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**Risks and Risk Management of Addis Ababa Light Rail Transit System Project**

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**Abstract**

*Risk management of construction projects is increasingly felt critical to the success of projects in general and large projects in particular. Addis Ababa Light Rail Transit project is a large and complex project involving the construction of civil works and assembly of considerable electromechanical components. The project is undertaken through EPC Turnkey Contract. A research proposal was prepared to identify the risks that may thwart the success of this flagship Project of the city. Assessing the project risk management practice was also of prime concern.*

*In order to understand the theoretical background, the research embarked upon intensive literature survey. Archival records including contract documents, reports, and correspondences were investigated. Questionnaires were distributed to respondents from the Employer and the Employer's representative. To supplement the low population of respondents and to further refine the responses, interviews were carried out with selected professionals involved in the project.*

*The findings have shown that the project is exposed to the vagaries of various risks. These risks have the tendency of severely affecting one or more of the project objectives and even the wider public as well. Despite of this risk prevalence, the Employer has not instituted formal risk management system. The method of risk management is not structured and process oriented. The term risk itself is not also properly understood and the conventional practice of managing risks has wider departures from the internationally accepted practice.*

*Furthermore, the research has given evidence that the way risk identification, analysis and treatment methods are handled is unsatisfactory. From among the three steps of risk management, risk analysis is the least practiced. Risk treatments are addressed through contract provisions by way of insurance and bonds.*

*Although the contract document clearly allocates risks to both the Employer and the Contractor in acceptable manner, most respondents replied that the contractor carries most of the risks. This entails that most of the respondents have no detailed understanding of the contract clauses that specifically dwell on risk allocation.*

**Keywords: Risk management, risk identification, risk analysis, risk treatment, risk allocation**

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**List of Acronyms:**

AA: Addis Ababa

AACRA: Addis Ababa City Roads Authority

AAiT: Addis Ababa Institute of Technology

AAU: Addis Ababa University

AAWSA: Addis Ababa Water and Sewerage Authority

CM: Construction Management

CREC: China Railway Engineering Corporation

EEPCO: Ethiopian Electric and Power Corporation

EPC: Engineering Procurement and Construction

ERC: Ethiopian Railways Corporation

ETC: Ethiopian Telecommunications Corporation

EW: East West

EXIM: Export Import

FDRE: Federal Democratic Republic of Ethiopia

FIDIC: Fédération Internationale des Ingénieurs Conseils

GCC: General Conditions of Contract

GoE: Government of Ethiopia

ICT: Information Communication Technology

ISO: International Standards Organization

LRT: Light Rail Transit

NS: North South

PCC: Particular Conditions of Contract

PDT: Project Development Team

PMBOK: Project Management Body of Knowledge

PMI: Project Management Institute

RII: Relative Importance Index

SWOT: Strength Weakness Opportunity Threat

UN ECA: United Nations Economic Commissions for Africa

UNESCO: United Nations Educational, Scientific and Cultural Organization

## CHAPTER ONE: INTRODUCTION

### 1. General Introduction

Like any other project, construction projects are initiated, planned and implemented to yield some expected deliverables. Certainly, the deliverables of a construction project are some kind of physical structures like roads, buildings, dams, railway systems and the like. In order to have the envisaged physical structure at the end of the project time, navigating through a dynamic and complex operating environment is mandatory. It is natural that the implementation of construction projects is somehow influenced by the environment and the environment is in turn affected by the project. This interaction of construction projects with the environment led to naming them as “open-adaptive” systems in the sense that they affect, and are affected by internal and external environment [13].

Presently, a light rail transit system project is under implementation in Addis Ababa. The project is large and the first of its type Addis Ababa had in its history. The fact that the project is large and complex invokes some challenges in its lifecycle. A complex project situation, the presence and interaction of various interest groups, natural forces, soil and underground conditions, some clauses in the contract arrangement, project management structure and other related factors create an atmosphere of high uncertainty and risk.

Generally, the operating environment has risks within it. These risks may have the propensity to deviate project objectives. The risks may emanate from within the project or they may crop up from the external environment. For the success of the project, it is clear that these risks should be identified, diagnosed and managed. In short, the project should have a risk management system in place. It is evident that incorporating risk management systems to Addis Ababa Light Rail Transit (AA LRT) Project will greatly help in arresting success thwarting risks by either mitigating them effectively and/or possibly eliminating them. Generally, instituting risk management system to the project enhances performance, leads to more certainty in achieving project objectives and fetches more benefits from the operation of this large infrastructure.

## 1.1 Background

As commonly stated, transportation networks of a country are considered just like as the arteries and veins of the human body. A country with much developed transportation networks enjoys high quality of life and overall enhanced level of socio-economic development. However, developing countries have severely constrained transportation networks both in size and type. Ethiopia is one of the developing countries and its transport system reflects this situation in the limited size and quality of the transport network, resulting high transport costs and a low level of accessibility to services and markets [5].

Addis Ababa, the capital city of Ethiopia, the seat of the African Union and United Nations Economic Commission for Africa (UN ECA), a tourist destination and a leading diplomatic city is facing a number of problems in the transportation sector. Inefficiency, limited size and disorganization best exemplify the transportation shortcomings.

The rapid urbanization of the city coupled with the need for fast socio-economic development has posed numerous transport related challenges and issues that need to be addressed. The main issues to be addressed are related to transportation planning, traffic management, transport infrastructure operational management and financing schemes.

The major issues of the transportation system are summarized, but not limited to the following: insufficient transport service provisions, inadequate transportation planning, weak traffic management systems, high road traffic accidents, inadequate transport infrastructure, insignificant private capital investment in public transport, weak institutional capacity, etc. [27]

Effective mass transportation systems are in high demand for Addis Ababa. In conformity with this demand, the master plan of the city has identified the East-West and North-South corridors as important mass transport routes. At the same time, the corridors are also classified as main arterial roads. The function of the corridor is thus of providing high capacity public transport service for thorough traffic. In addition, since the corridor is being developed as business corridor, access to the various services with limited conflict of traffic is its unavoidable function.

At present, City Buses and Minibuses serve the transport demand along the corridor. Both modes share the same space in the corridor along with other traffic. At rush hours, the corridor is too congested and travel time is high. It is evident that the travel demand is not being satisfied with the existing system. If no action is taken, the problem is expected to worsen in the future with consequences of seriously affecting the socio-economic activities of the city.



Picture No.1 Minibuses



Picture No. 2 Anbesa City Bus

At a national level, it is the vision of Government of Ethiopia to promote connectivity across the nation with affordable, time saving and dependable transportation system. Railway infrastructure construction for both freight and mass transportation is underway. The AA LRT project is solely dedicated to urban mass transportation.

The implementing agency for these railway projects is Ethiopian Railways Corporation (ERC). The corporation is established by the Council of Ministers Regulation No. 141/2007 and is mandated to perform the following Core Businesses:

- i) To build railway infrastructure
- ii) To operate freight and passenger transport services; and
- iii) To engage in other Business activities necessary for its sustainable commercial operation.

Currently, there is no operational railway transportation system operating under the corporation. AA LRT project is expected to proceed to operation sooner than other intercity railway projects.

## 1.2 Addis Ababa Light Rail Transit (AA-LRT) Project Information

The AA LRT project is under construction and is executed through EPC/Turnkey Contractor named China Railway Group Limited, a subsidiary of China Railway Engineering Corporation (CREC). The Chinese company signed a contract with Ethiopian Railways Corporation (ERC) to execute the works in conformity with the contract for the sum of USD475, 000,000.00 (Four Hundred and Seventy Five Million United States of America Dollars only). The contract was signed on September 3, 2009 and commenced on January 1, 2012.

The original contract states that from the total contract price 85% amounting to USD 403, 750, 00.00 is secured from EXIM Bank of China through Preferential Buyer's Credit and 15% amounting to USD 71,250,000.00 as Employer's contribution in Ethiopian Birr as Down payment with exchange rate applicable to the base rate. The time for the completion of the works and its individual sections is 910 calendar days from the commencement date.

The Addis Ababa LRT covers the East-West and North-South transport corridors. The altitude of the plateau is 2,400m. With an urban population of over 3,400,000, it takes 24% of the total urban population of Ethiopia. The city extends over an area of 530.14 km<sup>2</sup>, and the density reached 5,607.96/km<sup>2</sup>. About 2.66 km is the shared section for both E-W and N-S route. During operation, this section will have the greatest passenger current.

The main line of the East-West line is nearly 17.02 km and while the main line of the N-S line is 16.90 km long. Route of the Project is set with the following technical parameters-

- double tracks
- track gauge: 1435mm
- maximum gradient 5.5%
- minimum curve radius: 50m
- maximum running speed of train: 70 km/hr and
- average traveling speed: 20km/hr.

According to the plan, the north-south route starts from the St. George Church around Piazza and ends at the Southern part of the city near Kality. Similarly, the east-west part covers the distance between the Ayat neighborhoods to the East all the way to the Armed Forces Specialized Hospital in the West and is shown in fig. 1.1

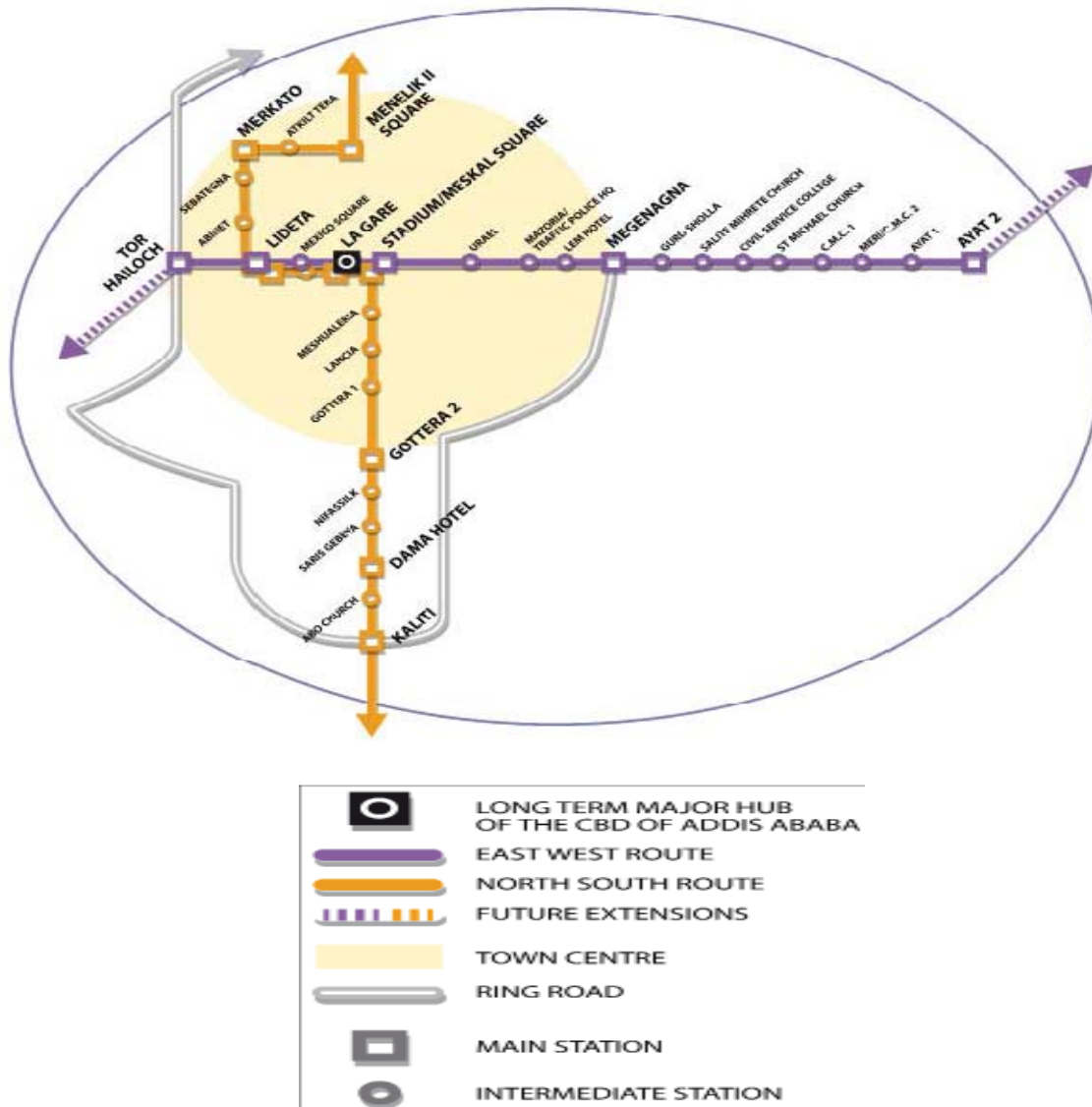


Fig 1.1 AA LRT N-S and E-W Route Phase I [7]

### **1.3 Problem Statement**

The present transport system of Addis Ababa is entangled with several problems such as inefficiency and disorganization [7]. The construction activities along the lines of the project and other adjacent allied infrastructure upgrading are posing tremendous risk for the entire public. Poor traffic management plan, dust, open excavation channels and the movement of heavy materials of construction are some of the risk invoking problems observed at the construction stage. The Light Rail Transit Project is expected to leverage the problems towards a city wide integrated transport system. Definitely, operation will come with its own challenges.

The problem statement of this thesis research focuses on the following key concept.

Addis Ababa Light Rail Transit project is exposed to several risk factors. The failure of such a large project by one or more of eventuating risks will have adverse consequences to the city as well as the national economy. Thus, identifying the risks, analyzing their impact, and suggesting mitigation strategies towards a comprehensive risk management system of the project are the main focus of the thesis research. In this regard an attempt is made in clearly stating those risks that thwart the implementation as well as the operation of Addis Ababa Light Rail Transit Project.

## 1.4 Aim, Objectives and Research Questions

The aim of the research is to identify the risks in Addis Ababa light rail transit system project and enlighten the need for risk management system to enhance achievement of project objectives, thereby contributing to effective implementation of the country's railway infrastructure development program.

### 1.4.1 General Objectives:

- ✚ Minimize the impact of unplanned incidents on a project by identifying and addressing potential risks before significant negative consequences occur.
- ✚ Identifying and reducing risks to an acceptable level
- ✚ Maximizing the probability of positive events and minimizing the probability and consequences of adverse events

### 1.4.2 Specific Objectives:

- ✚ To identify the risks in Addis Ababa light rail transit system project and find out the sources of risks.
- ✚ To assess and analyze the risk management practices of the owner of AA LRT.
- ✚ To assess the existing practices of risk reduction/mitigation.

### 1.4.3 Research Questions

The following research questions are addressed in the thesis:

- i) What are the risks in railway projects specifically the Addis Ababa Light Rail Transit Project?
- ii) What are the risks that prevail between the contracting parties?
- iii) What are the relations of the risks between the stakeholders of the project?
- iv) How are railway project construction risk managed?
- vi) What are the sources of risks in railway construction projects, how are they analyzed and mitigated?
- vii) How are risks allocated? Are there options to better allocate the risks?

### **1.5 Scope of the Study**

The scope of the study is limited to assessment of the owner's risk and risk management practices in the implementation of the Addis Ababa Light Rail Transit System and to suggest plausible options by analyzing the challenges to ultimately have safe, clean and efficient transit system.

### **1.6 Structure of the Thesis**

This thesis consists of five chapters and an Appendix. Chapter 1 is an introduction to the research and includes seven sections that present the background; project information, problem statement; aim, objectives and research questions; scope of the study; structure of the thesis; and significance of the research. Chapter 2 discusses the theoretical framework for the study through literature surveys Chapter 3 presents the Research design and methodology in detail. Chapter 4 focuses on the analysis of results and discussions and Chapter 5 forwards conclusions and recommendations of the research. Appendices A, B and C contain risk assessment matrix, the questionnaire and research proposal.

### **1.7 Significance of the research**

The research attempted to identify risks, analyze their impact and suggested mitigation strategies. After concluding the findings, a recommendation for AA LRT project risk management strategy is forwarded. The findings will greatly contribute to the owner of the project to revisit risk management practices and strategies in place. With certain contextual adjustments, the findings will also be applicable for similar ongoing and upcoming railway projects undertaken by the corporation.

## CHAPTER TWO: LITERATURE REVIEW

### 2.1 Overview on Risk and Uncertainty

The Oxford English Dictionary cites the earliest use of the word in English (in the spelling of *risqué*) as from 1621, and the spelling as *risk* from 1655, it defines risk as:

“(exposure to) the possibility of loss, injury, or other adverse or unwelcome circumstance: a chance of situation involving such a possibility”.

The PMBOK Guide [36] defines a project risk as “an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one project objective”.

Webster’s dictionary defines risk as “the possibility of loss, injury, disadvantages, or destruction”. The Random House College Dictionary defines risk as “exposure to the chance of injury or loss”. Risk is also defined as the exposure to loss/gain, or the probability of occurrence of loss/gain multiplied by its respective magnitude [20].

Risk is also defined as an exposure to the consequences of uncertainty. Dealing with risks is one of the most important elements of managing capital projects. The definition of risk clearly includes two distinct types of uncertainty: those that if they occur will have a negative effect on a project objective, and those that would have a positive effect. In other words, risk includes both threat and opportunity [9].

Risks are generally uncertainties, liabilities, or vulnerabilities, which may cause a project to deviate from its defined plan. While risk in a project environment cannot be totally eliminated or transferred, it can be monitored and minimized or mitigated wherever possible.

A risk is measured by a combination of the probability of a perceived threat or opportunity occurring and the magnitude of its impact on [project] objectives. Risk can be an opportunity or threat, good or bad, positive or negative, upside or downside. “Opportunities (upside risks and more effective ways of proceeding in general) and associated responses need to be identified and managed with the same resolve as threats [9].

The classical definition of risk states that:

$$\text{Risk} = \text{Probability of event} \times \text{Magnitude of loss/gain}$$

Risk is the chance that an investment's actual return will be different than expected. Risks are inevitable in projects and because of this, uncertainty influences project performance. The key to managing a project is not to avoid risks, but to understand them. [38]

Uncertainties result due to lack of knowledge about the parameters that characterize the physical system of projects. Risk and uncertainty characterize situations where the actual outcome for a particular event or activity is likely to deviate from the estimate or forecast value. The distinction is usually that risk is taken to have quantifiable attributes, whereas uncertainty does not.

Risks tend to be insurable and quantified while Uncertainty is used to describe situations where it is not possible to attach a probability to the likelihood of occurrence of an event. Uncertainties tend not to be insurable. Uncertainty attached to a high impact event represents a greater unknown than a quantified risk attached to the same event. However, the unknown may be shown to have been either more or less likely than the known risk. The following table illustrates the differences between uncertainty and risk [25].

Table 2.1 Risk-Uncertainty Continuums [25]

<b>Risk</b>	<b>Uncertainty</b>
Quantifiable	Non Quantifiable
Statistical Assessment	Subjective Probability
“Hard” data	Informed Opinion

While the vocabulary of risk management terms varies slightly from agency to agency, the fundamental definitions are consistent throughout the globe. Multiple industry organizations define risk terms in an attempt to provide standardization. The most pertinent definitions are listed in the following table below. A glimpse of the table gives a brief definition of each of the key risk management terminologies. The definition enhances understanding of risk in its general sense.

Table 2.2 Risk management definitions (from ISO 31000)

<b>Term</b>	<b>ISO 31000 Definition</b>
Risk	Effect of uncertainty on objectives
Risk management	Coordinated activities to direct and control an organization with regard to risk
Risk management framework	Set of components that provide the foundations and organizational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organization
Risk management Policy	Statement of the overall intentions and direction of an organization related to risk management
Risk management Plan	Scheme within the risk management frame work specifying the approach ,management components and resources to be applied to risk management
Risk attitude	Organizations approach to assess and eventually pursue ,retain, take, or turn away from risk
Risk identification	Process of finding, recognizing, and describing risks
Risk assessment	Over all process of risk identification ,risk analysis, and risk evaluation
Risk Analysis	Process to comprehend the nature of risk and determine the level of risk
Risk evaluation	Process of comparing the results of risk analysis with risk criteria to determine whether the risk and /or its magnitude is acceptable or tolerable
Event	Occurrence or change of a particular set of circumstances
Likelihood	Chance of something happening
Consequence	Outcome of an event affecting objectives
Level of Risk	Magnitude of a risk or combination of risks, expressed in terms of the combination of consequences and their likelihood.
Risk Treatment	Process to modify risk
Control	Measure that is modifying risk
Residual risk	Risk remaining after risk treatment
Monitoring	Continual changing, supervising, critically observing, or determining the status to identify change from the performance level required or expected.

## 2.2 Risk Classification

Risk classification is a significant step in the risk management process, as it attempts to structure the diverse risks affecting a construction project. In order to manage risks effectively, many approaches have been suggested for classifying risks. For classifying risks, one needs to know first if they are external or internal to the project. Authors assert that external risks are relatively uncontrollable while internal factors are more controllable and vary between projects. [46]

The PMI classifies risks as internal or external. Internal risks are those that arise within the scope and control of the project team. Most internal risks can be referenced to a specific project document such as a cost estimate or a schedule. Internal risks usually refer to items that are inherently variable. External risks are items that are generally imposed on the project from establishments beyond the limits of the project. Interactions with regulators are typical external risks. Funding constraints and restrictions are other common external risks. External risks tend to refer to items that are inherently unpredictable but generally foreseeable [6].

Risks that are not under direct control of the project owner are external *risks*. These often fall under the socio-political risk category, sometimes are financial risks, and also include “other risks” such as weather and changing market conditions. While there are internal and external risks involved in a project, legal risks should also be incorporated as a project risk that have legal issue as their source and they include a set of facts that are assessed under a set of legal norms [46].

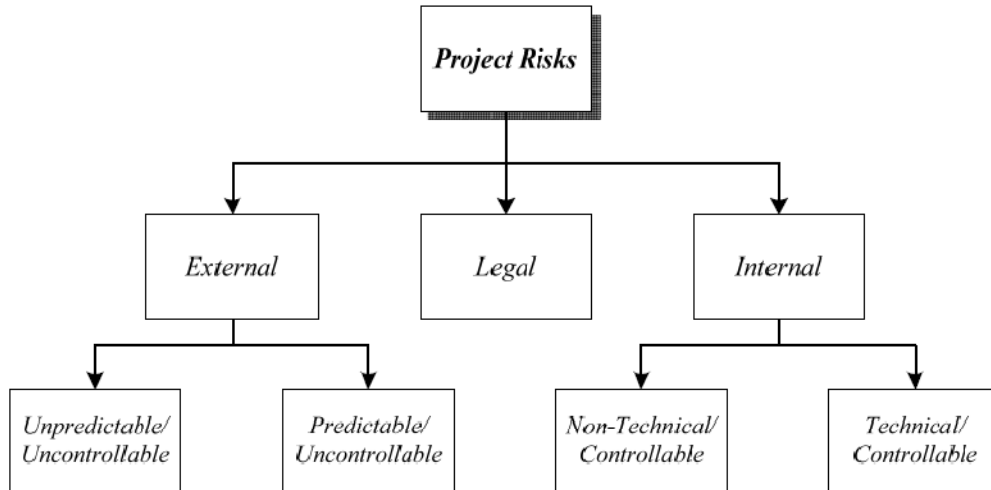


Fig. 2.1 Specific Project Risks [34]

All risk can be categorized according to whether it emanates from the internal or external environment. The figure below shows the interaction of a project with its internal and external environment.

