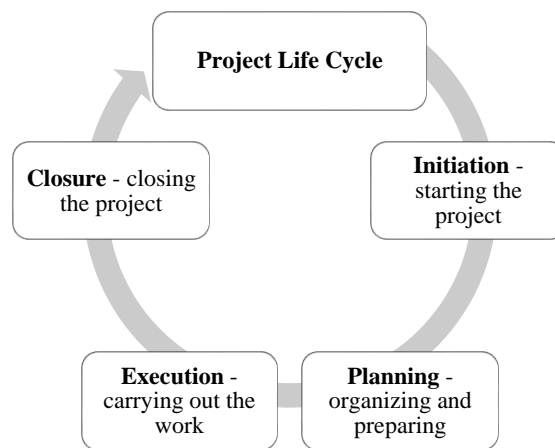


Figure 3. Project Life Cycle Definition  
(Source: <http://www.free-management-ebooks.com/faqpm/principles-08.htm>)

## VI. LINKS TO PROJECT PROCESSES

Risk Management is connected to all project processes. The risks of the projects will be monitored and controlled throughout the entire lifecycle of the project. Consequently, risks will be managed in the following processes:

- Project initiation;
- Project planning;
- Project execution;
- Project control and validation;
- Project closeout.

Risks can damage projects. They can also increase project costs. By having risk management plans established, the project management team will be prepared to deal with risks if they occur and attempt to mitigate the risks before they can damage the project.

The main techniques used in estimating the risks in this project were:

The main roles of the project that were taken into consideration in the initial process for analyzing the risks were:

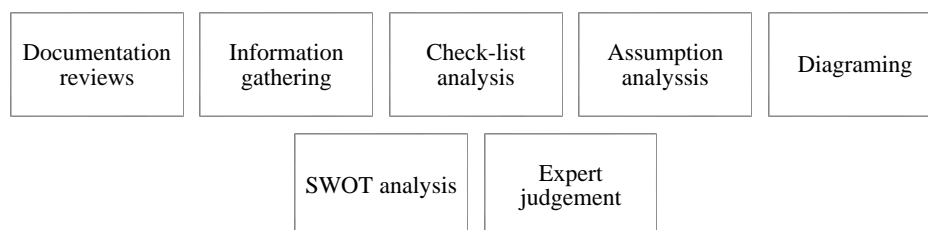


Figure 4 Methods used to identify project risks  
(Adapt from: <http://www.free-management-ebooks.com/faqpm/risk-03.htm>)



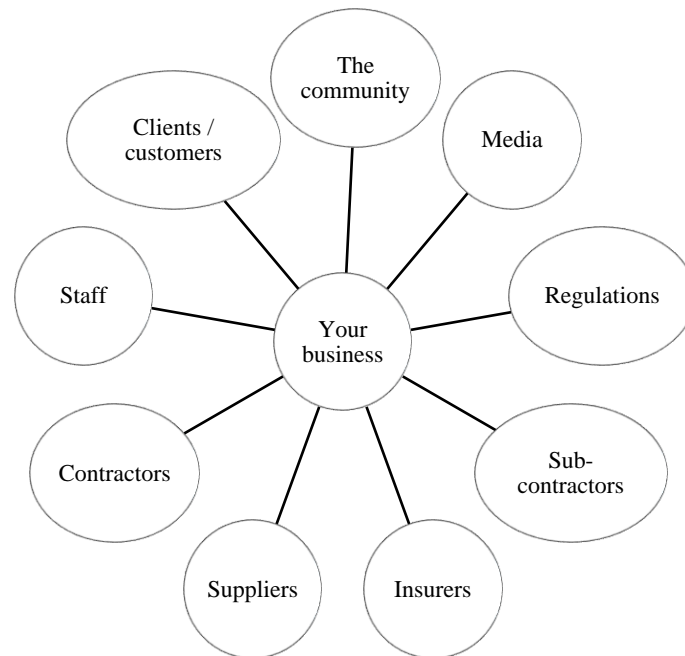


Figure 5. Entities involved in Risk Management [6]

Consequently, risk management involves working with all the stakeholders of the project in order to identify risks from all perspectives. Therefore, a Risk Manager must have a diplomatic attitude and perseverance to obtain all the information needed.

in our research. The views expressed are those of the authors and not necessarily those of the organizations they represent.

## VII CONCLUSIONS

The approach of risk management in construction investment projects has a very specific character. There are many entities involved in risk management for this type of projects. Risk management implies continuous monitoring and verifying risks on site. Risk Management as part of Project Management in construction projects is indispensable.

In order to implement successfully the project and to accomplish the projects' objectives, without loss of money and time, Risk Management is undoubtedly one of the key factors.

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