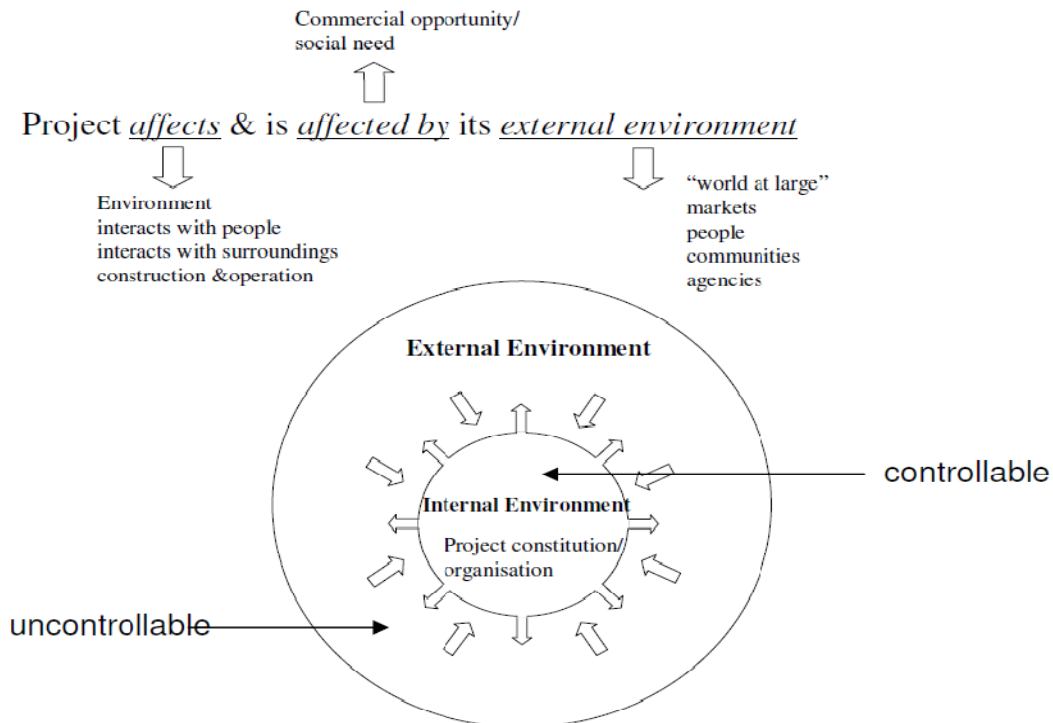


Fig. 2.2 Interaction of project with operating environment [13]

Risks can also be either local or global. Local risks affect a single or a group of work packages within a project, whereas global risks cannot be associated with any particular work package and affect the project as a whole. According to [43] all project risks can be divided into three main categories: known risks, known unknowns and unknown unknowns. The difference between the categories is the decreasing ability to predict or foresee the risks. A known is an item or situation containing no uncertainty.

Unknowns are things we know but we do not know how they will affect us. A known-unknown is an identifiable uncertainty. An unknown-unknown is simply an item or situation whose existence has yet to be encountered or imagined. Taking into account the probability of the occurrence and the consequence for project objectives, those events that have high probability and high impact are subject to risk management.

There are five main categories of risks associated with project management [51].

External, cost, schedule, technology and operational risks. External risks concern the unexpected events that can happen outside the control of project manager and, in most cases, the corporation. Most of these risks are very difficult to control by the project manager, but they should be at least identified.

Cost risks, on the other hand are directly or indirectly under the project manager's control, they may include cost overruns by project teams or sub-contractors, expansion and change of the project, poor estimating overrun of budget and schedule. Schedule risks can cause project failure by missing or delaying a market opportunity for a product or service.

Another category is technology risk that can result from a wide variety of circumstances such as unskillfulness and not applying knowledge based e-tools. As a result expectations of project's functionality and performance fail. Finally, operational risks are characterized by an inability to implement change effectively and inability to realize the expected benefits of the project.

Although there are a variety of risk categorization approaches, the source based identification and categorization of risks is widely accepted: [16]

- Financial and economic risk (unavailability of funds, inflation, exchange rate fluctuation)

- Contractual and legal risk (delay in solving contract issues, disputes, change order negotiations, extra payments)
- Subcontractors related risk (subcontractor's failure, lack of coordination, lack of staff)
- Operational risk (productivity, system outage, waste disposal)
- Safety and social risk (pollution and safety rules, accidents, damage to persons or property, ecological constraints)
- Design risk (inadequate specification, conflict of documents, design change, scope of work definition)
- Force majeure risk (war, tsunami, earthquake, typhoon, etc)
- Physical risk (subsurface geology, ground water, unforeseen site condition)
- Delay risk (construction delay, third party delay)

For consistency and simplicity reasons, the thesis research follows this source-based risk identification and classification.

### **2.3 Risks that influence project objectives:**

Through research and practice, risk management researchers and project managers have come up with a list of risks that affect project objectives. The following are key risks that influence project objectives: [33]

- ✓ Tight project schedule
- ✓ Design variations
- ✓ Excessive Approval procedures in administrative government departments
- ✓ High performance/quality expectations
- ✓ Inadequate program scheduling
- ✓ Unsuitable construction program planning
- ✓ Variations of construction programs
- ✓ Low management competency of subcontractors
- ✓ Variations by the client
- ✓ Incomplete approval and other documents
- ✓ Incomplete or inaccurate cost estimate
- ✓ Lack of coordination between project participants
- ✓ Unavailability of sufficient professionals and managers
- ✓ Bureaucracy of government

- ✓ General safety accident occurrence
- ✓ Inadequate or insufficient site information(soil test and survey report)
- ✓ Occurrence of dispute
- ✓ Price inflation of construction materials
- ✓ Serious noise pollution caused by construction

The risks that are stated above are associated with Cost, Time, Quality, Environment and, Safety. The referred risks are associated with stakeholders in a project and are related to clients, designers, contractors, sub contractors, government bodies and external environment.

#### **2.4 Sources of Risks**

The risks for infrastructure projects, according to [51], have a wide range of sources and can be classified into the following broad categories:

- Technical, quality or performance risk such as employment of inexperienced designers, changes to the technology used or to industry standards during the project.
- Organizational risks such as cost, time and scope objectives that are internally inconsistent, lack of prioritization of projects, inadequacy or interruption of funding, and resource conflicts with other projects in the organization.
- External risks such as shifting legal or regulatory environment including institutional changes, poor geological conditions and weather, force majeure risks such as earthquake and floods.
- Project management risks such as poor allocation of time and resources, inadequate quality of the project plan, poor use of project management disciplines.

In addition to the above, [3] includes design, construction, environmental, and right of way risks in its classifications.[18] also includes planning and selection, financial, contractual, site, resource, technology, communications risks, etc in its generic checklist for transportation projects.

There are also various sources of risks to public transit projects.[13] They include: Socio-political risks, Financial risks, Planning and design risks, Environmental concerns, Right-of-way acquisition, Permitting requirements, Third party agreements, Technology applications, availability, and reliability, Procurement requirements (civil facilities, systems equipment, materials), Construction risks, including maintenance of traffic, changed conditions, utilities and

subsurface conditions, *etc.*, Other risks, such as acts of God (weather, *etc.*) and changes in regulatory conditions or market conditions.

## **2.5 Risk Management**

Project risk management does not guarantee success but has the primary goal of identifying and responding to potential problems with sufficient lead time to avoid crises, so that it is possible for Project Management to achieve its goal of a successful project which meets its targets.

Effective risk management optimizes the chances of success, even in the face of bad luck, [15]. Opportunities (upside risks and more effective ways of proceeding in general) and associated responses need to be identified and managed with the same resolve as threats. The key to good Risk Management is “Act before you need to react”.

Risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives. It is a process which is an “add-in” to the project management process as a whole, rather than an “add-on”, [6]. This means that it should be included and be part of project management process from the beginning (add in) and not be used as a supplementary (add on) in the management process.

Risk management is one of the fourteen construction related knowledge areas presented by the Project Management Institute (PMI). The PMBOK® Guide and its construction extension recognize fourteen knowledge areas. These knowledge areas include all the aspects of the project management that are required for the successful completion of a project on time with the best output. They are areas of specialization that contain project management process each with inputs, tools, techniques and outputs. These processes together accomplish proven project management functions and drive project success. Knowledge areas assume specific skills and experience in order to accomplish project goals.

The knowledge areas recognized in PMBOK guide are:

1. Project integration management.
2. Project scope management.
3. Project time management.
4. Project cost management.

5. Project quality management.
6. Project human resource management.
7. Project communications management.
8. Project risk management.
9. Project procurement management.
10. Project stakeholder management
11. Claims Management.
12. Financial Management
13. Environment Management and
14. Safety Management.

### **2.5.1 Project Risk Management Process**

The PMBOK [36] defines the following project risk management processes:

- i) Risk Management Planning - deciding how to approach, plan, and execute the risk management activities for a project.
- ii) Risk Identification - determining which risks might affect the project and documenting their characteristics.
- iii) Qualitative Risk Analysis – prioritizing risk for subsequent further analysis or action by assessing and combining their probability of occurrence and impact.
- iv) Quantitative Risk Analysis – numerically analyzing the effect on overall project objectives of identified risks.
- v) Risk Response Planning – developing options and actions to enhance opportunities, and to reduce threats to project objectives.
- vi) Risk Monitoring and Control – tracking identified risks, monitoring residual risks, identifying new risks, executing risk response plans, and evaluating their effectiveness throughout the project life cycle.

**i) Plan Risk Management**

Plan Risk Management is the process of defining how to conduct risk management activities for a project. The key benefit of this process is it ensures that the degree, type, and visibility of risk management are commensurate with both the risks and the importance of the project to the organization. The risk management plan is vital to communicate with and obtain agreement and support from all stakeholders to ensure the risk management process is supported and performed effectively over the project life cycle. The inputs, tools and techniques, and outputs of this process are depicted in the following Figure

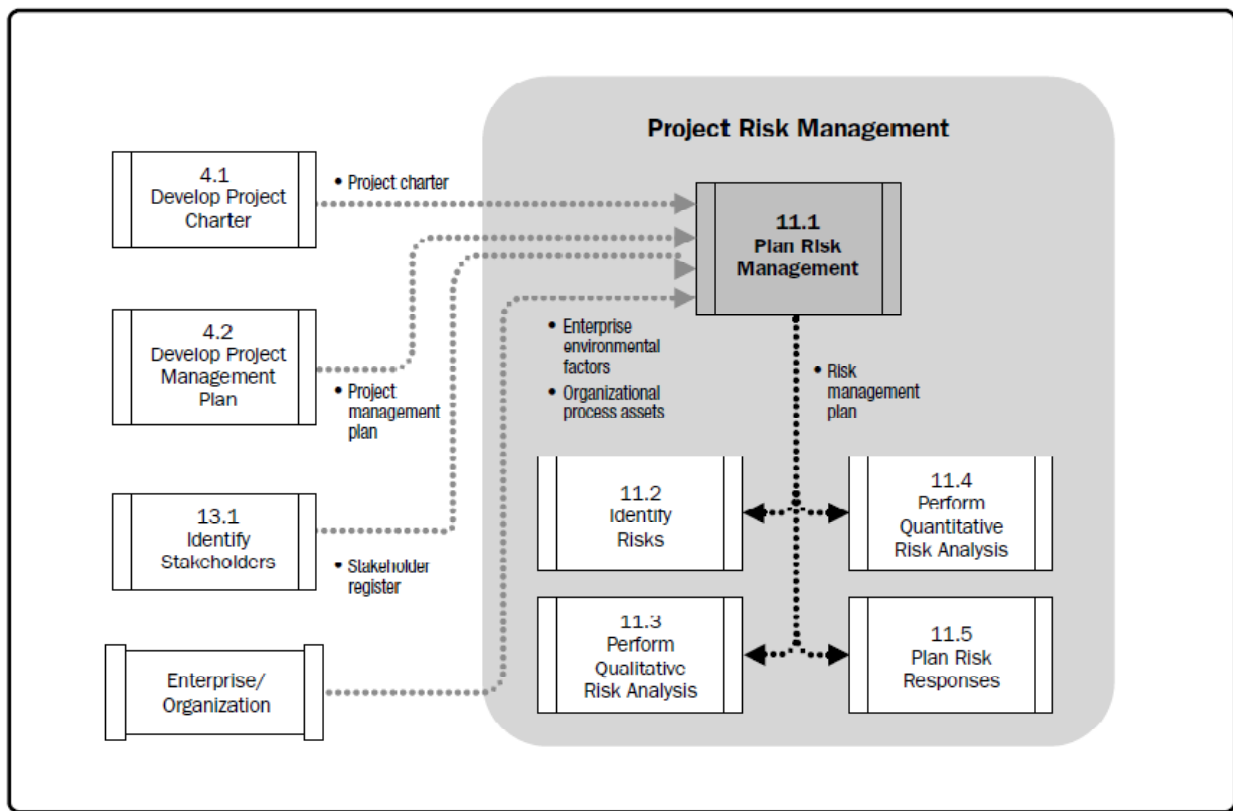


Fig 2.3 Risk management plan data flow diagram [36]

The Plan Risk Management process should begin when a project is conceived and should be completed early during project planning.

**ii) Identify Risks**

Identify Risks is the process of determining which risks may affect the project and documenting their characteristics. The key benefit of this process is the documentation of existing risks and the knowledge and ability it provides to the project team to anticipate events. The inputs, tools and techniques, and outputs of this process are depicted in the following figure

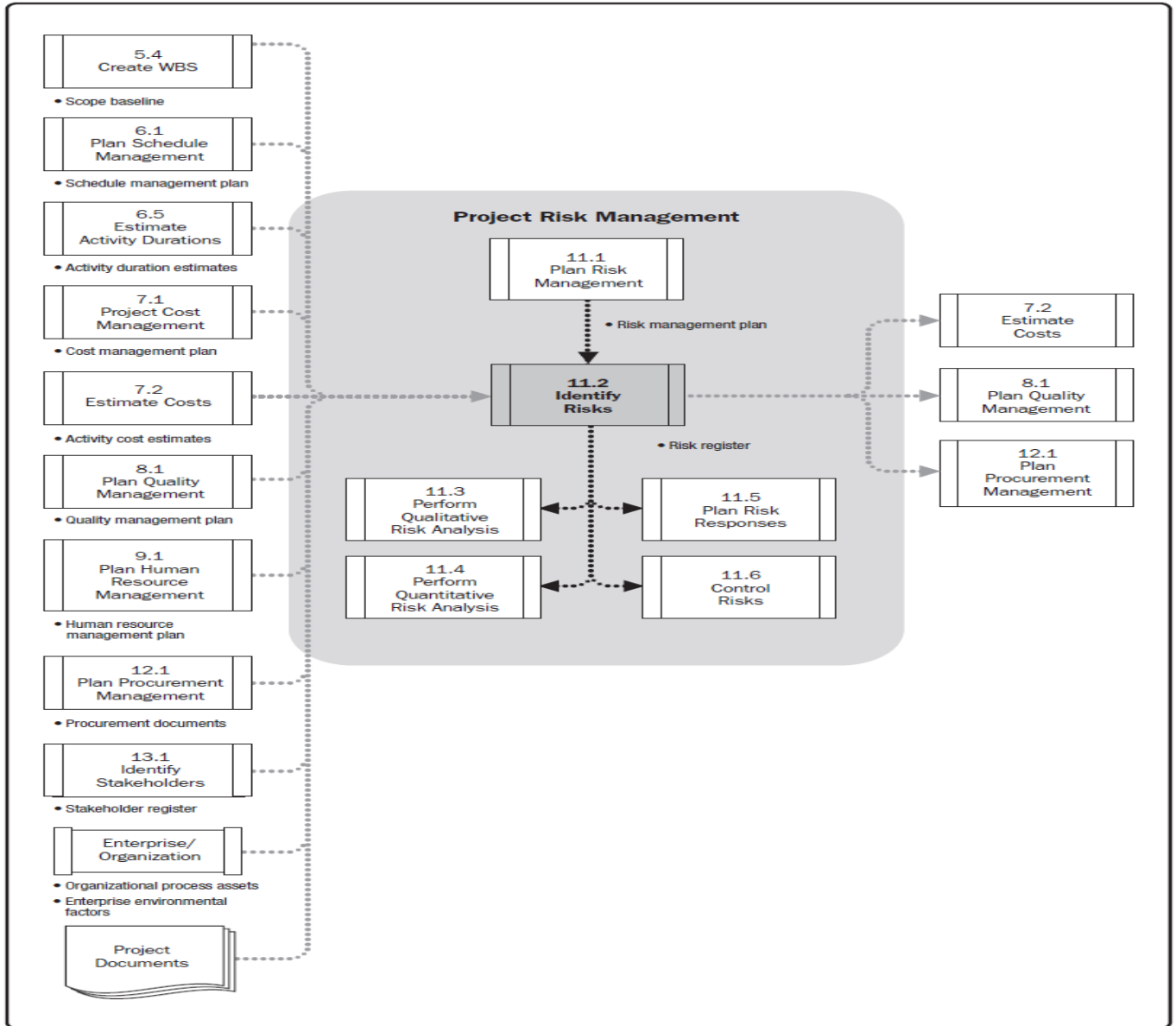


Fig. 2.4 Identify data risks flow diagram [36]

Participants in risk identification activities may include the following: project manager, project team members, risk management team, customers, subject matter experts from outside the project team, end users, other project managers, stakeholders, and risk management experts.

### iii) Qualitative Risk Analysis

Perform Qualitative Risk Analysis is the process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact. The key benefit of this process is that it enables project managers to reduce the level of uncertainty and to focus on high-priority risks. The inputs, tools and techniques, and outputs of this process are depicted in the following Figure

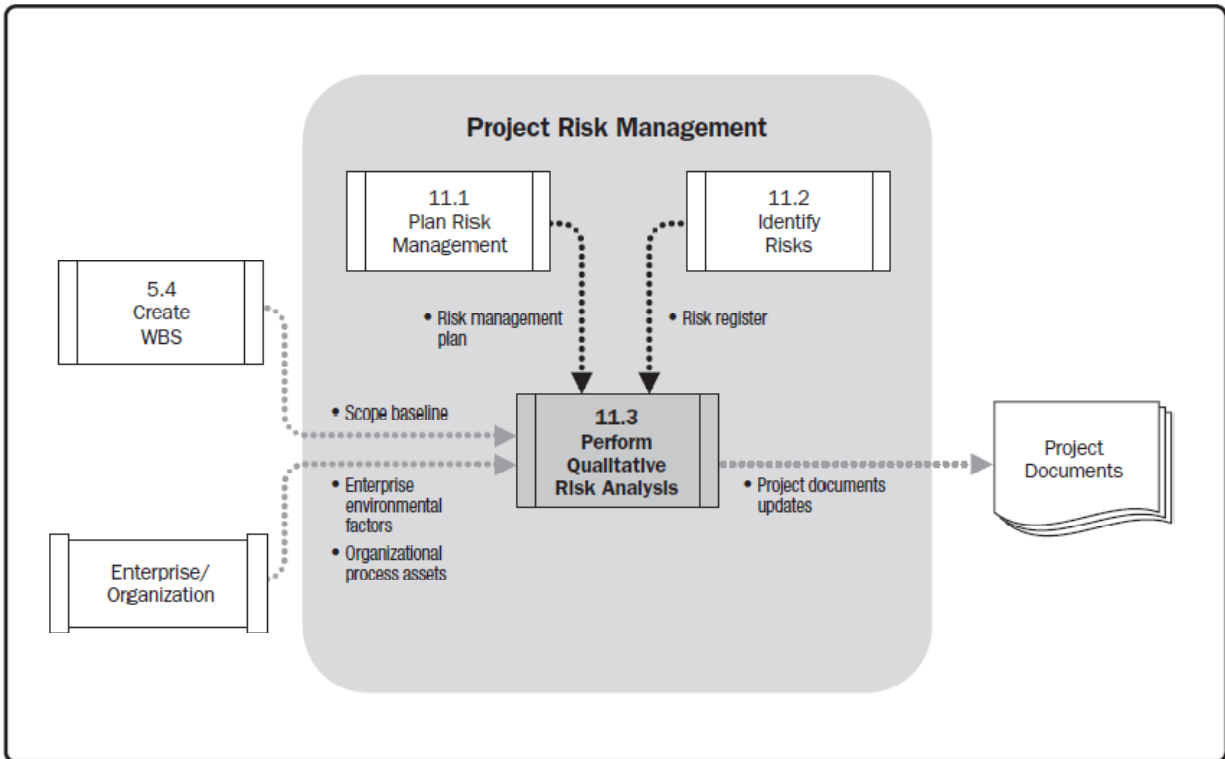


Fig 2.5 Qualitative risk analysis data flow diagram [36]

Perform Qualitative Risk Analysis assesses the priority of identified risks using their relative probability or likelihood of occurrence, the corresponding impact on project objectives if the risks occur, as well as other factors such as the time frame for response and the organization’s risk tolerance associated with the project constraints of cost, schedule, scope, and quality. Such assessments reflect the risk attitude of the project team and other stakeholders.

#### **iv) Perform Quantitative risk analysis**

Perform Quantitative Risk Analysis is the process of numerically analyzing the effect of identified risks on overall project objectives. The key benefit of this process is that it produces quantitative risk information to support decision making in order to reduce project uncertainty.[36]

Perform Quantitative Risk Analysis is performed on risks that have been prioritized by the Perform Qualitative Risk Analysis process as potentially and substantially impacting the project's competing demands. The Perform Quantitative Risk Analysis process analyzes the effect of those risks on project objectives. It is used mostly to evaluate the aggregate effect of all risks affecting the project. When the risks drive the quantitative analysis, the process may be used to assign a numerical priority rating to those risks individually.

Perform Quantitative Risk Analysis generally follows the Perform Qualitative Risk Analysis process. In some cases, it may not be possible to execute the Perform Quantitative Risk Analysis process due to lack of sufficient data to develop appropriate models. The availability of time and budget, and the need for qualitative or quantitative statements about risk and impacts, will determine which method(s) to use on any particular project. Perform Quantitative Risk Analysis should be repeated, as needed, as part of the Control Risks process to determine if the overall project risk has been satisfactorily decreased. Trends may indicate the need for more or less focus on appropriate risk management activities.

#### **v) Plan risk responses**

Plan Risk Responses is the process of developing options and actions to enhance opportunities and to reduce threats to project objectives. The key benefit of this process is that it addresses the risks by their priority, inserting resources and activities into the budget, schedule and project management plan as needed.[36]

The Plan Risk Responses process follows the Perform Quantitative Risk Analysis process (if used). Each risk response requires an understanding of the mechanism by which it will address the risk. This is the mechanism used to analyze if the risk response plan is having the desired effect. It includes the identification and assignment of one person (an owner for risk response) to

take responsibility for each agreed-to and funded risk response. Risk responses should be appropriate for the significance of the risk, cost-effective in meeting the challenge, realistic within the project context, agreed upon by all parties involved, and owned by a responsible person. Selecting the optimum risk response from several options is often required. The Plan Risk Responses process presents commonly used approaches to planning responses to the risks. Risks include threats and opportunities that can affect project success.

#### **vi) Control Risks**

Control Risks is the process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project. The key benefit of this process is that it improves efficiency of the risk approach throughout the project life cycle to continuously optimize risk responses. [36]

The Control Risks process applies techniques, such as variance and trend analysis, which require the use of performance information generated during project execution. Other purposes of the Control Risks process are to determine if:

- Project assumptions are still valid,
- Analysis shows an assessed risk has changed or can be retired,
- Risk management policies and procedures are being followed, and
- Contingency reserves for cost or schedule should be modified in alignment with the current risk assessment.

Control Risks can involve choosing alternative strategies, executing a contingency or fallback plan, taking corrective action, and modifying the project management plan. The risk response owner reports periodically to the project manager on the effectiveness of the plan, any unanticipated effects, and any correction needed to handle the risk appropriately. Control Risks also includes updating the organizational process assets, including project lessons learned databases and risk management templates, for the benefit of future projects.

As has been described in the introductory part of this thesis and the above paragraphs, the benefits of the risk management process include identifying and analyzing risks, and improvement of construction project management processes and effective use of resources.

Managing risks in construction projects has been recognized as a very important process so as to achieve project objectives in terms of time, cost, quality, safety and environmental sustainability [33].

Furthermore, project risk management is an iterative process: the process is beneficial when it is implemented in a systematic manner throughout the lifecycle of a construction project, from the planning stage to completion. Risk management is essentially removing or reducing the possibility of underperformance. It improves project performance via systematic identification, appraisal and management of project-related risk [6].

Generally, Project Risk management is not only iterative and process oriented but also of multifunctional in nature. A plausible and meaningful project risk management requires inputs from other knowledge area such as from cost management, time management, etc. Figure 2.6 below shows this interaction figuratively.

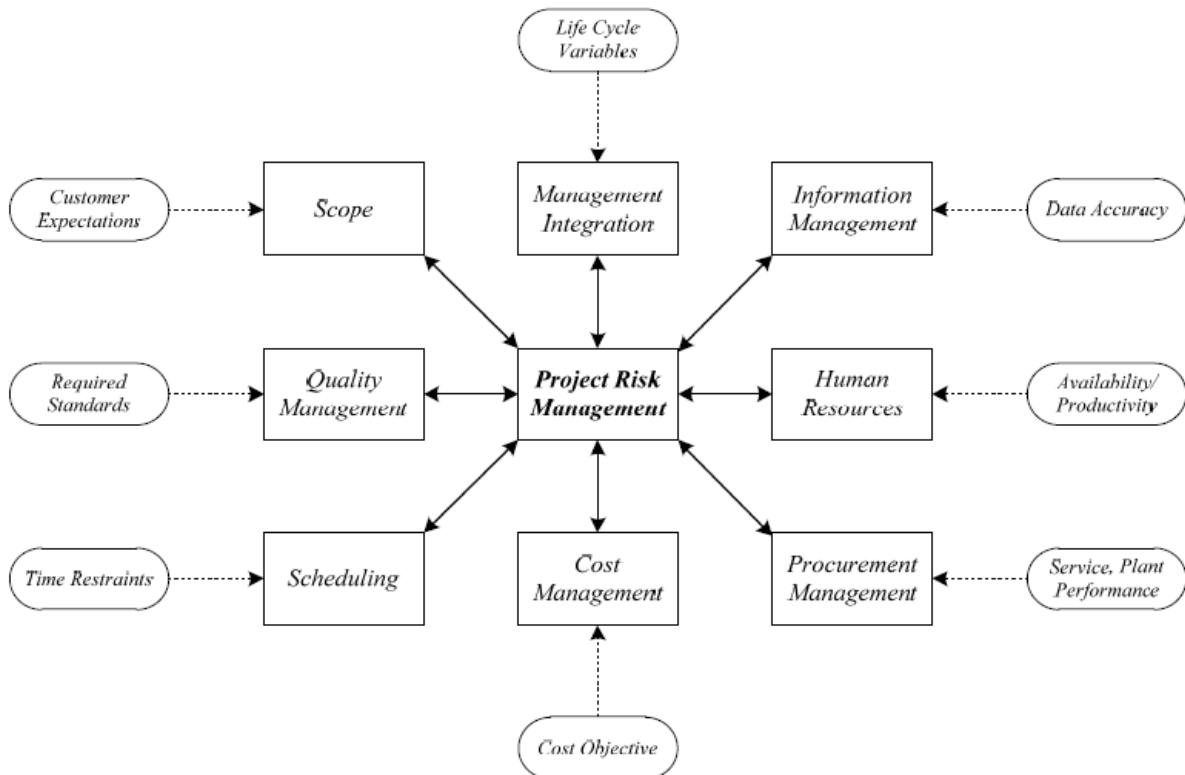


Fig 2.6 Classifying key risk factors in construction projects [34]

### 2.5.2 Steps effective in managing risk:

Jennifer S. Shane [23] has indicated that the following steps are crucial to the management of risk after a thorough risk management planning is conducted.

- (1) Identification,
- (2) Analysis,
- (3) Evaluation,
- (4) Treatment, and
- (5) Monitoring and review. Also, the risk management process should be iterative.

1. **Risk identification** is the process of determining which risks might affect objectives and documenting their characteristics. Risk identification uses simple tools such as brainstorming and checklists. Risks can affect objectives at the agency level (e.g., achievement of strategic goals), the program level (e.g., management of critical assets), and the project level (e.g., attainment of budget or schedule commitments). Risk identification should occur continuously throughout the risk management process since situations having an impact on project objectives may prevail.

2. **Risk analysis** involves defining, quantitatively or qualitatively, the consequence (i.e., impact) and likelihood (i.e., probability) of a risk. Risk analysis can use simple methods to describe risks, such as probability and impact matrices, or more sophisticated probabilistic methods, such as three-point estimates or probability functions and Monte Carlo simulations. More qualitative methods typically apply when analyzing strategic goals and related items.

3. **Risk evaluation** involves the process of comparing the results of risk analyses with an agency's level of risk tolerance. If risks are serious and have high impact, action (i.e., risk treatment) will need to be taken. Risk evaluation presupposes that an agency has defined its risk tolerance and is prepared to take action if a risk's consequence and likelihood are high.

4. **Risk treatment** involves a risk response and risk modification. Common options involve avoidance, mitigation, or transference of the risk. Risk avoidance is the best option if the agency's goals can still be achieved when the risk is avoided. Mitigation typically involves making an investment to reduce the consequence or likelihood of a risk. Transference involves

allocating the consequence of the risk to another party (e.g., a contractor), but there is typically a price to transferring the risk because the other party must mitigate the risk.

The fundamental tenets of risk transference include allocating risks to the party best able to manage them, allocating risks in alignment with agency goals, and allocating risks to promote team alignment with customer oriented performance goals.

5. **Risk monitoring** and review are the capture, analysis, and reporting of risk status in relation to performance. Risk monitoring and review typically employ a risk management plan to monitor risk status and identify changes from the performance level required or expected. Risk monitoring and review assist in contingency tracking and resolution.

At its foundation, project risk management involves asking and answering the following questions: [37]

- ✓ What risks might negatively (threats) or positively (opportunities) affect achieving the project objectives? (*Risk identification*)
- ✓ Which of these are most important? (*Qualitative risk analysis*)
- ✓ How could these affect the overall outcome of the project in probabilistic terms of cost and schedule? (*Quantitative risk analysis*)
- ✓ What can be done about it? (*Risk response*)
- ✓ Having taken action, how did the responses effect change, and where is the project now? (*Risk monitoring*)
- ✓ Who needs to know about this? (*Communication*)

## 2.6 EPC Turnkey Project Delivery System

In turnkey contract, the contractor is entrusted to design, construct, commission, and handover the project to the employer. The employer will make up lump-sum payment to the contractor at the different stages of work as per the agreement.

To address the development needs of Ethiopia in infrastructure expansion, the turnkey delivery system is chosen as a better option in executing the urgently needed projects. The conditions of contract used for the AA LRT project is the FIDIC EPC Turnkey conditions of contract published in 1999. [1]

### **2.6.1 Turnkey Contracts -the Client's Perspective**

Turnkey contracts are popular with clients and a significant number of major constructions are being executed under this contractual framework and the main benefits, constraints and useful precautions are discussed below.[8]

#### **Main Benefits**

- The first benefit is the fact that the client transacts with a single supplier for both the design and execution of the project, which simplifies its management.
- Once the client needs are precisely defined, the client may be presented with as many solutions, as there are bidders, providing the client with options that would not have otherwise been aware of.
- The supplier assumes the bulk of the risks related to the construction, which must be delivered as agreed and within the time-frame provided. The client assumes fewer risks and is less likely to face claims for cost overruns.
- When a problem occurs, it is not necessary for the client to determine which participant is at fault since there is only has a single supplier to deal with.
- It is possible to reduce or eliminate change orders; and
- Fewer disputes are likely to occur and, if they do, will be easier to resolve.

#### **Constraints**

- Since estimate costs are high, there is also the risk that fewer bidders will be interested in taking part in the bidding process. Accordingly, there may be less competition on prices and delivery times.
- Since the supplier assumes more risks, he may increase his bid price correspondingly.

#### **Useful Precautions**

- Experience shows that turnkey projects are more successful when the client is able to accurately indicate their needs and the financial resources available to realize the project. Where the client's expectations are not clear, dissatisfaction becomes a certainty for all participants.
- An internal or external project management team may be set up to define the owner's needs as well as monitor the progress of the work.

- It is also preferable that the client reserves some control at several critical phases of the project and establishes balanced payment methods.

As it is described in sub chapter 1 of the thesis AA LRT project is under construction by the EPC/ Turnkey contractor, CREC and the following are selected sub clauses related to time, cost, quality, environment and public from the General and Particular Conditions of the Contract signed by ERC and CREC.

Table 2.3 Sub clauses related to time, cost, quality, environment and public [11]

Sub Clause	Title of sub clause	Conditions for liability
2.1	Right of access to site	Employers delay on land hand over
2.6	Disposal site	Employer's failure in introducing the contractor to institutions in identifying disposal sites
4.2	Performance Security	Contractor's failure in providing security of performance within 42 days after effective date of project
4.16	Transport of goods	Contractor's failure to deliver shipping documents pertaining to any consignment.
4.16	Transport of goods	Employer's delay in receipt of shipping documents.
4.18	Protection of the environment	Contractor's failure to develop environmental management plan complying ISO 14000(2000)
6.1	Engagement of staff and labour	Contractor's utilization of staff and labour from sources in Ethiopia.
6.2	Rates of wages and conditions of labour	Contractor's failure in not meeting regulation of wages in building and construction industry.
6.7	Health and safety	Contractor's failure in recording and reporting about health and safety situation of workers.
7.4	Testing	Employer's failure in not assigning representatives for factory tests.
7.4	Testing	Contractor's failure in not delivering transportation facilities, daily allowances and accommodations for the employer.
7.8	Royalties	Contractor's compliance with the contractor
8.4	Extension of time for completion	Variations, entitlements in the contract for time extension and any delays related to the Employer. It is also the strong arm of the Contractor to claim any extension of time.
13.1	Variations	Contractor's compliance with the contractor
13.8	Adjustments for changes in costs	Contractor's compliance with the contractor (Price of materials being checked every three months)
14.8	Delayed payment	Employer's delay on approving due payments of the contractor.
14.18	Income taxes on staff	Contractor's failure in not paying personal income taxes in Ethiopia.
17.3	Employer's risks	Consequences of employer's risks

## **2.7 Risk Check Lists**

A checklist is a type of informational job aid used to reduce failure by compensating for potential limits of human memory and attention. It helps to ensure consistency and completeness in carrying out a task. PDT (Project Development Team)

The construction risks can be broadly grouped under the following categories: [14]

The list provides a valuable tool, meant to serve as an aid to potential risk items for a specific project. Consideration of all the features is critically important and the grouped risk items should be considered when performing a risk analysis. *Details are indicated in table 2.3 below:*

Major risk groups/sources	Risk Particulars
<b>Organizational and Project Management Risks</b>	<ul style="list-style-type: none"> <li>▪ Project purpose and objectives are poorly defined</li> <li>▪ Project scope definition is poor or incomplete</li> <li>▪ Project schedule in question</li> <li>▪ No control over staff priorities</li> <li>▪ Project competing with other projects, funding and resources</li> <li>▪ Functional and Technical labor units not available or overloaded</li> <li>▪ Losing critical staff at crucial point of the project</li> <li>▪ Inexperienced or inadequate staff assigned</li> <li>▪ Product development by several sources or entities (virtual or remote efforts)</li> <li>▪ Coordination/communication difficulties</li> <li>▪ Communication breakdown with project team</li> <li>▪ Insufficient time to plan</li> <li>▪ Timely response to critical decisions by PM and/or management</li> <li>▪ A/E/C Consultant or contractor delays</li> <li>▪ Pressure to deliver project on an accelerated schedule</li> <li>▪ Unanticipated project manager workload</li> <li>▪ Unplanned work that must be accommodated</li> <li>▪ Local agency/regulator issues</li> <li>▪ Priorities change on existing program</li> </ul>
<b>Contract Acquisition Risks</b>	<ul style="list-style-type: none"> <li>▪ Undefined acquisition strategy, Acquisition strategy decreasing competition</li> <li>▪ Lack of acquisition planning support/involvement</li> <li>▪ Acquisition planning to accommodate funding stream or anticipated strategy</li> </ul>
<b>Right-of-way analysis in question</b>	<ul style="list-style-type: none"> <li>▪ Lacking critical subsurface information for under-water / in-water work</li> <li>▪ Hazardous waste concerns</li> <li>▪ Need for design exceptions or waivers</li> <li>▪ Adaptive Dredge Estimate scope, quantities, equipment</li> </ul>

<p><b>Innovative designs, highly complex, first of a kind, or prototypes</b></p>	<ul style="list-style-type: none"> <li>▪ Incomplete studies (geotechnical, hydrology and hydraulic, structural, etc)</li> <li>▪ Surveys late and/or surveys in question</li> <li>▪ Sufficiency / availability of as-built data / base map data</li> <li>▪ Borrow/fill sources identified / secured</li> </ul>
<p><b>Technical Risks</b></p>	<ul style="list-style-type: none"> <li>▪ Design development stage, incomplete or preliminary</li> <li>▪ Confidence in scope, investigations, design, critical quantities</li> <li>▪ Consultant design not up to department standards</li> <li>▪ Inaccurate or risky design assumptions on technical issues</li> </ul>
<p><b>Lands and Damages</b></p>	<ul style="list-style-type: none"> <li>▪ Objections to right-of-way appraisal take more time and/or money</li> <li>▪ Ancillary owner rights, ownerships in question</li> <li>▪ Freeway agreements</li> <li>▪ Relocations identified</li> <li>▪ Records / as-built availability / inaccuracies</li> <li>▪ Known and unknown utility impacts</li> <li>▪ Relocations may not happen in time</li> <li>▪ Environmental mitigation needs identified</li> <li>▪ Vagrancy, loitering issues</li> <li>▪ Hidden estimate/schedule contingencies</li> </ul>
<p><b>Regulatory and Environmental Risks</b></p>	<ul style="list-style-type: none"> <li>▪ Established requirements for initial project studies and potential impacts</li> <li>▪ Environmental and Water quality issues</li> <li>▪ Conforming to the State implementation plan for air quality</li> <li>▪ Historic/Cultural site, endangered species, or wetlands present</li> <li>▪ Project in an area of high sensitivity for cultural artifacts</li> <li>▪ Numerous exclusion zones in project area / vicinity</li> <li>▪ Hazardous waste preliminary site investigation required</li> <li>▪ Status of critical environmental and regulatory studies</li> <li>▪ Status of permits</li> <li>▪ Lack of specialized staff (anthropology, archeology, etc.)</li> <li>▪ Reviewing agency requires higher-level review than assumed</li> <li>▪ Permits or agency actions delayed or take longer than expected</li> <li>▪ Potential for critical regulation changes</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Negative community impacts expected</li> </ul>
<p><b>Construction Risks</b></p>	<ul style="list-style-type: none"> <li>▪ Accelerated contract schedule</li> <li>▪ Inefficient contractor</li> <li>▪ Subcontractor capabilities</li> <li>▪ Conflicts with other contracts</li> <li>▪ Innovative project construction</li> <li>▪ Permits, licenses, submittal approvals</li> <li>▪ Environmental restrictions (equipment use, exhaust, paint fumes)</li> <li>▪ Adequate staging areas</li> <li>▪ Inadequate skilled trades available for labor force</li> <li>▪ Inadequate housing/utilities to support labor force</li> <li>▪ Special equipment and equipment availability</li> <li>▪ Material availability and delivery</li> <li>▪ Productivity of critical work items</li> <li>▪ Critical fabrication and delivery</li> <li>▪ Unknown utilities</li> <li>▪ Survey information</li> <li>▪ Limited transportation / haul routes available</li> <li>▪ Unusual transportation haul distances</li> <li>▪ Restricted schedule, accelerated schedule impacts</li> <li>▪ Control and diversion of water</li> <li>▪ Differing site conditions</li> <li>▪ Unidentified hazardous waste</li> <li>▪ Historic change order or modification growth</li> <li>▪ Consideration for standard weather impact</li> <li>▪ Adequacy of construction schedule depicting durations, sequencing, phasing, production rates</li> </ul>
<p><b>Estimate and Schedule Risks</b></p>	<ul style="list-style-type: none"> <li>▪ Estimate developed for current scope and design level</li> <li>▪ Estimate quality related to lesser designed features</li> <li>▪ Estimate excludes contingency and escalation</li> <li>▪ Estimate confidence in large and critical quantities</li> <li>▪ Estimate reasonableness of crews and productivities</li> <li>▪ Estimate reflects local material costs and delivery</li> <li>▪ Parametric estimates for unit prices adequate for critical items</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Consideration and local quotes for special equipment (cranes, barges, tugs, diving)</li> <li>▪ Adequate schedule depicting all project features</li> <li>▪ Schedule depicts logical construction sequencing, phasing and parallel activities</li> <li>▪ Estimate and schedule reflecting “most likely” occurrence</li> <li>▪ Overall confidence in estimate and schedule</li> </ul>
<p><b>External Risks</b></p>	<ul style="list-style-type: none"> <li>▪ Adequacy of project funding (incremental or full funding)</li> <li>▪ Priorities change on existing program</li> <li>▪ Local communities pose objections</li> <li>▪ Loss of public trust / goodwill</li> <li>▪ Political factors change at local, state or federal</li> <li>▪ Stakeholders request late changes</li> <li>▪ New stakeholders emerge and demand new work</li> <li>▪ Influential stakeholders request additional needs to serve other purposes</li> <li>▪ Political opposition / threat of lawsuits</li> <li>▪ Stakeholders choose time and / or cost over quality</li> <li>▪ Market conditions and bidding competition</li> <li>▪ Unexpected escalation on key materials</li> <li>▪ Labor disruptions</li> <li>▪ Acts of God (seismic events: volcanic activity, earthquakes, tsunamis; or severe weather: freezing, flooding or hurricane)</li> </ul>

### **2.7.1 The risk checklist from the owner's point of view**

Creating a check list for a project allows identifying and defining all the activities to be undertaken to initiate, plan, implement and close the project. The risk checklist presented below has been organized for risk reduction techniques from the owner's point of view. It is based upon the source of risk and important parameters that contribute to project uncertainty, which are owner's responsibility, are included. The check lists are good reminders for the practitioners in the field [2].

- i) Project Feasibility (Technical feasibility, Long-term viability)
- ii) Funding (Sources of funding, Inflation and growth rate, Accuracy of cost and contingency analysis, Cash flow, Exchange rates, Appropriation.
- iii) Planning (Scope, Complexity of the project, Technical constraints, Sole source material or service providers, Constructability, Milestones (schedule), Time to complete (schedule), Synchronization of work and payment schedules)
- iv) Engineering (Design and performance standards, Unreliable data, Complexity, Completeness of design, Accountability for design, System integration)
- v) Type of Contract (Lump sum, Unit price, Cost plus)
- vi) Contracting Arrangement (Turnkey, Joint venture, Single prime contractor, Several prime contractors, Innovative procurement methods)
- vii) Regional and Local Business Conditions (Number of bidders, Unemployment rate in construction trades, Workload of regional contractors)
- VIII. Contractor Reliability (Capability, Capacity Credit worthiness, Personnel experience)
- IX. Owner Involvement (Management of project, Supplying of material, Testing and inspection, Safety programs, Communications and problem solving, Partnering, Start-up operations)
- X. Regulatory Conditions (Licenses, permits, approvals, Environmental regulations and requirements, Patent infringement, Taxes and duties, DBE (Disadvantaged Business Enterprise) involvement)

XI. Acts of God (Storm, Earthquake, Flood, Fire, and Impact of site location on any of the acts)

XII. Site (Access, Congestion, Underground conditions, Noise, fume, dust, Abutting structures, Security, Disruption to public)

XIII. Labor (Productivity, Strikes, Minority representation, Sabotage, Availability, Work ethics, Wage scales, Substance abuse, Local rules, Unions, Material wastes, Workman's compensation)

XIV. Loss or Damages (Owner's responsibility, Contractor's responsibility, Engineer's responsibility, Vandalism, sabotages, Accidents, Third Party Claims)

XV. Guarantees (Schedule, Performance, Consequential losses, Liquidated damages)

The above stated checklists remind the owner to find out what type of risks to manage and, therefore, to eliminate or minimize risk outcomes. The Checklist helps project managers in conducting all-round analysis of projects before they are started and while they are on the run. In the checklist information is included on how to analyze project's background, environment, organization and other things.

It provides for the project to be well planned and established project and for communication channels to ensure that project participants are provided with a great mechanism of communication to prevent misunderstanding and conflicts. By applying the check lists a formal document will be included that allows identifying the parties involved in defining the project, implementing its goals and producing desired project deliverables that the project should be supported. The check list is also a good guide for documentation since it explains how to organize and establish an effective project documentation management system.

## 2.8 Risk Register

A **Risk Register** is a Risk Management tool commonly used in Project Management and organizational risk assessments. It acts as a central repository for all risks identified by the project or organization and, for each risk, includes information such as risk probability, impact, counter-measures, and risk owner and so on. It can sometimes be referred to as a **Risk Log**. [4]

The risk register is a document that describes risk characteristics. For identified risks, the register typically provides an assessment of the root causes, the objectives affected (e.g., agency goals, program performance measures, project cost and/or schedule), an analysis of their likelihood of occurring, their impact if they occurred, the criteria used to make those assessments, and the overall risk rating of each risk by objective.

### 2.8.1 Goals of having a Strategic Risk Register:

The risk register has the following goals:

- ✦ To develop and promote a risk management culture focusing on areas of risk
- ✦ To provide a document that will be utilized as a management tool to assist in achieving strategic objectives
- ✦ To assist toward the development of a long-term sustainable, and comprehensive approach to support the identification and management of risks and
- ✦ To provide the Board of Governors and senior management with a more comprehensive understanding of the risks faced, including an assessment of the risks and the activities that have been undertaken to manage the risks.

### 2.8.2 Key Elements of a Project Risk Register Template

Risk Register Template is a handy tool to add structure and consistency to a project risk management process. [20]

Elements 1 to 3 record the results of the **Risk Identification** phase.

**1. Risk Category** – This is where one categorizes the risk. Does it fall under the category of scope, time, cost, resources, environmental, or another key category? Using these categories helps tease out likely risks and groups them into relevant categories for future reference.

**2. Risk Description** – This is a brief description of the potential risk. For instance, the first potential risk identified in the Resources category is: *“There is conflict over resources and team members don’t have enough time due to competing demands.”*

**3. Risk ID** – This is a unique identification number used to identify and track the risk in the risk register. If Resources is Category 8, then the first risk identified in this category has a unique ID of 8.1.

Elements 4 to 6 record the results of the **Risk Analysis** phase.

**4. Project Impact** – is a description of the potential impact on the project as a result of the risk. For example: *“The project schedule may slip, budget may increase and project scope may not be achieved.”*

**5. Likelihood** – The estimated likelihood or probability that the risk will occur at some point and become a project issue. This can be qualitative: high, medium, or low; but it can also be quantitative if enough information is available. For example, it can be stated like the following know that resources have been over-committed in the past and we assess the likelihood of occurrence as “High.”

**6. Consequence** – The potential consequence or impact of the risk if it did become a project issue. It may read like, for the project, time is a fixed constraint, and so any risk that has the potential to significantly delay the project schedule has a “High” consequence.

Elements 7 and 8 record the outcomes of the **Risk Evaluation** phase.

**7. Risk Rank** – This is the magnitude or the level of the risk. It is a combination of likelihood and consequence. As they are both “High” in the example, then the risk rank is also “High.”

**8. Risk Trigger** – What are the triggers that would indicate the need to implement contingency plans? “If resource conflicts have not been resolved three weeks before the scheduled start date, then implement contingency plans.”

These last four elements record the outcomes of the **Risk Treatment** phase.

**9. Prevention Plan** – This is an action plan to prevent the risk from occurring. For the given example, the Prevention Plan includes: Liaise with functional managers and team members to pre-empt future conflicts; and specify and agree resource needs (staff and equipment) with *functional managers*.

**10. Contingency Plan** – This is an action plan to address the risk if it does occur. For the given example, the Contingency Plan includes: “*Train and up-skill existing team members in combination with HR department.*”

**11. Risk Owner** – This is the person responsible for managing the risk and implementing the Prevention or Contingency Plans. Stakeholders, members of the project team, the Project Manager and the Project Sponsor can all be risk owners.

**12. Residual Risk** – This is the risk that remains after treatment is carried out. After treatment, one assesses the residual risk level as “Low.”

## **2.9 Operational Risk**

Operational risk is defined as uncertainty about the level of operational performance achievable during the operating life of infrastructure assets. It is associated with uncertainty about the performance of infrastructure once it has been constructed, during the long-lived operating phase of infrastructure projects. A starting premise is that such operational risk is very important, particularly when large construction costs and durations are involved and modifications to the infrastructure are costly. [37]

Rail systems are inherently technically complex being systems of a large number of closely coupled assets that all need to work together. This complexity and close coupling creates significant operational risk from even quite minor failures of network components (for example, failures of signals or points on a main line).

Operational risk is the broad discipline focusing on the risks arising from the people, systems and processes through which a company operates. It can also include other classes of risk, such as fraud, legal risks, physical or environmental risks.

Operational risk management differs from other types of risk, because it is not used to generate profit (e.g. credit risk is exploited by lending institutions to create profit, market risk is exploited by traders and fund managers, and insurance risk is exploited by insurers). They all however manage operational risk to keep losses within their risk tolerance - the amount of risk they are prepared to accept in pursuit of their objectives. What this means in practical terms is that organizations accept that their people, processes and systems are imperfect, and that losses will arise from errors and ineffective operations. The size of the loss they are prepared to accept, because the cost of correcting the errors or improving the systems is disproportionate to the benefit they will receive, determines their tolerance for operational risk. [39]

## 2.10 Risk Allocation

Every party to a construction project holds a particular and unique position relative to the risk elements for which it assumes responsibility during the execution of that project. [43] The importance of risk allocation should be recognized since unfair and misallocations of several inherent risks in construction contract inevitably affect all project parties - client, contractors, and consultant. [47]

Basically, the principal means practically used for contractual allocation or reallocation of risks is the construction contract. [41] It is important that the contract clauses allocating the risk are clear and unambiguous. The meaning the owner wishes to convey should be what the contractor interprets. [45]

Risk allocation in any contract affects cost, time, quality, and the potential for disputes, delays, and claims. [31] One measure of contract's efficiency and effectiveness is its ability to clearly assign risk between contracting parties. Clear risk assignment means that both contracting parties have the same understanding of risk apportionment and risk management accountability.

Mismanaged events cause project inefficiencies and make contract relationships adversarial. The resulting impacts on project execution ultimately increase project costs.

### 2.10.1 Principle of Risk Allocation

It is widely accepted that “the risks in a project should be apportioned to those project parties who can best manage them”.

The objectives of risk allocation can vary depending on unique project goals, but four fundamental tenets of sound risk allocation should always be followed [47]:

- i. **Allocate risks to the party best able to manage them;** A fundamental tenet of risk management is to allocate the risks to the party best able to manage them. The party assuming the risk should be able to best evaluate, control, bear the cost of, and benefit from its assumption. Inappropriate risk shifting from the owner to the contractor can result in misaligned incentives, mistrust, and an increase in disputes.
- ii. **Allocate the risk in alignment with project goals;** Risks should be allocated in a manner that maximizes the probability of project success. The definition of a clear and concise set of project objectives is essential to project success and these objectives must be understood to properly allocate project risks. Allocating risks in alignment with project objectives begins with a

clear understanding of the project objectives by the agency and a clear communication of these objectives to the contracting, consulting, or design community. While this idea seems simple, in practice it is often difficult to identify and prioritize concise objectives because of the complex nature of highway construction projects.

iii. **Share risk when appropriate to accomplish project goals.**

iv. **Ultimately seek to allocate risks to promote team alignment with customer oriented performance goals;** while the concept of allocating risks in alignment with customer-oriented performance goals may seem to be a significant departure from traditional practices, highway agencies are already doing this through the use of alternative contracting techniques. Agencies and the industry should strive to innovate and develop new risk allocation techniques that align all team members with customer goals.

### **2.10.2 Risk allocation approach**

Theoretically, the approaches to allocate the risk can be classified into two main approaches i.e. qualitative and quantitative approaches. [41] The quantitative approaches objectively focus on quantification of magnitude of the allocated risks, which is the main difference and extension from the qualitative approaches.

#### **i) Qualitative approach**

A common qualitative approach is considered as standardized form of contract, which specify the obligation of contractual parties and some relief such as time extension for the party bearing the risk associated with that obligations. The standardized form of contract provides a framework of risk allocation by a government owner based on the principle that each risk element should be distributed so that the total effect on the total expected cost is minimized.

#### **ii) Quantitative Approach**

The quantitative approaches to risk allocation have been developed to overcome the limitation of qualitative approaches especially the issue of how much risk should be borne by each party.

## 2.11 Risk Strategies

The actions that can avoid a risk are determined by the nature of risk, as are actions that can reduce the impact or probability of the risk event. Risk strategies are categorized in accordance with their approach to dealing with the risk [4]

**Avoidance** The action or strategy chosen will be such that it eliminates the factors that generate the risk.

- **Mitigate** Risk mitigation entails devising an approach that can lessen the likelihood of the risk event happening, but not completely avoid it, or lessen the impact if it does happen, but not completely eliminate it.
- **Transfer** If one cannot avoid the risk or mitigate its impact or probability; it is better to transfer responsibility for dealing with the risk to a third party.

These strategies all deal with risk events that are threats to the project's goals and objectives. There are things that could actually enable a project to exceed its goals and objectives and these are called Opportunities. Opportunities differ from risks in that risks are discouraged while opportunities are courted.

- **Exploit** To exploit an opportunity one can implement a plan to increase the likelihood of the event happening.
- **Enhance** Deals with the impact of the opportunity.
- **Share** Sharing the opportunity means that the opportunity is shared with one or more parties outside the organization performing the project. The purpose of sharing is to engage skill or expertise that the performing organization does not have in order to enhance or exploit the opportunity.

Strategies to be applied for both threats and opportunities:

- **Acceptance** Risks that are accepted have scores that are below the project's risk threshold. The costs saved by avoiding or mitigating the risk do not justify the expense. Opportunities that are accepted are not acted upon for a similar reason: the expense of

enhancing, exploiting, or sharing the opportunities exceed the benefits that would be reaped should the event happen.

- **Contingency** The key difference between a contingency plan and the other actions for threats and opportunities is that the other plans (avoid, mitigate or transfer for threats; exploit, enhance, or share for opportunities) are proactive; they require to act before the risk event happens. Contingency plans require devising a plan that will be acted upon should the risk event happen.

The skill that one should have is not the ability to categorize an approach to a threat or an opportunity, rather it is the ability to identify the best strategy or plan to deal with the threat or opportunity with the budget available. Focus on the strategy or plan before worrying about whether the action falls into the avoidance or mitigation category. It is better to know the limitations when it comes to identifying the best strategies and plans and know how to supplement the knowledge with Subject Matter Experts (SMEs) to address shortcomings. The first part of risk strategy planning should be the identification of areas of deficiencies and a plan to engage SMEs who can make up for them.

## 2.12 Risk Mitigation and allocation Strategies

The authority [4] recommends the following mitigation and management approaches and strategies that have to be implemented to mitigate risks.

### *Principles*

- **All project personnel are part of the risk management process**—Risk management is integrated with other program management processes and aligned with the Authority’s goals and values. As such, everyone is involved, and risk management is every team member’s responsibility.
- **Key risks must be documented and monitored**—all key programmatic risks are documented in a risk register that contains relevant information about the risk, including underlying causes, probability of occurrence, potential impact, mitigation strategy, and status.
- **Risks are “owned”**—all key risks are assigned a named owner within the team responsible for monitoring and control of the risk. Additionally, specific mitigation actions are assigned to

named team members who are in the best position to execute these actions, with due dates for their completion.

- **Communication and reviews are regular**—the risk register is reviewed weekly and updated to reflect the current status of the program and its risk management efforts. Progress on mitigation actions, status of key program risks, and mitigation actions along with any new risks that have arisen is reported monthly.

## CHAPTER III: RESEARCH METHODOLOGY

### 3.1 The study approach and research design

The study area is the East -West and North-South LRT sections of Addis Ababa. The thesis is qualitative research of exploratory type which diagnoses a situation, assesses alternatives, and discovers ideas by studying archival documents, analyzing questionnaire survey and semi structured interviews of professionals involved in the project.

The methodology followed for the research has four main parts as described hereunder.

- i. Establishing the basis of the research: Literatures were reviewed to obtain a theoretical basis for the research and formulating the research questions and defining the scope.
- ii. Conducting the study: aimed at finding out how risks are identified and managed and its effect on project objectives, and identifying the existing practices of risk management by:
  - Distributing questionnaires and key informants were interviewed to get in-depth understanding of risk management processes being practiced, and to explore their opinions on risk management for the ongoing project.
- iii. Analyzing the findings
- iv. Conclusion and recommendation based on the findings.

### 3.2 Data sources and collection

The methods of data collections employed for the research were review of archival records and contract documents, and semi structured interviews. Questionnaires to selected Chief Project officers and Senior Engineers were also distributed and collected.

The number of professionals in the corporation having exposure and experience on Risk Management is quite few. For having a better output and not to rely only on the questionnaire the output of the questionnaire survey was supported with an interview and data from archival records. Also taking into account the small number of interviews, the questionnaire was designed substantially as open ended questions which enabled respondents to express their opinions and experiences.

### 3.3 Population Definition

The selection of the respondents was limited only to workers from the client and the consultant comprising Contract administrators, Claim management experts, resident engineers and Project office engineers from the Addis Ababa Light rail transit project and also from head office staffs of Ethiopian Railways Corporation. The contractor's personnel response to the questionnaire could not be obtained due to unwillingness to assist in the study.

### 3.4 Method of analysis

The Questionnaires and interviews were analyzed in relation to the theoretical propositions. The method used to analyze the data is mainly qualitative method of analysis. A tabular presentation followed by discussions and analysis on the findings is done for the raised issues on the questionnaire and during the interview. The research analysis is conducted in perspective with the research objectives.

Besides tabular presentations and discussions the Analysis of the data gathered was executed by the following questionnaire survey analysis methods for the risk issues raised in the study:

- i) Relative importance Index and
- ii) Risk ranking of frequency and impact

#### Relative Importance

This was used in ranking the significant factors in terms of degree of importance. The respondents were asked to rank the contributing factors for risks according to their level of importance to determine significant sources for the occurrence of risks in Addis Ababa LRT project. This was done using a scale of 1- 3. The scale is as follows:

The expression used for the calculation of Relative importance index is:

$$\text{Relative Importance Index (RII)} = \sum P_i U_i / N(n) \dots\dots\dots \text{Eqn (i)}$$

Where,

$P_i$  = respondent's rating of risk,

$U_i$  = number of respondents placing identical weighting/ rating on the risk

$N$  = the total number of samples

$n$  = the highest attainable score for each risk

### Ranking of the sources of risks from questionnaire analysis

After calculating the relative importance index each is ranked according to the RII. The results related to survey responses on probability of occurrence and impact on cost, time, quality, environment and safety are presented.

The following chart illustrates the process followed when conducting the research.

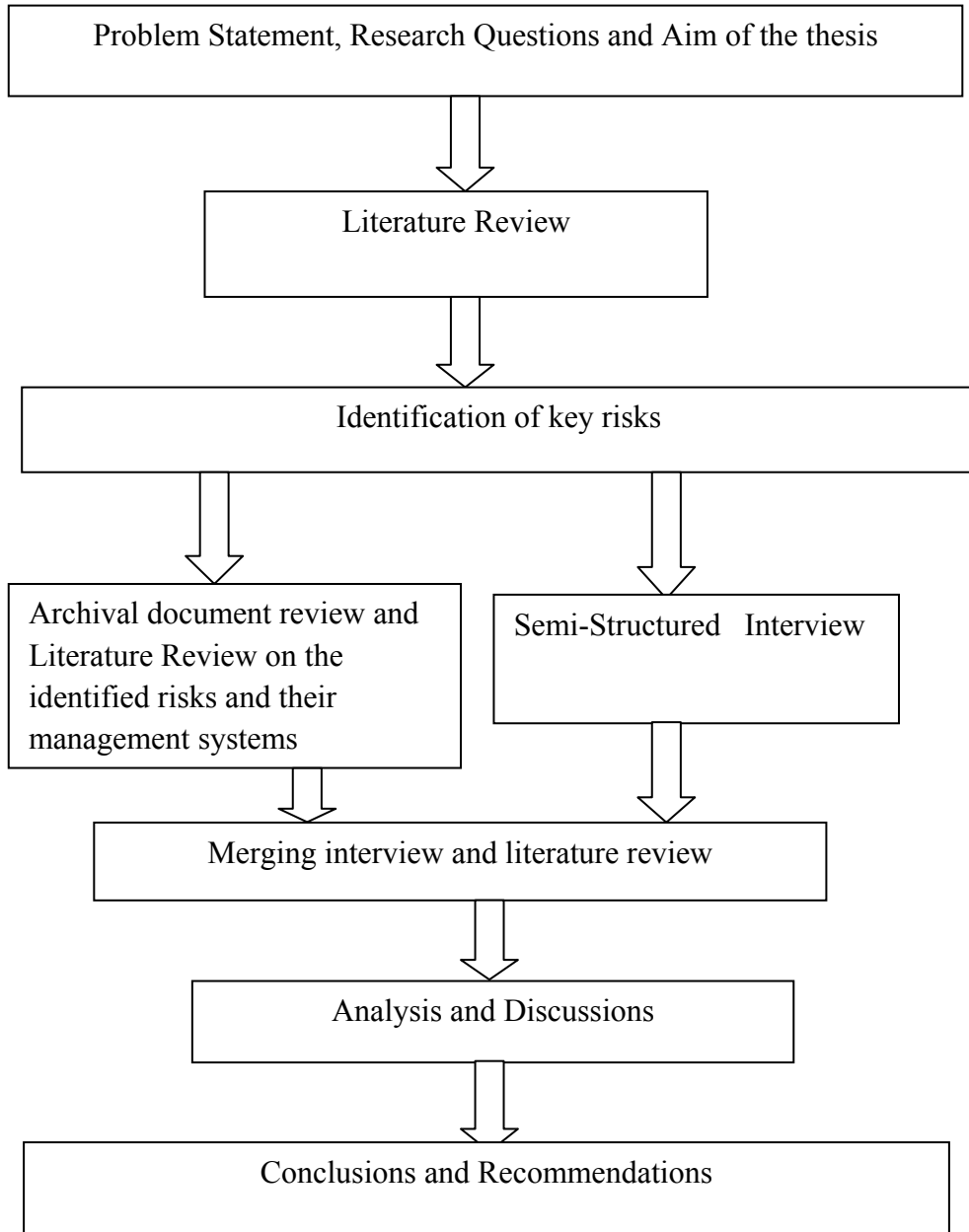


Fig 3.1 Methodology Chart

## **CHAPTER FOUR: RESULTS AND DISCUSSIONS**

### **4.1 Introduction**

The foregoing chapters of the thesis have discussed on the theme of the research, the literature and research methodology. This chapter is dedicated to a discussion on the findings of the research. Findings from review of archival records, interviews and questionnaire surveys are presented. These sources of findings are briefly stated hereunder.

#### **4.1.1 Archival records**

Assessment of archival records was one of the methods for answering the research questions stated on chapter 1. In this method of data collection, contract documents, project progress reports, Employer's Requirements and feasibility studies were reviewed. The following were the findings.

- i) Feasibility studies have covered all aspects of the projects such as technical, financial/economical, environmental impact assessment, and project implementation plans.
- ii) Contract conditions and employer's requirements are investigated, details of which are indicated where list of standards to be met, documents to be submitted, lines of communication and similar requirements are stated.
- iii) Reports covering progress of works, problems encountered and actions taken are revealed.

#### **4.1.2 Questionnaire Surveys**

Eight respondents from Ethiopian Railways Corporation that are Chief Project Execution Officers, Senior Engineers and two respondents from the consultant side, the Deputy Resident Engineer and Claim Expert have responded to the questionnaires.

Questionnaires were sent to 15 persons, consisting of clients and consultants of whom 10 responses were received for a response rate of 67%.The responses were further analyzed to determine the sources, probability of occurrences and their impacts on Addis Ababa Light Rail transit project.

### 4.2.3 Questionnaires Response Rate

To perform a comprehensive study of the risk identification and to determine the probability of occurrence and impact of the risks in Addis Ababa's light rail transit project a total of 14 respondents were selected, respondents comprised of Resident engineers, claim experts, contract administrators, project managers and project engineers. Out of these 15 respondents 10 questionnaires were collected giving a response rate of 67%. From these 15 questionnaires analysis was conducted to determine the occurrence, impact and management practice of risks and mitigation measures which are being conducted to prevent the presence of the risks.

<b>Respondent category</b>	<b>Questioner Distributed</b>	<b>Questioner collected</b>	<b>Percentage collected</b>
<b>consultant</b>	4	2	50%
<b>Client/owner</b>	11	8	73%
<b>Total</b>	15	10	67%

Table 4.1 Questionnaires response rate

### 4.1.3 Interviews

Semi structured interviews were conducted with Project Execution Officers and senior engineers. The interviews have disclosed a number of risks, the mitigation strategies followed and lessons learnt. Also additional refinement interviews have been held with selected respondents to refine the Responses given in the questionnaire.

## 4.2 Understanding the term risk

The first question forwarded to the respondents of the questionnaire survey was whether there is a common understanding of the term risk by most of the personnel in the corporation. As indicated on table 4.1, from a total of ten respondents, seven of them responded the term risk is not commonly understood by most of the personnel in the corporation and the rest three replied it is well understood by most of the staffs. For the respondents saying "No" a question was forwarded to specify what may be the reason and their response is stated as follows:

- i) Background of the personnel is different and their exposure to handle or know the term risk is different
- ii) The difference in level of education between the personnel.
- iii) Less practice of giving attention to the term risk and
- iv) Lack of awareness regarding risks

Figure 4.1 below indicate the responses in graphical presentation

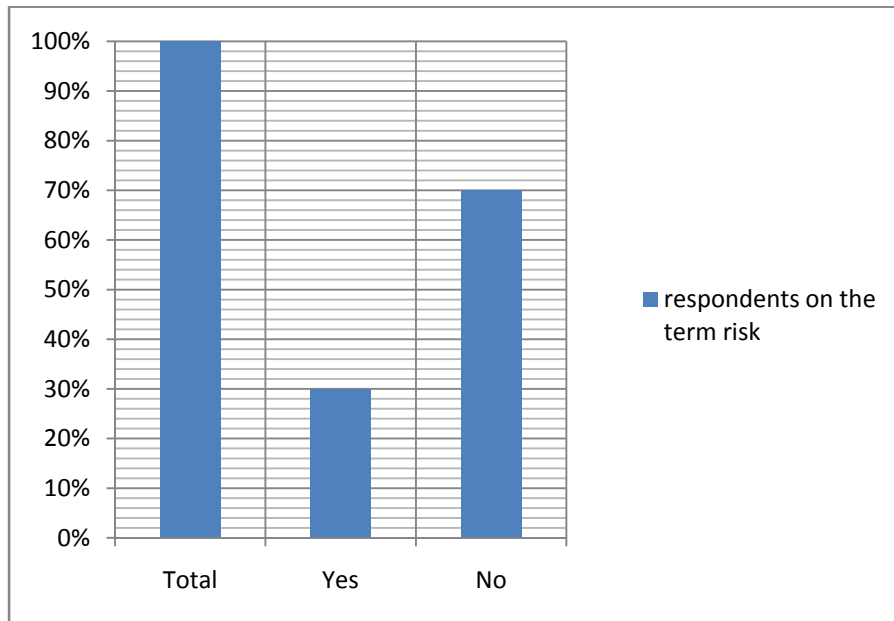


Fig. 4.1 Response rates on the term risk

The graph clearly shows that 70% of the respondents believe that the term risk is not commonly understood by the staffs of the Ethiopian railways corporation and on the other hand 30 % of the respondents believe it is well understood by the personnel in the corporation. The difference in academic background, less practice and limited awareness in the area of risk are found to be the reasons for the difference for not having a common ground in the knowhow of the term risk.

The responses given to this first question clearly show that the term risk is less understood by the corporation’s personnel. Having low awareness is more often a reason to poor or unavailable risk management system. [1]

### 4.3 Integration of risk management with the strategic plan

Respondents were also asked to describe how risk management is integrated with the corporation's strategic plan. The following are the summary of their responses:

- i) The term risk and ideas related with risk are incorporated during feasibility studies and environmental impact assessments, and when developing employer's requirements and contract documents. By including all the above points in contractual documents both in the general and particular conditions of the contract it is believed that risk management is integrated while awarding projects through all these processes. After getting respondents idea further interviews were conducted on the raised subject for the appropriate professionals involved in the project and the following were analyzed:
  - Even if a risk management plan that is to be submitted by the EPC turnkey contractor (CREC) is included in the employers requirement no such documents were submitted and it was confirmed by the interviewees. It is observed from the questionnaire surveys and the interviews that, even if there are trials to incorporate risk management plans on various documents as the ones stated above they are not interpreted into practice. This indicates that risks will prevail until contract requirements on risk management are appropriately incorporated and interpreted.
- ii) The other approach being implemented by the Ethiopian railways corporation is adopting EPC turnkey contract for the AA LRT system as a source of finance for transferring the risk. It was observed during interview and questionnaire surveys that most personnel in the corporation believe that the turnkey contract will secure the risks that may prevail since it is transferred to the contractor. This idea seems risky by itself since the contractor is not here forever and the project has its completion date and the key is to be transferred to the employer for operation: Just believing and assuming that the risk is transferred to the contractor is not the right approach to integrate risk management with strategic plan of the corporation. It should be also noted that although the EPC Turnkey contractor takes more risk than a conventional contract, still large and complex risks linger with the employer. For instance, force majeure risks remain to be the risks

of the employer. Generally, the respondents seem not to have a clear understanding of the risk allocation of the contract.

iii) By transferring the risk handling responsibility to the employer's representative. The questionnaire surveys and the interviews have revealed that the consultant (employer's representative) is taking care of the risks resulting during the construction of the project by using different mechanisms of approach like discussions with higher government officials and stake holders of the project for example in solving right of way problems.

The concept of transferring risk to the employer's representative has also its own deficiencies. In the FIDIC Silver book, the authority of the employer's representative is much more reduced than in the Red book. Besides employer's representatives is a professional consultant assigned to oversee technical issues and does not have the obligation to take care of the employer's risks.

Additionally, while conducting the interview the respondents have forwarded that risk management is not formally coordinated with the strategic plans of the corporation. The planning department identifies and allocates expected difficulties to respective departments and the said department will take care of the subjects raised in the plan. This approach by itself is not also well structured and process oriented.

#### **4.4 Risk Management Plan and Addis Ababa Light Rail Transit Project**

Out of ten, two respondents have answered that there was a risk management plan that was developed before entering into the construction of the LRT project while the rest eight replied that there was no risk management plan developed before entering in to the construction of the LRT Project. Since disparity was clearly seen between the respondents the question was raised to respondents during the semi structured interview and discussions.

The "Yes" respondents emphasize that the risk management plan was included during the feasibility study and it is currently handled by the employer's representative. On the other hand the "No" respondents forwarded the part included in the feasibility study is not sufficient enough and it can be concluded that there was no risk management plan developed before entering in to the construction of the LRT.



The researcher has also noticed that on the Employer's Requirement of the LRT article 6.2-24 it says:

*”Contractor shall institute a risk management plan issue a set of Project Procedures within 42 days from the Commencement Date for Employer's review and approval. Such document shall give the procedures which shall govern the relationship between Employer and Contractor. Document distribution, lines of communication (including contact information), responsibility of project participants, etc.”*

*“The project risk management system shall follow accepted principles of risk management, such as the Australian/New Zealand risk management manual or any other such acceptable procedure.” “The project risk management system shall fulfill the following basics*

- a. Establishing the risk management context including environmental scanning and setting criteria*
- b. Risk identification*
- c. Risk analysis (quantitative and qualitative)*
- d. Risk evaluation*
- e. Risk treatment*
- f. Monitor and Review the process of risk management*
- g. Communicate and consult risk with the Employer and stakeholders.”*

Even if the above statement is included in the requirement, as per analysis of the existing archival documents, questionnaire survey and conducted interviews and discussions, no

documents were submitted by the contractor regarding risk management plan. This implies that close follow up and sufficient care was not given by the concerned bodies of the Ethiopian Railways Corporation specially the AA LRT project office, contract administration department of the Corporation and the employer's representative in the implementation of the raised item that was already written and signed on the submitted documents.

It is also observed that a number of risks like right of way and delay might have got mitigation measures if the risk management plan was submitted by the contractor as stated on the employer's requirement.

#### **4.5 Risks during implementing the LRT project**

Respondents have forwarded the following risks that have occurred during implementation of the project having an impact on quality, cost and time:

- i) Financial risks, technical and technological risks, risks related to design and supervision, contract administration risks such as delay in solving contract issues and ground surveying risks such as encountering cultural and religious relics along proposed alignment.
- ii) Cost overrun due to variation of works and design adjustments
- iii) Risks on safety of workers.
- iv) Risks related to environmental protection.
- v) Risks due to lack of trained personnel
- vii) Right of way risks
- viii) Newness of the project:

Completeness of environmental impact assessments and safety of workers should be secured and risks of adapting a new technology have to be considered and analyzed before the implementation of a specific project. Since there was no experience in developing LRT systems in Ethiopia, construction of AA LRT is challenging and vulnerable for risks like the ones stated above. Not having developed risk handling mechanisms in the sector will result in risks having a significance impact on time, cost and quality.

**4.6 Risk management practice**

**a) formal/informal**

A question was forwarded if there is a formal/informal risk management practice/system in the foregoing LRT project consisting of risk identification, analysis, treatment, monitoring, and consultations with stakeholders.

Out of the total ten respondent’s two saying “Yes” was asked to specify the methods/tools they use to identify, analyze, treat, monitor and consult project risks and are stated as follows:

- i) There is a system by the consultants for controlling and analyzing the risks.
- ii) Discussions are being held with the local community and administration staffs on different issues.
- iii) Risks are being monitored depending on submitted reports.
- iv) Weekly and monthly meetings are held on raised issues.
- v) Risks are being avoided by using project management techniques and project delivery systems.
- vi) By conducting SWOT analysis
- vii) Collecting feed backs from respective bodies and by doing query assessments.
- viii) Document review, site assessment and analysis and experts judgments.

It is observed that most of the above stated points raised by the respondents are not consistent and compatible with the accepted risk management practices as methods or tools for identifying, analyzing, treating, monitoring and consulting project risks.

Table 4.2 Response rates on formal risk management of the corporation

Question						
	Yes		No		I don't know	
	Total Responses	%	Total Responses	%	Total Responses	%
Does the corporation have a <b>formal risk management system</b> consisting of risk management features for the AA LRT	2	20	6	60	2	20

**b) Constraints to establish the system:**

Respondents saying that, there is no formal risk management have forwarded the constraints to establish the system and these are:

- i) Non conducive company policy.
- ii) Lack of trained/committed personnel and officials.
- iii) Lack of knowledge and skills in risk management and its benefits.

It is seen that: lacks of capable, trained, and qualified professionals in the area of risk have resulted for not having a formal risk management system in the corporation. Besides the corporation’s working atmosphere not being comfortable plus personnel and officials lack of commitment have hindered the institution of the system.

**Type of risks taking attention Project Execution Engineers**

The impact of prevailing risks in a project differs one from the other due to their effect on objectives to be met that are set for the specific project. Respondents were asked to name risks they concentrate more and the responses are summarized in the figure below.

High attention is given for risks labeled no. 5, 3 for Medium and 1 for low.

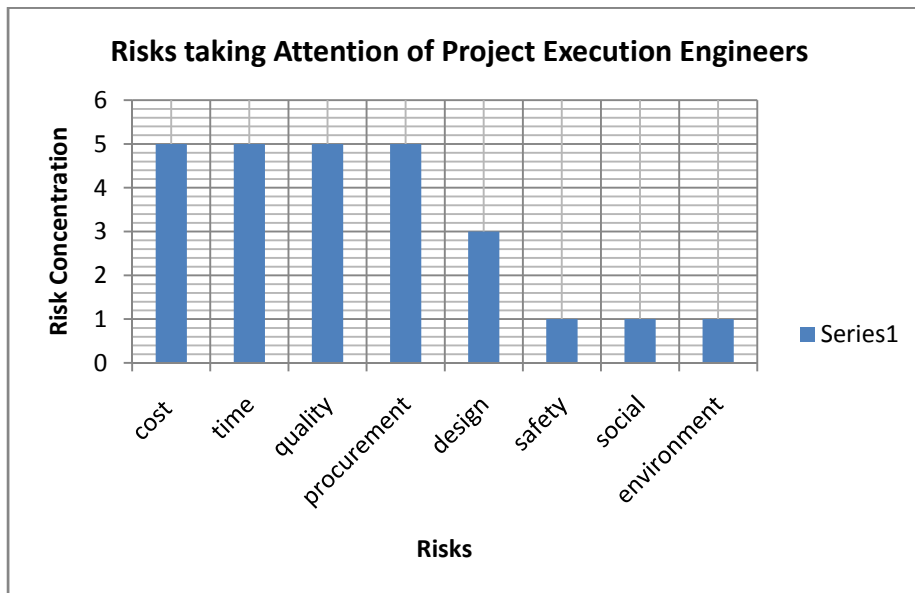


Fig 4.2 Risks Taking Attention of Project Execution Engineers

From the graph it is clearly observed that:

- ✓ Risks that have adverse impact on time, cost, quality, and procurement are given more priority.
- ✓ Medium attention is given to risks regarding design and technical issues.

- ✓ Low attention is given to safety, social and environment related risks.

Remedial and mitigation measures are addressed to the above stated risks by making meeting with higher officials and board of management in the corporation and a team of personnel will be designated for seeking a solution of the encountered risks.

#### **4.7 Sources of Risks and Risk Identification**

Respondents were given a list of groups of risks collected from the literature review. The list of risks and the respondent's responses are given in table 4.3.

Respondents have forwarded their opinion for the sources of risks listed in the table to be the following:

- ✓ Newness of the project: Risks of adapting a new technology have to be considered and analyzed before the implementation of the project. Since there was no experience in developing LRT systems in Ethiopia, construction of AA LRT is challenging and vulnerable for risks like the ones stated in table 4.3. Not having developed risk handling mechanisms in the sector will result in risks having a significance impact on time, cost, quality, environment and safety.
- ✓ Lack of awareness and trained/skilled personnel in the sector: not having improved understanding on the foregoing project and not being able in evaluating contingencies in the area will have its own effect and be a source for risks to emerge.
- ✓ Lack of experience to predict the expected risks: lacking the exposure in construction and operation of LRT systems leads in not having clear view of expected risks that may result due to not having the experience in the sector.
- ✓ Lack of willingness and negligence from the stakeholder side to avoid risks.
- ✓ Lack of motivation: this will result in being a source for risks to prevail if sufficient time and attention is not paid by the concerned staffs and the public.
- ✓ Currency inflation and devaluation.
- ✓ Not giving the proper (appropriate) project duration: appropriate project duration should be set from the inception to the completion of the project not to rush through the stages of the construction and result in an unacceptable ending.
- ✓ Lack of clear and participatory planning program: the planning program should be transparent and based on feed backs of stakeholder's of the project in order not to result in risks of poor planning like stated in table 4.3.

No	Sources of Risk	Probability of Occurrence			Impact															
					Cost			Time			Quality			Environment			Safety			
		High	Moderate	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low	
1	<b>Financial and economic risk</b> (unavailability of funds, inflation, exchange rate fluctuation, insolvency/bankruptcy of major participant, etc.)	3	7		6	2	2	5	5			4	4	2		7	3	5	3	2
2	<b>Contractual and legal risk</b> (delay in solving contract issues, disputes, change order negotiations, extra payments, etc...)	5	4	1		4	6	7	2	1		2	6	2		3	7	2	1	7
3	<b>Subcontractors related risk</b> (subcontractor's failure, lack of coordination, lack of staff, etc...)	3	3	4		4	6	2	3	5		4		6		3	7	2	1	7
4	<b>Operational risk</b> (productivity,	3	4	3	1	5	4	2	3	5		5	2	3	7		3	6	1	3

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	system outage, waste disposal, etc...)																			
5	<b>Safety and social risk</b> (pollution and safety rules, accidents, damage to persons or property, ecological constraints, malaria outbreak, resistance from communities etc.)	5	3	2	2	6	2	4	4	2		4	4	2	6	2	2	6	2	2
6	<b>Design risk</b> (inadequate specification, conflict of documents, design change, scope of work definition, errors, etc.)	5	3	2	9	1		5	3	2		4	5	1	5	1	4	3	5	2
7	<b>Construction Risk</b> (Rush bidding, accuracy of work, accidents and safety, cost overrun, productivity of labor and equipment, etc...)		7	3	3	6	1	3	2	5		3	4	3		5	5		7	3
8	<b>Force majeure risk</b> (war, tsunami, earthquake, typhoon, etc...)			10		1	9		1	9			1	9		1	9		1	9
9	<b>Physical risk</b> (subsurface geology,		6	4		3	7		1	9		2	1	7	2	2	6	2	2	6

Risks and Risk Management of Addis Ababa Light Rail Transit System project

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	ground water, unforeseen site condition, mud flows, release of encased gases, etc.)																			
10	<b>Delay risk</b> (construction delays, third party delay, demand delay, etc...)		7	3	2	5	3	5	2	3			8	2	2	3	5	2	2	6
11	<b>Environmental risks</b> ( Incomplete environmental analysis, Historic site, endangered species, etc)	2	1	7	2	1	7	2	1	7		2	4	4	3	1	6	2	1	7
12	<b>Planning and procurement risks</b> (Rushed decisions to get into contract, Inappropriate contract award process, not well planned contract negotiations, etc.)	3	6	1	6	2	2	6	2	2		6	3	1	2	6	2	3	5	2
13	<b>Risk from a remote stakeholder</b> (environmentalists, media, interest groups, etc.)	2	1	7		1	9		1	9			2	8		2	8		1	9
14	<b>Other</b> (please specify)																			

Table 4.4 Percentage of probability of occurrence and impact of risks

	Sources of risks	% of Probability of occurrence			% of impact on cost			% of impact on time			% of impact on quality			% of impact on environment			% of impact on safety		
		H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
1	Financial and economic risk	30	70		60	20	20	50	50		40	40	20		70	30	50	30	20
2	Contractual and legal risk	50	40	10		40	60	70	20	10	20	60	20		30	70	20	10	70
3	Subcontractors related risk	30	30	40		40	60	20	30	50	40		60		30	70	20	10	70
4	Operational risk	30	40	30	10	50	40	20	30	50	50	20	30	70		30	60	10	30
5	Safety and social risk	50	30	20	20	60	20	40	40	20	40	40	20	60	20	20	60	20	20
6	Design risk	50	30	20	90	10		50	30	20	40	50	10	50	10	40	30	50	20
7	Construction risk		70	30	30	60	10	30	20	50	30	40	30	50	50			70	30
8	Force majeure risk			100		10	90		10	90			90		10	90		10	90
9	Physical risk		60	40		30	70		10	90	20	10	70	20	20	60	20	20	60
10	Delay risk		70	30	20	50	30	50	20	30		80	20	20	30	50	20	20	60
11	Environmental risk	20	10	70	20	10	70	20	10	70	20	40	40	30	10	60	20	10	70
12	Planning and procurement risk	30	60	10	60	20	20	60	20	20	60	30	10	20	60	20	30	50	20
13	Stakeholders risk	20	10	70		10	90		10	90		20	80		20	80		10	90

H: High

M: Medium

L: Low

For the sources of risks stated in table 4.4 above, graphs and their interpretations are given below on their probability of occurrence and impact on cost, time, quality, environment, and safety.

The Percentage of Probability of Occurrence of the risks is shown in the following figure:

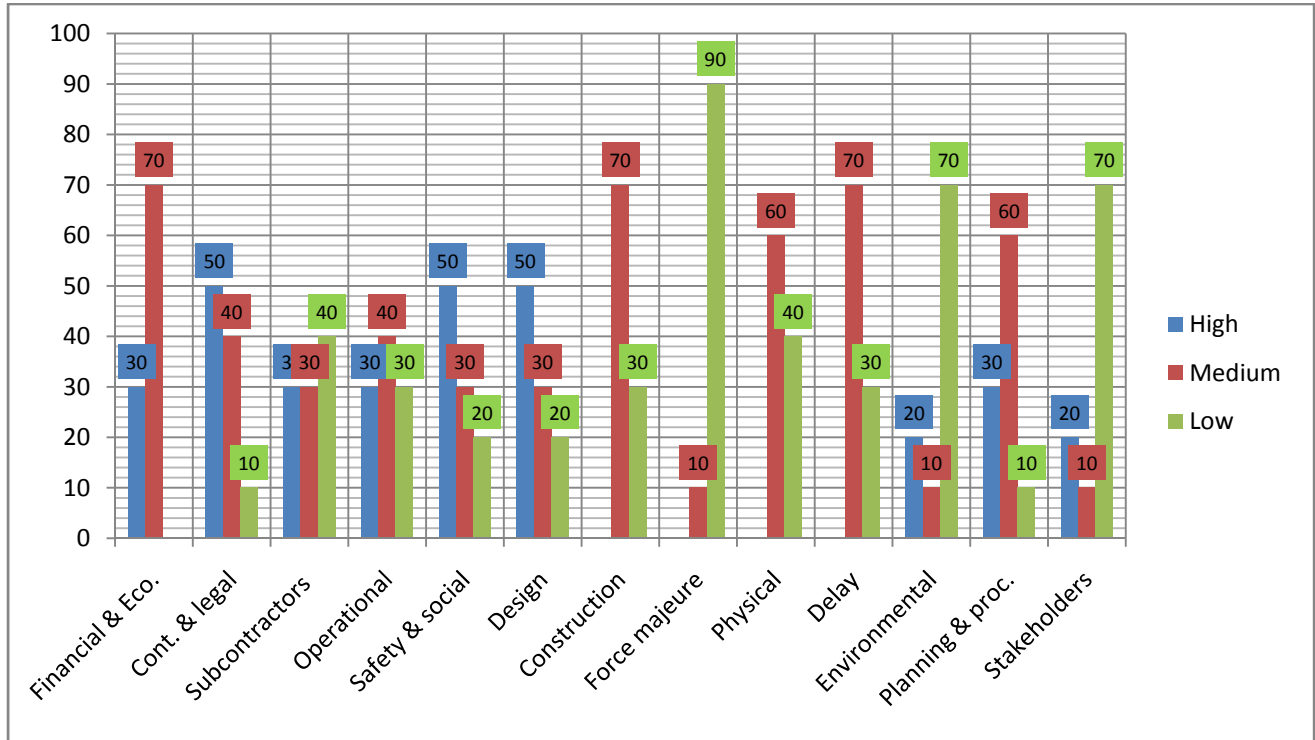


Fig. 4.3 Percentage of Probability of Occurrence of risks

From the graph it is clearly seen that contractual, legal, safety, social and design risks have high probability of occurrence whereas force majeure risks have low probability of occurrence. It is believed that significant and invaluable losses will result if the identified risks having high probability of occurrence are not handled and the owner needs to get prepared to get rid of the identified risks before they prevail. Even if the occurrence of force majeure risks is low it should be remembered that once they occur the loss will be significant. The fact that there is no formal, structured and process oriented risk management system makes the project vulnerable and to any eventuating risks.

Analysis using Relative Importance Index and Ranking of the risks is shown in the following table followed by discussion.

RISK ID	Risk Factors(Sources of Risk)	Degree of Relative Importance Quoted by Respondents			RII	Risk Ranking
		3	2	1		
R1	<b>Financial and economic risk</b> (unavailability of funds, inflation, exchange rate fluctuation, insolvency/bankruptcy of major participant, etc.)	3	7	0	0.76	2
R2	<b>Contractual and legal risk</b> (delay in solving contract issues, disputes, change order negotiations, extra payments, etc...)	5	4	1	0.79	1
R3	<b>Subcontractors related risk</b> (subcontractor's failure, lack of coordination, lack of staff, etc...)	3	3	4	0.63	7
R4	<b>Operational risk</b> (productivity, system outage, waste disposal, etc...)	3	4	3	0.66	6
R5	<b>Safety and social risk</b> (pollution and safety rules, accidents, damage to persons or property, ecological constraints, malaria outbreak, resistance from communities etc.)	5	3	2	0.76	2
R6	<b>Design risk</b> (inadequate specification, conflict of documents, design change, scope of work definition, errors, etc.)	5	3	2	0.76	2
R7	<b>Construction Risk</b> (Rush bidding, accuracy of work, accidents and safety, cost overrun, productivity of labor and equipment, etc...)	0	7	3	0.56	8
R8	<b>Force majeure risk</b> (war, tsunami, earthquake, typhoon, etc...)	0	0	10	0.33	13
R9	<b>Physical risk</b> (subsurface geology, ground water, unforeseen site condition, mud flows, release of encased gases, etc.)	0	6	4	0.53	10
R10	Delay risk (construction delays, third party delay, demand delay, etc...)	0	7	3	0.56	8
R11	<b>Environmental risks</b> ( Incomplete environmental analysis, Historic site, endangered species, etc)	2	1	7	0.50	11
R12	<b>Planning and procurement risks</b> (Rushed decisions to get into contract, Inappropriate contract award process, not well planned contract negotiations, etc.)	3	6	1	0.73	5
R13	<b>Risk from a remote stakeholder</b> (environmentalists, media, interest groups, etc.)	2	1	7	0.50	11

According to the ranking, the top five critical risks that have high probability of occurrence are:

1. Contractual and legal risks (RII = 0.79)
2. Safety and social risk (RII = 0.76)
3. Financial and economic risk (RII = 0.76)
4. Design risk (RII = 0.76)
5. Planning and procurement risks (RII = 0.73)

The most significant risk is ‘Contractual and legal risks’ (RII = 0.79) resulting from delay in solving contract issues, disputes, change order negotiations, extra payments, etc...

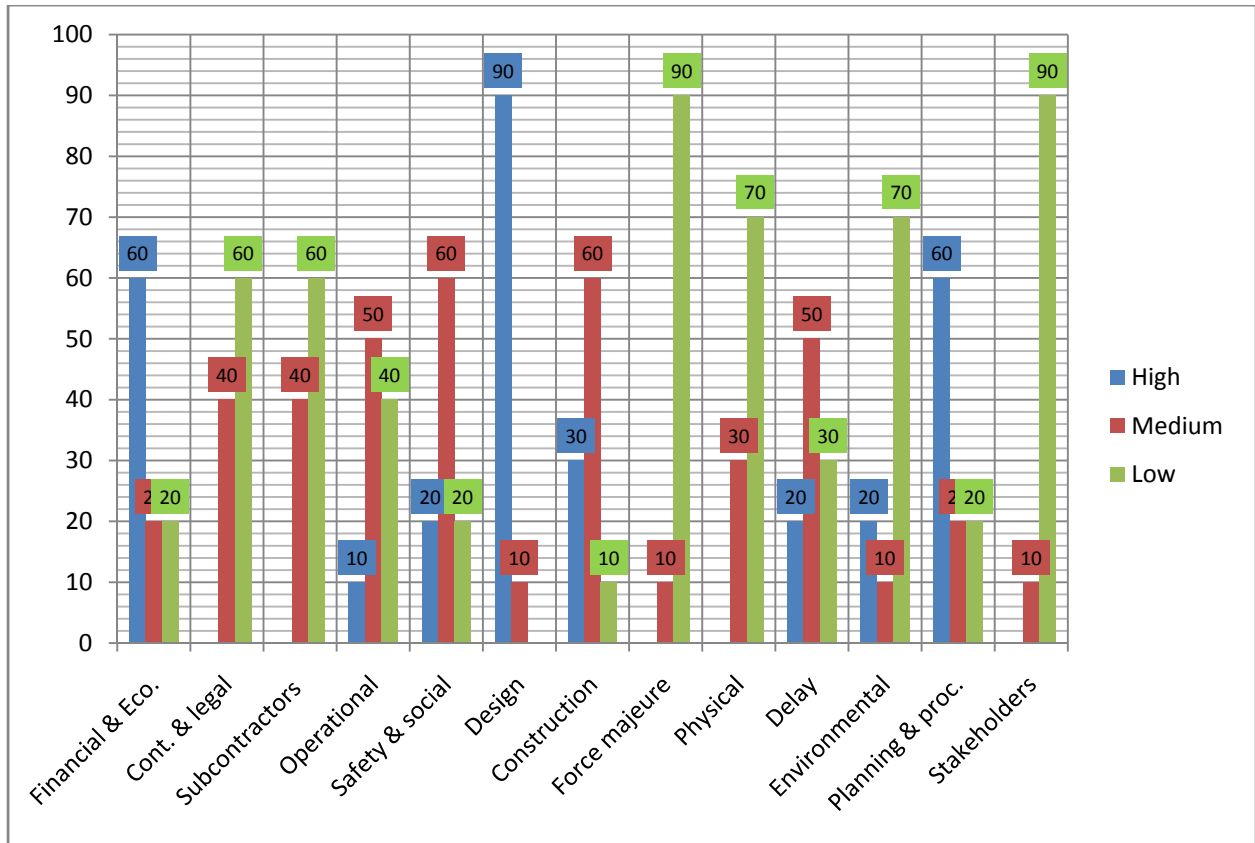


Fig. 4.4 Percentage of Impact of risks on cost

The impact of design risks on cost is high followed by financial and economic, and planning and procurement risks. On the other hand, the impact of risks from stakeholders and force majeure is low. It is noted that, design risks that may result due to inadequate specifications, conflict of documents, change in design and scope of work conditions and also due to errors encountered on design, there will be a significant increment on cost and proper cautions like preparation of detail designs need to be taken not to be exposed in such kind of extra project costs.

As AA LRT is an EPC turnkey contract, Design is handled by the contractor. It is vivid that unless the employer or employer’s representative is well aware of risks emanating from this responsibility, there will be a chance that the contractor’s performance not as per the standard. In this regard, he may come up with altered or deficient designs that may have adverse consequences to the employer. With 90% response rate, the graph under figure 4.4 above is a clear indication towards this presumption. Analysis using Relative Importance Index and Ranking of the risks is shown in the following table followed by discussion.

RISK ID	Risk Factors(Sources of Risk)	Degree of Relative Importance Quoted by Respondents			RII	Risk Ranking
		3	2	1		
R1	<b>Financial and economic risk</b> (unavailability of funds, inflation, exchange rate fluctuation, insolvency/bankruptcy of major participant, etc.)	6	2	2	0.79	2
R2	<b>Contractual and legal risk</b> (delay in solving contract issues, disputes, change order negotiations, extra payments, etc...)	0	4	6	0.46	9
R3	<b>Subcontractors related risk</b> (subcontractor's failure, lack of coordination, lack of staff, etc...)	0	4	6	0.46	9
R4	<b>Operational risk</b> (productivity, system outage, waste disposal, etc...)	1	5	4	0.56	7
R5	<b>Safety and social risk</b> (pollution and safety rules, accidents, damage to persons or property, ecological constraints, malaria outbreak, resistance from communities etc.)	2	6	2	0.66	5
R6	<b>Design risk</b> (inadequate specification, conflict of documents, design change, scope of work definition, errors, etc.)	9	1		0.96	1
R7	<b>Construction Risk</b> (Rush bidding, accuracy of work, accidents and safety, cost overrun, productivity of labor and equipment, etc...)	3	6	1	0.73	4
R8	<b>Force majeure risk</b> (war, tsunami, earthquake, typhoon, etc...)	0	1	9	0.36	12
R9	<b>Physical risk</b> (subsurface geology, ground water, unforeseen site condition, mud flows, release of encased gases, etc.)	0	3	7	0.43	11
R10	Delay risk (construction delays, third party delay, demand delay, etc...)	2	5	3	0.63	6
R11	<b>Environmental risks</b> ( Incomplete environmental analysis, Historic site, endangered species, etc)	2	1	7	0.50	8
R12	<b>Planning and procurement risks</b> (Rushed decisions to get into contract, Inappropriate contract award process, not well planned contract negotiations, etc.)	6	2	2	0.79	2
R13	<b>Risk from a remote stakeholder</b> (environmentalists, media, interest groups, etc.)	0	1	9	0.36	12

According to the ranking, the top five critical sources of risks that have high impact on cost are:

1. Design risk (RII = 0.96)
2. Planning and procurement risks (RII = 0.79)
3. Financial and economic risk (RII = 0.79)
4. Construction risk (RII = 0.73)
5. Safety and social risk (RII = 0.66)

The most significant risk having high impact on cost is 'Design risk' (RII = 0.96) resulting from inadequate specification, conflict of documents, design change, scope of work definition, errors, etc...

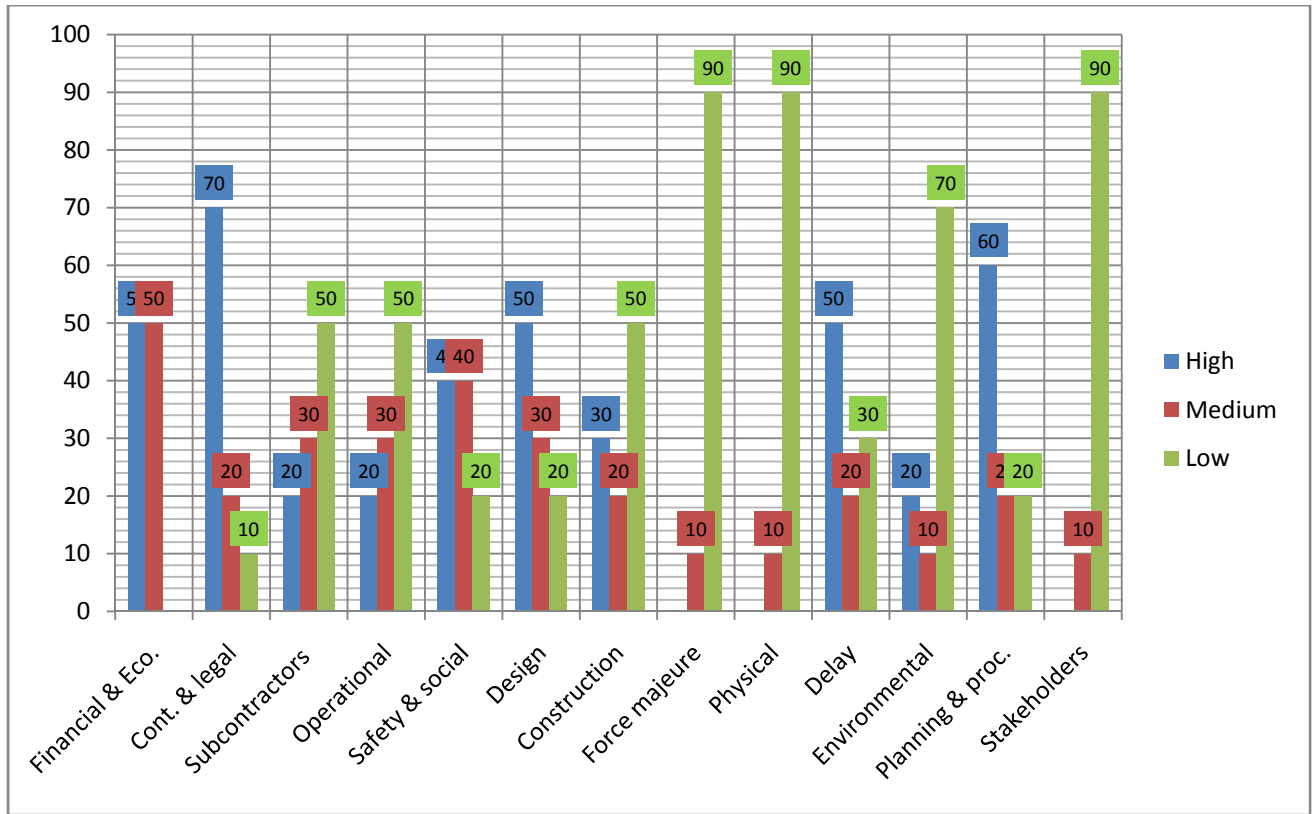


Fig. 4.5 Percentage of Impact of risks on time

From the graph it can be easily observed that contractual and legal risks have great impact on time followed by planning and procurement risks. Physical, force majeure and risks from stakeholders have low impact on time. Proper attention should be given in solving delay in contract issues, disputes and change order negotiations and the like in order not to result in contractual and legal risks that will have high impact on project time.

The figure above shows that contractual and legal risks followed by planning and procurement risks received higher response rates. Problems in contract management like that of delayed responses to contractor’s requests are often a cause of claims and disputes. Also procurement anomalies and rushed decision cause defective and contradictory clauses to creep later on. In this regard, the responses on contractual and procurement related rates are consistent with the surveyed literature.

Analysis using Relative Importance Index and Ranking of the risks is shown in the following table followed by discussion.

RISK ID	Risk Factors(Sources of Risk)	Degree of Relative Importance Quoted by Respondents			RII	Risk Ranking
		3	2	1		
R1	<b>Financial and economic risk</b> (unavailability of funds, inflation, exchange rate fluctuation, insolvency/bankruptcy of major participant, etc.)	5	5	0	0.83	2
R2	<b>Contractual and legal risk</b> (delay in solving contract issues, disputes, change order negotiations, extra payments, etc...)	7	2	1	0.86	1
R3	<b>Subcontractors related risk</b> (subcontractor's failure, lack of coordination, lack of staff, etc...)	2	3	5	0.56	8
R4	<b>Operational risk</b> (productivity, system outage, waste disposal, etc...)	2	3	5	0.56	8
R5	<b>Safety and social risk</b> (pollution and safety rules, accidents, damage to persons or property, ecological constraints, malaria outbreak, resistance from communities etc.)	4	4	2	0.73	5
R6	<b>Design risk</b> (inadequate specification, conflict of documents, design change, scope of work definition, errors, etc.)	5	3	2	0.76	4
R7	<b>Construction Risk</b> (Rush bidding, accuracy of work, accidents and safety, cost overrun, productivity of labor and equipment, etc...)	3	2	5	0.59	7
R8	<b>Force majeure risk</b> (war, tsunami, earthquake, typhoon, etc...)	0	1	9	0.36	11
R9	<b>Physical risk</b> (subsurface geology, ground water, unforeseen site condition, mud flows, release of encased gases, etc.)	0	1	9	0.36	11
R10	Delay risk (construction delays, third party delay, demand delay, etc...)	5	2	3	0.73	5
R11	<b>Environmental risks</b> ( Incomplete environmental analysis, Historic site, endangered species, etc)	2	1	7	0.50	4
R12	<b>Planning and procurement risks</b> (Rushed decisions to get into contract, Inappropriate contract award process, not well planned contract negotiations, etc.)	6	2	2	0.79	3
R13	<b>Risk from a remote stakeholder</b> (environmentalists, media, interest groups, etc.)	0	1	9	0.36	11

According to the ranking, the top five critical sources of risks that have high impact on time are:

1. Contractual and legal risks (RII = 0.86)
2. Financial and economic risk (RII = 0.83)
3. Planning and procurement risks (RII = 0.79)
4. Design risk (RII = 0.76)
5. Safety and social risks (RII = 0.73)

The most significant risk having high impact on time is ‘Contractual and legal risks’ (RII = 0.86) resulting from delay in solving contract issues, disputes, change order negotiations, extra payments, etc...

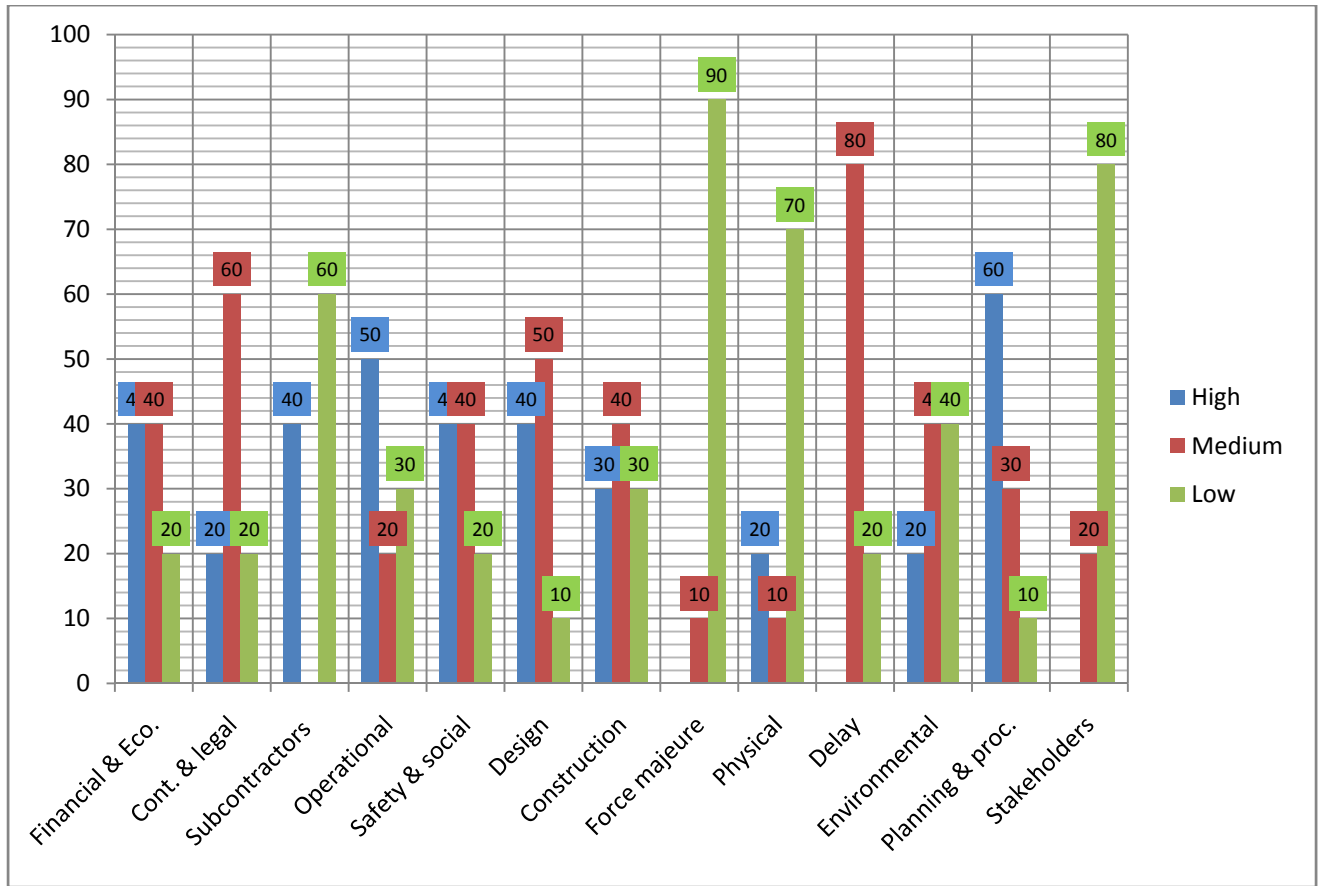


Fig. 4.6 Percentage of Impact of risks on quality

From the graph above, planning and procurement risks have high impact on quality followed by operational risks. It is believed that a number of factors affect quality of a project and it is seen from the graph that rushed decisions to get in to contract, defects in contract awarding process and not well planned contract negotiations in planning and procurement of a project have high impact on the desired quality of a project. But, further studies should be conducted by involving a lot of participants and stakeholder’s in the railway sector since quality of a project is a sensitive issue.

Looking at figure 4.6 above again, planning and procurement related risks followed by operational risks affect quality respectively highly than others. The effect on quality from poor planning and improper procurement is clear. However, operational risk is a post project scenario affected quality even greater than design and construction is highly debatable. This specific point requires further elucidation in similar researches for proving the result found in this study.

Analysis using Relative Importance Index and Ranking of the risks is shown in the following table followed by discussion.

RISK ID	Risk Factors(Sources of Risk)	Degree of Relative Importance Quoted by Respondents			RII	Risk Ranking
		3	2	1		
<b>R1</b>	<b>Financial and economic risk</b> (unavailability of funds, inflation, exchange rate fluctuation, insolvency/bankruptcy of major participant, etc.)	4	4	2	0.73	3
<b>R2</b>	<b>Contractual and legal risk</b> (delay in solving contract issues, disputes, change order negotiations, extra payments, etc...)	2	6	2	0.66	6
<b>R3</b>	<b>Subcontractors related risk</b> (subcontractor's failure, lack of coordination, lack of staff, etc...)	4	0	6	0.59	8
<b>R4</b>	<b>Operational risk</b> (productivity, system outage, waste disposal, etc...)	5	2	3	0.73	3
<b>R5</b>	<b>Safety and social risk</b> (pollution and safety rules, accidents, damage to persons or property, ecological constraints, malaria outbreak, resistance from communities etc.)	4	4	2	0.73	3
<b>R6</b>	<b>Design risk</b> (inadequate specification, conflict of documents, design change, scope of work definition, errors, etc.)	4	5	1	0.76	2
<b>R7</b>	<b>Construction Risk</b> (Rush bidding, accuracy of work, accidents and safety, cost overrun, productivity of labor and equipment, etc...)	3	4	3	0.66	6
<b>R8</b>	<b>Force majeure risk</b> (war, tsunami, earthquake, typhoon, etc...)	0	1	9	0.36	13
<b>R9</b>	<b>Physical risk</b> (subsurface geology, ground water, unforeseen site condition, mud flows, release of encased gases, etc.)	2	1	7	0.50	11
<b>R10</b>	Delay risk (construction delays, third party delay, demand delay, etc...)	0	8	2	0.59	8
<b>R11</b>	<b>Environmental risks</b> ( Incomplete environmental analysis, Historic site, endangered species, etc)	2	4	4	0.59	8
<b>R12</b>	<b>Planning and procurement risks</b> (Rushed decisions to get into contract, Inappropriate contract award process, not well planned contract negotiations, etc.)	6	3	1	0.83	1

<b>R13</b>	<b>Risk from a remote stakeholder</b> (environmentalists, media, interest groups, etc.)	0	2	8	0.40	12
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According to the ranking, the top five critical sources of risks that have high impact on quality are:

1. Planning and procurement risks (RII = 0.83)
2. Design risk (RII = 0.76)
3. Safety and social risks (RII = 0.73)
4. Financial and economic risk (RII = 0.73)
5. Operational risk (RII = 0.73)

The most significant risk having high impact on time is ‘Planning and procurement risks’ (RII = 0.83) resulting from rushed decisions to get in to contract, inappropriate contract award process, not well planned contract negotiations, etc...

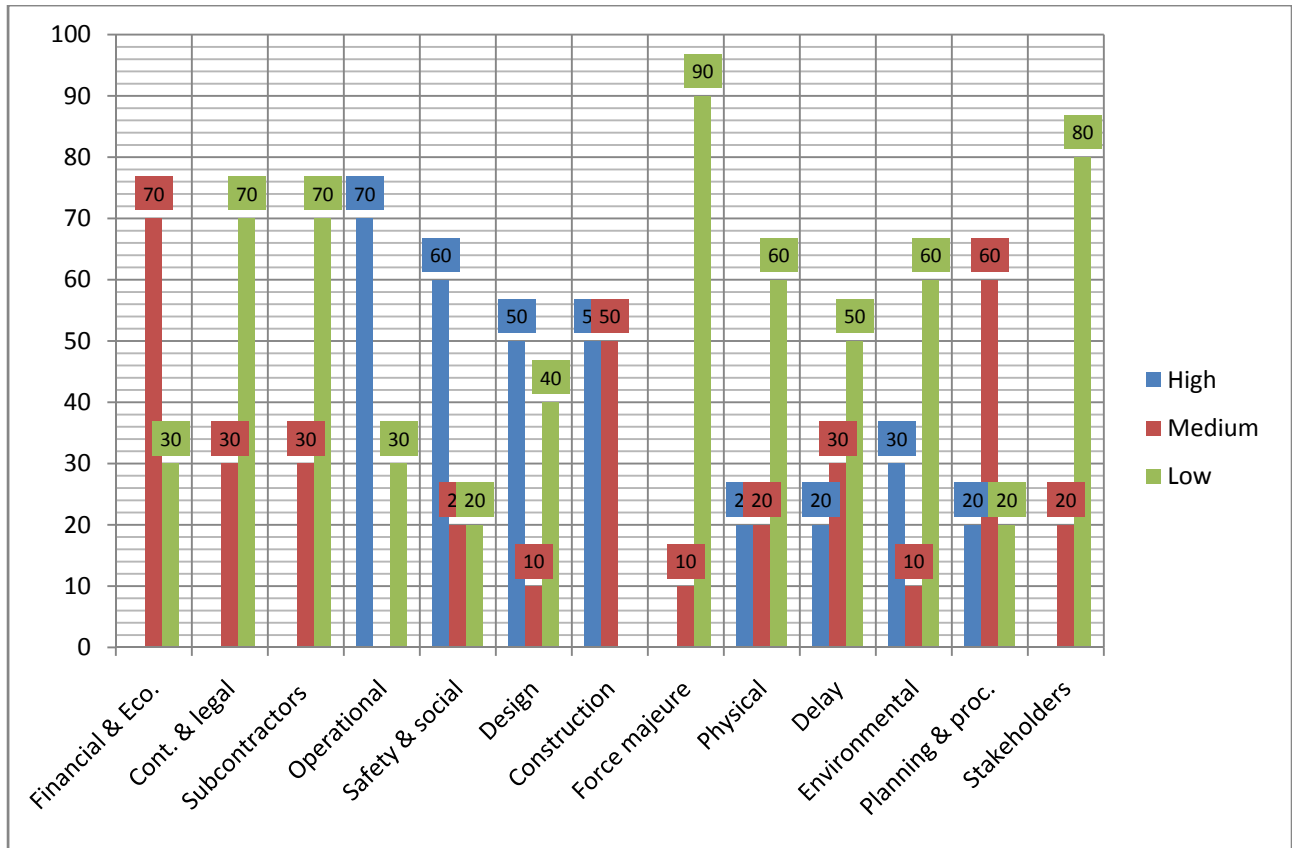


Fig. 4.7 Percentage of Impact of risks on environment

Operational risks, safety and social risks and design risks have high impact on the environment as clearly seen on the graph. It is seen that appropriate care mandatory during operation of the system, the community that is near by the LRT and also users of the system should feel secured by significantly reducing the prevalence of operational, safety, and social risks. It should also be noted that further investigations are necessary in the completeness of environmental impact assessments and the effect of environmental risks on the environment.

Analysis using Relative Importance Index and Ranking of the risks is shown in the following table followed by discussion.

RISK ID	Risk Factors(Sources of Risk)	Degree of Relative Importance Quoted by Respondents			RII	Risk Ranking
		3	2	1		
<b>R1</b>	<b>Financial and economic risk</b> (unavailability of funds, inflation, exchange rate fluctuation, insolvency/bankruptcy of major participant, etc.)	<b>0</b>	<b>7</b>	<b>3</b>	<b>0.56</b>	<b>5</b>
<b>R2</b>	<b>Contractual and legal risk</b> (delay in solving contract issues, disputes, change order negotiations, extra payments, etc...)	<b>0</b>	<b>3</b>	<b>7</b>	<b>0.43</b>	<b>10</b>
<b>R3</b>	<b>Subcontractors related risk</b> (subcontractor's failure, lack of coordination, lack of staff, etc...)	<b>0</b>	<b>3</b>	<b>7</b>	<b>0.43</b>	<b>10</b>
<b>R4</b>	<b>Operational risk</b> (productivity, system outage, waste disposal, etc...)	<b>7</b>	<b>0</b>	<b>3</b>	<b>0.79</b>	<b>1</b>
<b>R5</b>	<b>Safety and social risk</b> (pollution and safety rules, accidents, damage to persons or property, ecological constraints, malaria outbreak, resistance from communities etc.)	<b>6</b>	<b>2</b>	<b>2</b>	<b>0.79</b>	<b>1</b>
<b>R6</b>	<b>Design risk</b> (inadequate specification, conflict of documents, design change, scope of work definition, errors, etc.)	<b>5</b>	<b>1</b>	<b>4</b>	<b>0.69</b>	<b>3</b>
<b>R7</b>	<b>Construction Risk</b> (Rush bidding, accuracy of work, accidents and safety, cost overrun, productivity of labor and equipment, etc...)	<b>5</b>	<b>5</b>	<b>0</b>	<b>0.50</b>	<b>9</b>
<b>R8</b>	<b>Force majeure risk</b> (war, tsunami, earthquake, typhoon, etc...)	<b>0</b>	<b>1</b>	<b>9</b>	<b>0.36</b>	<b>13</b>
<b>R9</b>	<b>Physical risk</b> (subsurface geology, ground water, unforeseen site condition, mud flows, release of encased gases, etc.)	<b>2</b>	<b>2</b>	<b>6</b>	<b>0.53</b>	<b>8</b>
<b>R10</b>	Delay risk (construction delays, third party delay, demand delay, etc...)	<b>2</b>	<b>3</b>	<b>5</b>	<b>0.56</b>	<b>5</b>
<b>R11</b>	<b>Environmental risks</b> ( Incomplete environmental analysis, Historic site, endangered species, etc)	<b>3</b>	<b>1</b>	<b>6</b>	<b>0.56</b>	<b>5</b>
<b>R12</b>	<b>Planning and procurement risks</b> (Rushed decisions to get into contract, Inappropriate contract award process, not well planned contract negotiations, etc.)	<b>2</b>	<b>6</b>	<b>2</b>	<b>0.66</b>	<b>4</b>
<b>R13</b>	<b>Risk from a remote stakeholder</b> (environmentalists, media, interest groups, etc.)	<b>0</b>	<b>2</b>	<b>8</b>	<b>0.40</b>	<b>12</b>

According to the ranking, the top five critical sources of risks that have high impact on environment are:

1. Safety and social risks (RII = 0.79)
2. Operational risk (RII = 0.79)
3. Design risk (RII = 0.69)
4. Planning and procurement risks (RII = 0.66)
5. Environmental and delay risks (RII = 0.56)

The most significant risk having high impact on environment are ‘Safety and social risks’ (RII = 0.79) that will result from accidents, damage to persons or property, ecological constraints, resistance from communities, etc...

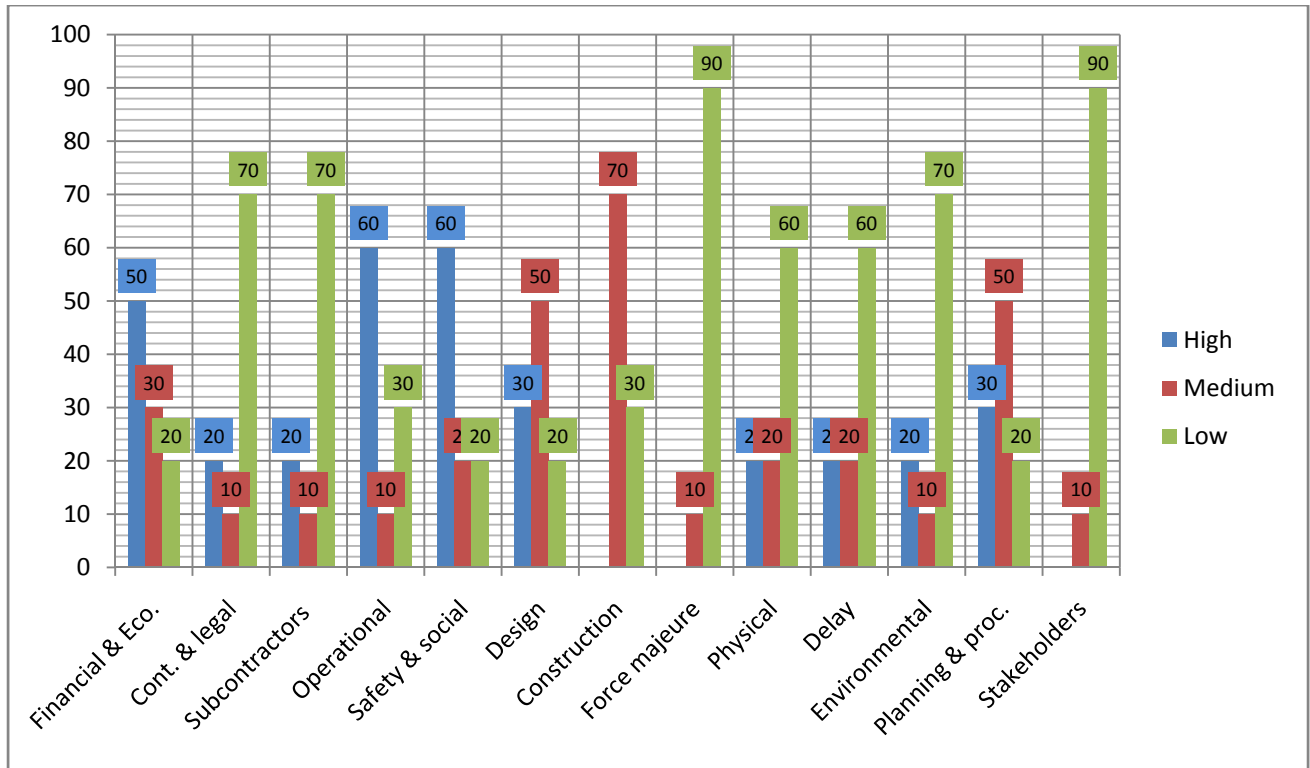


Fig. 4.8 Percentage of Impact of risks on safety

From the graph one can observe that operational risks, safety and social risk have high impact on safety. One can note that critical assessments are needed in factors affecting the operation of the LRT system like system outages and situations that make the public vulnerable to safety and social risks like pollution, inappropriate usage of infrastructures by the public and the like need to be addressed not to result risks related with safety.

Analysis using Relative Importance Index and Ranking of the risks is shown in the following table followed by discussion.

RISK ID	Risk Factors(Sources of Risk)	Degree of Relative Importance Quoted by Respondents			RII	Risk Ranking
		3	2	1		
R1	<b>Financial and economic risk</b> (unavailability of funds, inflation, exchange rate fluctuation, insolvency/bankruptcy of major participant, etc.)	5	3	2	0.76	2
R2	<b>Contractual and legal risk</b> (delay in solving contract issues, disputes, change order negotiations, extra payments, etc...)	2	1	7	0.50	9
R3	<b>Subcontractors related risk</b> (subcontractor's failure, lack of coordination, lack of staff, etc...)	2	1	7	0.50	9
R4	<b>Operational risk</b> (productivity, system outage, waste disposal, etc...)	6	1	3	0.76	2
R5	<b>Safety and social risk</b> (pollution and safety rules, accidents, damage to persons or property, ecological constraints, malaria outbreak, resistance from communities etc.)	6	2	2	0.79	1
R6	<b>Design risk</b> (inadequate specification, conflict of documents, design change, scope of work definition, errors, etc.)	3	5	2	0.69	4
R7	<b>Construction Risk</b> (Rush bidding, accuracy of work, accidents and safety, cost overrun, productivity of labor and equipment, etc...)	0	7	3	0.56	6
R8	<b>Force majeure risk</b> (war, tsunami, earthquake, typhoon, etc...)	0	1	9	0.36	12
R9	<b>Physical risk</b> (subsurface geology, ground water, unforeseen site condition, mud flows, release of encased gases, etc.)	2	2	6	0.53	7
R10	Delay risk (construction delays, third party delay, demand delay, etc...)	2	2	6	0.53	7
R11	<b>Environmental risks</b> ( Incomplete environmental analysis, Historic site, endangered species, etc)	2	1	7	0.50	9
R12	<b>Planning and procurement risks</b> (Rushed decisions to get into contract, Inappropriate contract award process, not well planned contract negotiations, etc.)	3	5	2	0.69	4
R13	<b>Risk from a remote stakeholder</b> (environmentalists, media, interest groups, etc.)	0	1	9	0.36	12

According to the ranking, the top five critical sources of risks that have high impact on safety are:

1. Safety and social risks (RII = 0.79)
2. Operational risk (RII = 0.76)
3. Financial and economic risk (RII = 0.76)
4. Planning and procurement risks (RII = 0.69)
5. Design risk (RII = 0.69)

The most significant risk having high impact on safety is ‘Safety and social risks’ (RII = 0.79) that will result from accidents, damage to persons or property, ecological constraints, resistance from communities, etc...

#### 4.8 Risk Identification

Respondents have been further asked to indicate the methods they use for risk identification. The following are the responses given:

- ✓ Assessment of the project status/condition
- ✓ Document review
- ✓ Experts judgment
- ✓ Project follow ups
- ✓ SWOT analysis
- ✓ Assumption analysis
- ✓ Worst Scenario analysis and
- ✓ Loop hole search are used.

The above stated risk identification techniques are consistent with the internationally accepted techniques for risk identification but other techniques like check list analysis and diagramming techniques should get practiced for making the risk identification more certain.

#### 4.9 Risk analysis

Out of the respondents only one had an experience on risk analysis methods/software. Eight of them do not know whether risk analysis method is applied or not by the corporation and one said there is no risk analysis method or program used by the corporation.

But from their experience of risk analysis and evaluation: High emphasis is given to Time, followed by Cost, Quality, Environmental sustainability and Safety respectively. Respondents experience is shown below:

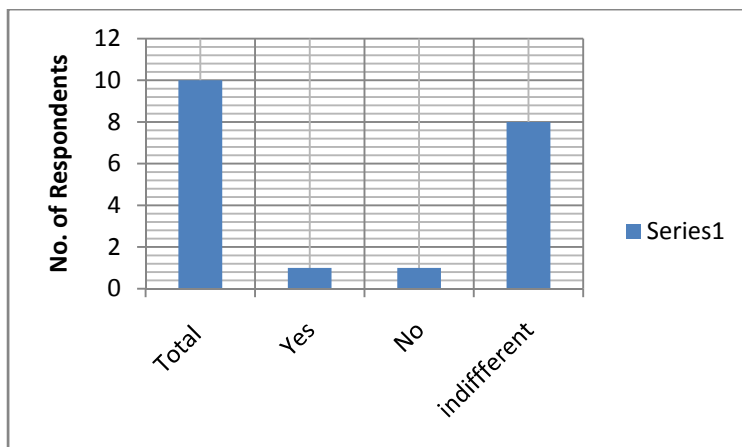


Fig. 4.9 Experience in Using risk analysis Programs by the respondents

Out of the respondents 10% of them do have an experience in using risk analysis methods or software's and also similarly the other 10% do not have an experience in using risk analysis methods or software's and the rest 80% of the respondents do not have information whether risk analysis methods or software's are being implemented by Ethiopian railways corporation.

It is provided in the literature review that Risk analysis involves defining, quantitatively or qualitatively, the consequence (i.e., impact) and likelihood (i.e., probability) of a risk. Risk analysis should use methods to describe risks, such as probability and impact matrices, or more sophisticated probabilistic methods, such as three-point estimates or probability functions and Monte Carlo simulations. Qualitative methods typically applied when analyzing strategic goals and related items.

It is observed that since risk analysis is not appropriately implemented the process to comprehend the nature, impact and probability of occurrence of the risk will be a remaining work and it will have high impact on the project objectives not to be met at an acceptable and desired level.

The response rates and the interviews have given clear indication that risk analysis is the least understood step when compared to identification and treatment. This entails that unstructured and informal risk management that ends up in non systematic identification and conventional treatment methods is not dependable. Such a poor level of understanding on risk analysis is an indication that the core of risk management is not understood in its proper meaning of the internationally accepted practice.

#### **4.10 Stakeholders Analysis**

The construction industry and its stake holders are widely associated with a high degree of risk due to the nature of the construction business, its activities, processes, environment and organizations.[50]

Identifying all the stakeholders and the levels of importance of each stakeholder and evaluating the degree of risk pertaining to each stakeholder are essential ingredients to evolve suitable risk management methods.

Before attempting to deal with stakeholder risk management, it is necessary to understand who the stakeholders are. Project stakeholders are more like project sponsors who do not have any internal project commitments, but they do affect the project externally. They have an interest in furthering the project and they expect to benefit upon successful completion of the project. A project stakeholder is anyone who has an interest in the project.

There are interested bodies and organizations that have got an interest in the outcome and the foregoing activities of the Addis Ababa light rail transit project. Ministry of transport, users of rail services, general public, development partners, media and employees are some identified stake holder expectations as identified and are captured in table 4.5

## Risks and Risk Management of Addis Ababa Light Rail Transit System project

Stakeholder	Stakeholder's expectations from the Corporation	What the Corporation should do to meet stakeholder's expectations
Ministry of Transport	<ul style="list-style-type: none"> <li>▪ Effective and efficient implementation of railway policies</li> <li>▪ Shift of freight from road to rail</li> <li>▪ Decongestion of the major city roads through implementation of metropolitan and commuter rail services</li> <li>▪ Safe operations of railway services</li> <li>▪ Effective Management of the concessions</li> <li>▪ Efficient utilization of non conceded assets</li> </ul>	<ul style="list-style-type: none"> <li>▪ Implement city commuter rail services</li> <li>▪ Monitor safety of concessionaires' operations</li> <li>▪ Monitor the concession</li> <li>▪ Redevelop idle assets</li> </ul>
Users of rail services	<ul style="list-style-type: none"> <li>▪ Efficient and reliable freight and passenger service</li> <li>▪ Safety of rail services</li> <li>▪ Affordable rail services</li> </ul>	<ul style="list-style-type: none"> <li>▪ Invest in rail infrastructure and equipment</li> <li>▪ Ensure safety of operations</li> <li>▪ Expansion of network</li> <li>▪ Efficient cost controls and utilization of public resources</li> </ul>
General public	<ul style="list-style-type: none"> <li>▪ Efficient and effective modern rail services</li> <li>▪ Cost effective mode of transport</li> <li>▪ Network expansion</li> <li>▪ Re development and modernization of real estate assets</li> <li>▪ Friendly customer services</li> <li>▪ Prudent management of resources</li> <li>▪ Safety during and after construction</li> </ul>	<ul style="list-style-type: none"> <li>▪ Effective management of the concession</li> <li>▪ Train and inculcate customer relations in ERC</li> <li>▪ Implementation suitable controls and systems across the organization</li> </ul>
Development partners	<ul style="list-style-type: none"> <li>▪ Transparency and accountability</li> <li>▪ Regulatory framework</li> <li>▪ Enabling environment</li> <li>▪ Compliance with International Best Practice Standards</li> </ul>	<ul style="list-style-type: none"> <li>▪ Provide legal framework</li> <li>▪ Sound financial position</li> </ul>
		<ul style="list-style-type: none"> <li>▪ Provide access to information</li> </ul>

Media	<ul style="list-style-type: none"> <li>▪ Update media regularly</li> <li>▪ Provide accurate information</li> <li>▪ Timely communication</li> <li>▪ Transparency and accountability in the Corporation's operations</li> </ul>	<ul style="list-style-type: none"> <li>▪ Transparency and accountability in the Corporations operations</li> </ul>
Employees	<ul style="list-style-type: none"> <li>▪ Conducive working conditions and safety</li> <li>▪ Fair and equitable remuneration</li> <li>▪ Flexible internal processes</li> <li>▪ Job security</li> <li>▪ Proper internal communication</li> <li>▪ Professional development, growth and empowerment</li> <li>▪ Recognition for achievement</li> <li>▪ Facilitation and support</li> </ul>	<ul style="list-style-type: none"> <li>▪ Training and development programme</li> <li>▪ Formulate proper policies</li> <li>▪ Flexible internal processes</li> <li>▪ Institute and communicate clear work process</li> <li>▪ Provide appropriate and adequate internal infrastructure resources</li> </ul>

Table 4.5 Stake holder's analysis

#### **4.10.1 Successful Stakeholder Risk Management**

Project stakeholders have a huge impact on the overall performance of a particular project from the inception to end level of project execution. Their interests may completely affect the whole system of project management and can lead to improper project execution or delayed project completion.

Risk mitigation and risk prevention are the top stakeholder risk management priorities. The success of risk management lies in the fact that all risk perceptions are fully visualized and proactive risk management measures are put in place. It is necessary to evaluate all types of risks and find solutions to preempt the threats before the risk occurs. The more one knows about the stakeholders and their levels of importance, the more effective and purposeful the risk management strategy will be.

#### **4.11 Identified risks from archival documents, Questionnaire Surveys and Interviews**

##### **4.11.1 Strategic Risks**

It is believed that ERC has a strategic plan that describes the common purpose of the corporation, identifies key priorities and strategies to achieve objectives and sets policy agenda for years. But it is clearly seen that formal risk management plan and department are not set on the strategic plan and its organizational structure. It is also observed that no qualified risk officers are appointed in the corporation.

This shows that risk management system is not formally coordinated with the strategic plan. As a result risks prevailing at this level may affect the decisions made around whole-of-government and organizational priorities, resource allocation, and tolerance and acceptance of risk.

##### **4.11.2 Operational risks**

These include inadequate staff, level of operational performance achievable during the operating life of infrastructure assets and lack of understanding of operational procedures by either internal or external customer.

After the project is completed, the risks of the project may be reflected in the operation process. Operation risks generally occur in the following processes:

- (1) Due to lack of operation management experience of LRT projects, the project operation organization may not have the capacity of operation management, resulting in operation risk.
- (2) The national finance departments like ministry of finance and economic development and the project employer failure to establish reasonable financial subsidy principles for the operation company, leading to unstable continuous fund supply during the operation and unsustainable operation of the project.
- (3) Not being accurate in the prediction of transport demand during planning. An overestimate will reduce the expected operating revenues and increase the construction and maintenance costs of infrastructure and subsequent operation risk. To reduce such risks, the demand should be planned prudently first.

#### **4.11.3 Technological risks**

These include slow pace in adoption of the required technology in handling the foregoing LRT project by the corporation, national contractors and professionals. Also the complexity introduced as a result of new technology in design, construction, operation and usage will have its own impact on the professionals in the field and also for users and stakeholders of the project.

#### **4.11.4 Power Supply risk**

A significant power supply interruptions are being observed and are still occurring in the city of Addis Ababa. A single line is on construction for providing the required power consumption for the LRT but till now there is no such guarantee that, there will be no system outage in the operation of the LRT system. Although Ethiopia boasts rich power resources, more supporting power facilities should be constructed to meet the requirements of power supply stations along the railway track.

#### **4.11.5 Labor risk**

The average price of Ethiopian labor force is low. Moreover, local labors must be employed for some low-end posts.

As stated in sub clause 6.1 of the Particular Conditions of Contract about engagement of staff and labour:

*“Generally unskilled labour which is required by the contractor for the work shall be recruited directly by the contractor, or through a labour supplier.*

*The contractor is encouraged to the extent practicable and reasonable to utilize staff and skilled labour with the required qualifications and experience from sources within Ethiopia.”*

In order to prevent and control labor risk, the EPC contractor and employer of the project shall strengthen their communication for the implementation of the above stated clause, and there should be respect of local culture and regular trainings should be provided to promote compatibility of the culture between both parties.

#### **4.11.6 Knowledge transfer Risk**

Even if there was great ambition by the owner, in transfer of knowledge from the EPC contractor to national professionals in the railway sector, the number of mentally skilled national professionals participating in this huge and vast LRT system is quite few and this will definitely result in difficulties to receive and handle the near future expansion LRT projects by national professionals.

#### **4.11.7 Repayment Risk**

As an important infrastructure project the AA LRT will play a significant role in promoting the economic development in vicinity areas. However, as per the interviewees it is difficult for the AA LRT to repay the loan and interest by its own financial benefit and subsidy from the government is needed. Therefore, the project has certain repayment risks.

#### **4.11.8 Capacity Building for ERC**

ERC proposed that issues involving Capacity Building of the Light Rail Transit (LRT) System requires serious attention as the sustainability of the project is fundamental concern in the context of Ethiopia. It is stated in the contract agreement that:

The Contractor together with the Employer will work towards building the local capacity and propose a Capacity Building Programme including:

- a) Pre-construction period Capacity Building involving the training of local staff to understand and able to capture the LRT system design.
- b) During Construction period Capacity Building encouraging local input at all levels of the implementation of the LRT project comprising subcontractors, the training of skilled and semi-skilled personnel and
- c) Post Construction: It is envisaged that the maintenance and operation of the LRT project will be run by Ethiopians and preparation of the local staff should be planned at early stage.

Even if the Capacity Building programme is stated in the contract, it should have been clearly stated in type and quantified manner for not to result the program to be subjected on negotiation. A number of workshops and training are being given for Ethiopian professionals by the Chinese

government but since this capacity building programs are not dealt in depth in the contract document the programs are being conducted by making negotiations.

**4.11.9 Land Acquisition (Right of Way) risks:** includes failure in not meeting the responsibility for clearing and expropriation cost of any utilities (underground, above ground or at the surface) and buildings within the right of way that will result in financial and time extension claims.

For a reference the contractor have submitted claim notices through letters ET/ERC/LRT/2013-207 and ET/ERC/LRT/2013-214 on the employer's serious delay of land acquisition and demolition work and for the employer's failure to relocate underground sewages for No. 4 and No. 5 Bridge on NS line on time. It has also resulted in slow progress of the project due to relocation and demolishment works that are to be done by the employer are slow.

**4.11.10 Flood risk:**

One of the most important issues of the track form design for the Addis Ababa LRT project is the drainage system. Given the urgency of the LRT project and time constraints to complete the project, it would be prudent to undertake a thorough review of all the drainage design work undertaken by the International Contractor to manage the flood risk to the project as a whole. These designs would then need to be signed off by an independent consultant that has the relevant experience on similar projects. This exercise manages the risk of poor design and will not expose the ERC to unnecessary risks. [32]

Extreme flood events as a result of heavy rainfall will result in hydrological and flood risks. This situation was observed in the mid of August, 2014 and the following picture illustrates the situation.



Picture no. 3 Flood event near Gotera

#### **4.11.11 Documentation risks:**

Since “information is power” appropriate documentation mechanisms should be set for projects like AA LRT and access to needed data’s should be in comfortable manner. Documents that are not confidential should be easily accessed and nearby for visitors who are in need for it. Things may be done repeatedly if one is not informed for the existence of the information. It will be beneficiary to use e-tools and make data’s be easily accessible.

#### **4.11.12 Natural and Cultural heritage risks**

The AA LRT project area has some cultural and historical sites like the statue of Minilik II and Abune Petros monuments. Attention should be given to local religious institutions and cultural bureaus to be invited for monitoring such sites and report any findings to relevant authorities for further investigations before construction work continues in the immediate areas of the site.

Careful selection of alignments should be done not to result in losing magnificent cultural and religious relics.

Impacts of negligence of cultural relics and religious heritages:

- Loss of cultural, religious and historical heritage as well as aesthetic resources.
- Breach in agreements with traditional authorities concerning cultural, religious, historical and aesthetic sites and resources.

Before getting into construction, it should be mandatory to carry out an archaeological search in the potential areas containing artifacts and preserve discovered artifacts. Also in depth Negotiations should be held with traditional authorities for the preservation of important cultural, religious, historical and aesthetic sites and resources and agree on potential compensation for the communities.

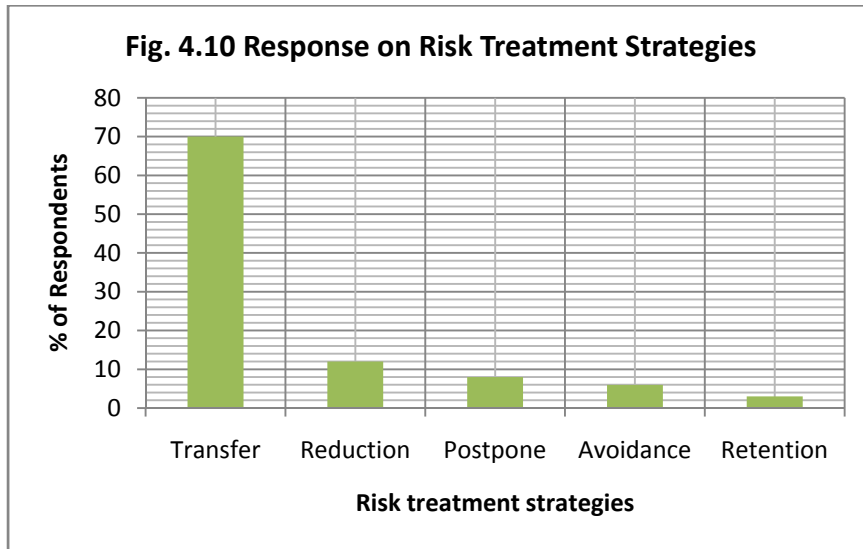
During land clearing, ensuring an archaeological surveillance in the potential areas containing artifacts and in case of a discovery, advising the concerned authorities is necessary and involving traditional authorities in monitoring cultural, religious, historical and aesthetic sites and resources during construction activities is critical.

**4.11.13 Contract administration related risks:**

Contracts should be carefully administered not to result in big losses of project objectives. It is observed that sufficient follow ups on employer's requirement agreements are not being conducted. As per the employers agreement a risk management plan was to be submitted to the employer by the contractor after 42 days of commencement of the contract, but no such document was submitted. Also clauses especially in the particular conditions of contract should be dealt in depth such as the capacity building program for the case of the LRT project which is subjected to negotiation in case of trainings, workshops and further professional studies since there is no clearly quantified and described program in the contract.

#### 4.12 Risk Treatment

After undergoing a risk analysis and evaluation, risks are treated so that their overall adverse impact on the success of the project will be minimized to the lowest level possible. Respondent's response on risk treatment methods mentioned in the questionnaire survey is indicated in the following figure



The risk treatment methods are compatible with the internationally accepted methods and it can be concluded from the graph that risk transfer mechanism is more utilized by the corporation than other methods for risk treatment. Risk treatment methods are developed after identifying and analyzing each for its impact on project objectives of completion time, cost and quality.

It should be revisited here that for the identified risks discussed in 4.10 a risk management plan and strategy should be developed and they should get treated by the owner of the project before they result in a significant investment loss.

**4.13 Risk Allocation**

Risk allocation involves the allocation of risks and responsibilities between the contracting parties. Respondents were asked from their practice, to whom are risks arising from unforeseeable difficulties assigned:

Out of ten respondents six of them responded it is to be assigned to the contractor and the rest four said the risks are to be assigned for both the employer and the contractor.

Table 4.6 response rates on risk allocation

To whom are risks arising from unforeseeable difficulties assigned?	Contractor		Contractor and Employer		Employer	
	Total Responses	%	Total Responses	%	Total Responses	%
	6	60	4	40		

As per the article 4.12 of General Conditions of Contract Unforeseeable difficulties are assigned to the contractor and reads as:

- “a) The contractor shall be deemed to have obtained all necessary information to risks, contingencies and other circumstances which may influence or affect the works:*
- b) By signing the contract, the contractor accepts total responsibility for having foreseen all the difficulties and costs of successfully completing the works: and*
- c) The contract price shall not be adjusted to take account of any unforeseen difficulties or costs”*

**Risk allocation practices of Interviews**

It is observed from the interviews conducted that the risk allocation practiced by Ethiopian Railways Corporation is not controlled formally. But as per the informants the planning department of the corporation identifies challenges and difficulties during planning stage and the identified challenges and difficulties will be distributed to respective departments in the corporation that are able to manage.

#### 4.14 Summary on Findings

The foregoing chapter of the thesis has presented detail analysis of the data collected from the archival documents, questionnaire surveys and interviews. This sub chapter is dedicated to detail presentation of the findings of the research.

1) the term risk lacks clear understanding between the personnel of Ethiopian railways corporation and the difference in level of academic background of the staff, limited awareness and less practice in the area of risk, lack of practitioners in the field and not having a related department in the corporation are raised to be the reasons for the common knowhow of the term risk not to prevail.

2) Even if ERC has a planning department for setting goals and strategies of the organization risk management is not formally integrated in its strategic plan. Trials have been done to incorporate it in an unstructured way like by including ideas related with risk and risk management in contract documents, employer's requirements, feasibility studies and environmental impact assessment plans. The other way of integration of risk management with the plans is using EPC turnkey project delivery system for transferring the risk to the contractor and the rest risk handling responsibility was given to the employer's representative to take care of risks resulting during the construction of the project.

3) There was no risk management plan developed before entering in to the construction of AA LRT project. Even if it was included in the employer's requirement for the EPC contractor to submit a risk management plan, as per the analysis there was no such document submitted. It shows that there are gaps in contract administration and close follow ups of written documents. A number of risks like right of way might have got mitigation measures if the document was being at hand by the employer.

4) Risks having an impact on quality, cost and time have been forwarded during the questionnaire survey and interview. Among them are Financial risks, technical and technological risks, design risks, supervision risks, contract administration risks, and ground surveying risks. Risks on safety of workers, Risks related to environmental protection, Risks due to lack of

trained personnel, risks due to Lack of national contractors capable of executing this kind of mega projects and Right of way risks are pointed to be risks encountered during the implementation of the AA LRT.

5) The constraints for establishing a formal risk management practice were forwarded to be non conducive company policy, lack of trained and committed personnel and officials and lack of knowledge and skills in risk management and its benefits.

6) Risks related to cost, time, quality and procurement are given more attention by project execution engineers than risks related to design and technical issues, followed by safety, social and environmental related risks.

7) Lack of awareness in the risk management sector, newness of the project, lack of trained or skilled personnel and lack of experience to predict expected risks and lack of willingness and negligence from the stakeholders side to avoid risks, lack of motivation, not giving proper (appropriate) project duration and lack of clear and participatory planning program are listed to be sources of risks for the list of risks presented in table 4.3 of the thesis.

8) Based on the assessment done on a group of risks presented in table 4.3 the analysis has revealed that contractual, legal, safety, social and design risks have high probability of occurrence and impact of design risks on cost is high followed by financial, economic, planning and procurement risks. It is also observed that contractual and legal risks are having high impact on time and quality followed by planning and procurement risks. Operational risks, safety and social risks and design risks are observed to have high impact on the environment and safety.

9) Respondents have forwarded that the risk identification techniques they experience and are stated as follows: Document review, expert's judgment, project follow ups, SWOT analysis, Assumption analysis, worst scenario analysis and loop whole search are mentioned. It is observed that the above stated techniques are consistent with the internationally accepted practice.

10) Risk analysis methods or software's are not being implemented in the corporation. But from their experience on risk analysis the respondents have forwarded that high emphasis is given to time followed by cost, quality, environmental sustainability and safety respectively.

11) Risks from the archival document, questionnaire surveys and interviews are gathered and are stated as follows:

Strategic risks, operational risks, knowledge transfer risks, technological risks, power supply risks, labour risks, repayment risks, risks related to capacity building programs, right of way risks, flood risks, documentation risks, natural and cultural heritage risks and contract administration risks.

12) The risk treatment methods are compatible with the internationally accepted methods and risk transfer methods are more employed than other methods for risk treatment.

13) The analysis of the thesis on risk allocation revealed that risks arising from unforeseeable difficulties are assigned 60% to the contractor and 40 % for both the contractor and the employer. Risks are allocated to respective departments after difficulties and challenges are identified by the planning department of ERC. But the contract allocates risks arising from unforeseeable difficulties to the contractor as per article 4.12 of the GCC.

## CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

### 5.1 Conclusions

As described in section 1.2, the aim of this research is to identify the risks in Addis Ababa light rail transit system project and enlighten the need for risk management system. It is the objective of the thesis study to analyze and treat the identified risks so that project objectives can be met with more certainty.

Other objectives include to assess the existing practices of risk reduction/mitigation strategies, Minimize the impact of unplanned incidents on the project by identifying and addressing potential risks before significant negative consequences occur, Maximizing the probability of positive events and minimizing the probability and consequences of adverse events and to come up with recommendations on risk identification and risk management system for the project. Answering questions on risk identification, analysis, treatment and their management system was assessed.

A literature survey was carried and research methodology developed. The data collected through archival records, questionnaire survey and interviews was analyzed and case project contract reviewed. The findings have been analyzed and discussed in the relevant sections. The conclusions drawn from the study are presented hereunder.

1. The archival record investigations and the interviews have concluded that Ethiopian Railways Corporation has not instituted formal project risk management systems for the AA LRT.
2. Construction project risk identification is performed in one or more of the following methods.
  - ✓ Assessment of the project status/condition
  - ✓ Document review
  - ✓ Experts judgment
  - ✓ Project follow ups
  - ✓ SWOT analysis
  - ✓ Assumption analysis
  - ✓ Worst Scenario analysis
  - ✓ Loop hole search

The following risks have been identified in the project

**Strategic risks** such as not instituting a formal risk management system for the foregoing AA LRT project.

**Construction risks** such as Completion with cost overruns, Delayed completion, Completion with performance deficiency, etc.

**Planning risks** such as not having formal and detailed project risk management plans and lack of operation and maintenance manuals.

**Technology risk:** slow pace in adoption of the required technology in handling the foregoing LRT project

**Right of way risks:** not making ready the construction site ready.

**Project management risk** (Lack of knowledge, skills and qualifications, Lack of motivation).

**Hydrological risks** (extreme flood events)

**Operation Risk**

**Capacity Building Programs:** not clearly stated on the contract.

**Usage Risk:** Newness of the sector

**Repayment risk:**

**Risks related to Contract Effectiveness:** poor contract administration.

3. Even if a risk analysis mechanism is not as such developed by the owner of the project, the questionnaire surveys and interviews have revealed that high emphasis is given to Time, followed by Cost, Quality, Environmental sustainability and Safety respectively.

4. Risk transfer mechanism is more employed than other methods for risk treatment. Risk treatment methods are developed after identifying and analyzing each for its impact on project objectives of completion time, cost and quality.

## 5.2 Recommendations

Based on the findings of the research, the following recommendations are made.

1. Strategic plan and program consisting of authorities like ERC, EEPCO, AAWSA, AACRA and ETC should be developed for smooth and parallel flow of construction activities to prevail among the referred authorities and every concerned authority will be effective and efficient by manipulating this program.
2. Exercising risk management and applying quantitative risk quantification techniques helps in informed and objective decision making. The use of tools such as risk management software is helpful in this case.
3. Contract documents like Tender documents, Contract negotiations and Designs should always be structured and detailed and should not be subject to negotiations.
4. Having qualified experienced and motivated staff and a risk management department benefits the Corporation in many respects.
5. National contractors and consultants should be involved in the railway sector by upgrading their capacities since there will be a significant reduction in cost for erecting the desired infrastructures and there will be an outstanding support for the national economy by significantly reducing exchanges of foreign currencies.
6. The measures to be put in place by the Corporation for ensuring identification of risks and mitigation must include periodic monitoring of the implementation process to enable detection of risks, recruitment and training of staff, holding of regular meetings with stakeholders and development partners, and acquisition of requisite facilities.
7. At grade, elevated and underground sections of the LRT should be well integrated and the Choices that have been made or to be made concerning the integration of a future LRT system have their own impact on the entire landscape of the city, urban image and functioning of the mass transit system. Some cities in the world have deteriorated their urban landscape because of poor integration of elevated systems. The LRT lines and stations need adequate right-of-ways and therefore will have an impact on existing or new public spaces. Choices will have to be made

concerning accessibility to the stations and street furniture, as they will contribute to defining the new identity of Addis Ababa.

8. The corporation should give attention in addressing problems related to capacity limitations in the area of technology, design and construction, project management and resolving problems associated with right of ways.

9. Consultations with stakeholders, Identifying and applying appropriate type and conditions of contract, Plan and allocate sufficient time and source to propose the employers requirement, Allocation of skilled and committed personnel in the project, Include every executable item in the contract document before awarding the contract, Closely follow the project, Have experienced personnel in administering EPC turnkey contracts, Minimize variation of works and design adjustments that lead to cost overrun and Create an awareness on risk management.

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**Risk Assessment Matrix Cited on**  
[Documents/risk-management.pdf](#)  
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Appendix – A

Probability of Occurrences			Catastrophic	Critical	Moderate	Minor	Negligible
Definition	Meaning	Value	(A)	(B)	(C)	(D)	(E)
<b>Frequent</b>	<ul style="list-style-type: none"> <li>Occurs frequently</li> <li>Will be continuously experienced unless action is taken to change events</li> </ul>	<b>5</b>	5A	5B	5C	5D	5E
<b>Likely</b>	<ul style="list-style-type: none"> <li>Occur less frequently if process is corrected</li> <li>Issues identified with minimal audit activity</li> <li>Process performance failures evident to trained personnel</li> </ul>	<b>4</b>	4A	4B	4C	4D	4E
<b>Occasional</b>	<ul style="list-style-type: none"> <li>Occurs sporadically</li> <li>Potential issues discovered during focused review.</li> </ul>	<b>3</b>	3A	3B	3C	3D	3E
<b>Seldom</b>	<ul style="list-style-type: none"> <li>Unlikely to occur</li> <li>Minimal issue identification during focused review</li> </ul>	<b>2</b>	2A	2B	2C	2D	2E
<b>Improbable</b>	<ul style="list-style-type: none"> <li>Highly unlikely to occur</li> </ul>	<b>1</b>	1A	1B	1C	1D	1E

Risk Levels:

- Risk is High for codes 5A, 5B,5C,4A,4B,3A
- Risk is Medium High for codes 5D, 5E, 4C, 3B, 3C, 2A,2B
- Risk is Medium Low for codes 4D, 4E, 3D, 2C, 1A, 1B
- Risk is Low for codes 3E, 2D, 2E, 1C, 1D, 1E

## **Appendix-B**

### **Specific Recommendation of Risk Management System**

Based on the findings of the research general recommendation was given in section 5.2 and the following is adopted organizational risk management process from UNESCO [48], Bureau of Strategic Planning, which is believed to be helpful for ERC for the ongoing and upcoming railway infrastructure projects.

A robust process for managing organizational risk involves three steps:

Step I clarify the corporation's goals and critical stakeholders.

Step II Before deciding how to proceed with activities: identify, prioritize and act on uncertainties.

Step III Review and communicate uncertainties.

#### **Step I – Clarify the corporation's goals and critical stakeholders**

First, clarify your unit's expected outcomes and results – each head of unit should ensure all staff understand this and know their role in the plans to achieve expected outcomes and results.

Second, determine the critical stakeholders – who they are, how they may affect your objectives, and how to engage them. Engaging stakeholders enhances understanding of objectives and the associated uncertainties.

#### **Step II– Identify, prioritize, and act**

##### **Identify risks**

##### **Scan the environment**

First, capture a range of uncertainties by scanning the internal and external environment.

It is helpful to ask:

- What are the significant internal factors?
- What are the significant external factors?
- Is the context likely to change? How?

It is important to remember that risks are uncertainties that can represent not only a threat but also an opportunity.

Likewise when considering beneficiary or target groups for a given activity, also consider how other groups could be negatively affected.

### **Use a variety of techniques to analyze information about uncertainties**

Some useful techniques to help identify uncertainties:

Your own experience, asking yourself ‘what-if’ questions, Challenging and questioning assumptions, Thinking wider than given facts, Expert and specialist judgment, Audit findings, Historic data and future trends, Critical path analysis, Scenario planning, Root cause analysis, One-to-one interviews, Anonymous questionnaires, Team brainstorming, Structured discussions involving a relatively small group of people, Workshops

### **Capture both cause and effect**

Third, capture both cause and effect: uncertainties should be as specific as possible in relation to an objective/expected result.

### **Involve stakeholders**

Work with your critical stakeholders, if applicable, to help identify uncertainties you both share (i.e. stakeholders with whom you share one or more objectives) and bring to light any differences in perception.

### **Determine risk ownership**

All risks, once identified, should be assigned to an owner who has responsibility for ensuring that the risk is managed and monitored over time. The owner has to have sufficient authority to manage the risk sufficiently.

### **Horizon scanning**

Many problems can be turned into opportunities when spotted early enough. That is why, when scanning an organization and its environments for risks, future risks should also be taken into account. Systematically identifying indicators of changes, and searching for potential future disruptive challenges, opportunities and threats, is an activity called horizon scanning. Therefore, foresight, strategic intelligence and anticipation should be encouraged among staff at all levels.

### **Existing internal control**

While identifying risks, it is important to take note of existing internal controls to identify the current risk management capacity of the organization and undertake a strategic gap analysis.

The first step in undertaking a strategic gap analysis is to determine the exposure a combination of impact and likelihood of the organization to a particular risk. The next step will be to compare the inherent and the residual risk to identify the effectiveness of actual and/or planned risk control. Inherent risk can be defined as exposure when there is no control or control fails, while residual risk refers to exposure after action has been taken to control a risk, making the assumption that the action of control is effective. The residual risk therefore corresponds to the actual exposure of the organization.

### **Prioritize risks**

The next step will be to undertake a probabilistic risk assessment (PRA) – a method to systematically evaluate, rank and prioritize risk by generating a risk matrix.

Once risks have been identified they must be assessed against two criteria:

- Their *likelihood* – a qualitative or quantitative description of probability – what is the likelihood of these risks/uncertainties occurring? And, if they do occur:
- Their potential *impact* – the implications of a risk/uncertainty, either positive or negative – what are the possible consequences and what is the scale of the impact? (implications/consequences/effects on your expected outcomes and results)

### **Vulnerability**

Vulnerability is the combination of the impact that a risk may have on the achievement of objectives and the likelihood of it occurring. Risks can then be ranked according to vulnerability using the matrix.

### **Risk profiles**

The risk profile is a documented and prioritized overall assessment of risks. It is used to identify risk priorities, to record decisions about addressing risk, to help assigning responsibilities and to facilitate monitoring and reviewing of risk management. A risk profile can be drawn for all risks facing an organization, for a certain group of risks, or for a certain project.

### **Act on risks**

The next step will be to act on the risks that have been identified and prioritized using the risk matrix. Brainstorm with your team, and if applicable with critical stakeholders, about what action needs to be taken to manage the most important uncertainties

Then, decide how to proceed with actions and activities to achieve expected outcomes and results. Remember the rule of the 4 Ts:

- **Tolerate:** accept the risk by keeping activities unchanged. This option may be applied when exposure is tolerable, control is impossible or cost of control exceeds potential benefit. It may be supplemented by contingency planning for handling the potential impact.
- **Treat:** adjust (add or revise) relevant activities;
- **Transfer:** share the risk by involving stakeholders. Transferring risk works especially well for financial risks or risks to assets, e.g. by taking conventional insurance or paying a third party to take the risk. This option is not possible for reputational risks. The relationship with the third party needs to be carefully managed.
- **Terminate:** avoid or cancel the activities that give rise to the risk by terminating the activity that gives rise to the risk, especially when the cost/benefit relationship is in jeopardy.

In choosing which risk control action to adopt, bear in mind the two main objectives of risk management:

1 **Loss avoidance:** aiming to limit the frequency and extent of loss. In all cases it is necessary to show that losses can be dealt with, and how.

2 **Preparedness:** being in a position to restore or recover. For certain risks there is no alternative to this, for e.g. a deliberate attack on reputation can neither be, strictly speaking, avoided, nor transferred, the only form of protection is to be prepared to deal with the consequences.

### **The 5th T?**

It is important to remember that risks may also lead to opportunities and may therefore have a beneficial and positive impact on the organization as a whole or on a particular programme or project. A 5th T – Take an opportunity – could therefore be added to the previous 4 (Tolerate, Treat, Transfer, and Terminate). Do circumstances offer opportunities or can taking certain risks create opportunities? Note that this option should be considered whenever tolerating, transferring or treating a risk and is not an alternative to the other options.

## **Decide**

Once all elements have been carefully weighed, make an informed decision on action to be taken, bearing in mind expected outcomes and results.

### **Step III – Monitor, review and communicate on risks**

The last step of the risk management process involves monitoring, reviewing and communicating risks.

#### **Monitoring and reviewing risks**

Review and communicate risks, at least as often as performance is reviewed,<sup>8</sup> to see if:

- Further action is needed;
- Appropriate controls are in place; and
- New uncertainties are emerging

The monitoring and review process for risk management has to take place on three levels:

- First, adequacy and effectiveness of internal control have to be monitored, evaluated and reported for every single internal control action. It is extremely important for the evolution of risk management in an organization to communicate and share lessons learned at this level.
- Second, the general risk profile of the organization and eventual changes in uncertainties have to be monitored to allow an early identification of upcoming risks early enough and to stop internal control on outdated risks. The monitoring process can, if need be, entail the redistribution of resources. Again it is crucial at this stage to communicate with partners, stakeholders, and the environment in general.

Third, the progress of the implementation of risk management itself has to be monitored and fostered. The following questions can serve as a point of orientation:

- Is risk management well supported and promoted?
- Are people equipped to do risk management?
- Is there a clear risk strategy / policy?
- Are there arrangements for managing risk with partners?
- Do the organization's processes incorporate risk management?
- Does risk management contribute to outcomes / achievement of objectives?
- Are risks well handled?

### **Communicating and reporting**

Communicating risks to partners and stakeholders also allows the organization that risks are being managed on both sides. In all cases, ensure that reporting and communications are accurate, as complete as possible, and regularly updated to reflect reality to the best of your knowledge. Remember that risk formulation and risk reporting are essential for the understanding of issues at stake.

## Appendix C Questionnaire

### Introduction

The following questionnaire is prepared to gather information from Selected Staffs of Ethiopian Railways Corporation and other Professionals related with the railway sector. The information is required for an academic research entitled “**Risks and Risk Management of Addis Ababa Light Rail Transit System Project**”. The outcome of the research will serve as partial fulfillment of MSc in Civil Engineering with Railway Stream. The main focus of the research is identifying risks, analyzing their impact, and suggesting mitigation strategies towards a comprehensive risk management system of Addis Ababa Light Rail Transit System Project. The questionnaire is categorized into eight major sections with a total of 33 questions.

Section 1: covers general profile of the respondent. Section 2: assesses the current practices of risk management of the Corporation on the foregoing project. Section 3: examines the sources of risks during Project implementation specifically to Addis Ababa Light Rail Transit System Project. Section 4: assesses the risk identification and analysis methodologies employed by the Corporation. Section 5: dwell on the risk treatment strategies in managing risks. Section 6: investigates experience on risk allocation and sharing Section 7: explores the opinion of the respondent for risk reduction strategies and Section 8: general comments on the research.

Your response is highly valuable and contributory to the outcome of the research. All feedback will be kept strictly confidential, and utilized for this academic research only.

Thank you,

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Addis Ababa University Institute of Technology

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E-mail: wubshetbekele88@gmail.com

Addis Ababa, Ethiopia

## 1. General Profile of the Respondent

1.1 Name (Optional): .....

1.2 Position: .....

1.3 Organization: .....

1.4 Address: .....

1.5 Educational status?

BSc     MSc     PhD     other; please specify.....

1.6 What is your field of specialization?

Railway engineering    civil engineering    Electrical engineering

Mechanical engineering    others, please specify.....

1.7 How long have you worked in the in the Construction sector?

0 – 5 years    6 – 10 years    11 – 15 years    More than 15 years

1.8 How long have you been involved in railway construction projects?

0 – 5 years    6 – 10 years        More than 10 years

## 2. Risks and Risk management

All projects have risks. Risk management is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve project objectives. It is a very important process so as to achieve project objectives in terms of time, cost, quality, safety and environmental sustainability.

Generally, risk management process in construction involves risk identification, analysis and treatment. Consultation with stakeholders and monitoring the process are also other important aspects of risk management. The following questions are intended to assess the current practice of Risks and Risk management in the Corporation specifically related to the Addis Ababa Light Rail Transit Project:









- By designating risk management officer
- By designating risk management team
- Other arrangements, please describe .....
- .....
- .....
- .....
- .....

2.12) Who owns and is accountable for the risks, and to whom are these risks reported?

.....

.....

.....

.....

2.13 If you don't have a formal risk management system,

a) Would you like to share **your experience on how you deal with risks** that may have an impact on cost, time, and quality of works, safety and environmental sustainability of a project?

.....

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.....

b) What are the **main hindrances** to establish/practice the risk management system? [Please specify in order of importance]

- Lack of knowledge and skills in risk management and its benefits
- Non-conducive company policy
- Lack of trained/committed personnel
- Short project duration to apply risk management
- Other, Please specify

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**3. Sources of Risks and risk identification techniques**

This section is intended to investigate the **sources of risks on the foregoing Addis Ababa Light Rail Transit System Project.**

**3.1 Sources of risks**

3.1.1 From your experience and observation what are the sources of risks in the LRT project?  
Identify from the list and rank them in order of probability of occurrence and severity of impact?  
You can add, if any.

Risks and Risk Management of Addis Ababa Light Rail Transit System project

No	Sources of Risk	Probability of Occurrence			Impact														
					Cost			Time			Quality			Environment			Safety		
		High	Moderate	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
1	<b>Financial and economic risk</b> (unavailability of funds, inflation, exchange rate fluctuation, insolvency/bankruptcy of major participant, etc.)																		
2	<b>Contractual and legal risk</b> (delay in solving contract issues, disputes, change order negotiations, extra payments, etc...)																		
3	<b>Subcontractors related risk</b> (subcontractor's failure, lack of coordination, lack of staff, etc...)																		
4	<b>Operational risk</b> (productivity, system outage, waste disposal, etc...)																		
5	<b>Safety and social risk</b> (pollution and safety rules, accidents, damage to persons or property, ecological constraints, malaria outbreak, resistance from communities etc.)																		
6	<b>Design risk</b> (inadequate																		

Risks and Risk Management of Addis Ababa Light Rail Transit System project

	specification, conflict of documents, design change, scope of work definition, errors, etc.)																		
7	<b>Construction Risk</b> (Rush bidding, accuracy of work, accidents and safety, cost overrun, productivity of labor and equipment, etc...)																		
8	<b>Force majeure risk</b> (war, tsunami, earthquake, typhoon, etc...)																		
9	<b>Physical risk</b> (subsurface geology, ground water, unforeseen site condition, mud flows, release of encased gases, etc.)																		
10	<b>Delay risk</b> (construction delays, third party delay, demand delay, etc...)																		
11	<b>Environmental risks</b> ( Incomplete environmental analysis, Historic site, endangered species, etc)																		
12	<b>Planning and procurement risks</b> (Rushed decisions to get into contract, Inappropriate contract award process, not well planned contract negotiations, etc.)																		
13	<b>Risk from a remote stakeholder</b>																		

Risks and Risk Management of Addis Ababa Light Rail Transit System project

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	(environmentalists, media, interest groups, etc.)																		
14	<b>Other</b> (please specify)																		

### 3.2 Risk identification

3.2.1 What methods do you apply to identify risks? Why?

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3.2.2 How effective is the corporation in managing its risks?

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### 4. Risk Analysis

Risk analysis is generally developing a better understanding of the identified project risks. The analysis further assists in quantifying the magnitude and impact of risk so that risks can be evaluated and prioritized for treatment. The following questions dwell on risk analysis in general and your experience of risk analysis in particular.

4.1 From your experience do you/your company used risk analysis programs and/or software's?  
 Yes       No       I do not know

4.2 If your answer is Yes to the above question what type of methods are used for the analysis?

.....

.....

.....

4.3 From your experience of risk analysis and risk evaluation, to which project objective(s) do you give more emphasis in prioritizing risks for treatment? [Please rank them in order of prioritization]

- Cost
- Time
- Quality
- Environmental sustainability
- Safety

- Equal weight for all
- Other (please specify) .....

**5. Risk Treatment**

After undergoing a risk analysis and evaluation, risks are treated so that their overall adverse impact on the success of the project will be minimized to the lowest level possible.

5.1 In your practice, which risk treatment strategies do you most often use? Please indicate in order of importance.

- Risk elimination or avoidance
  
- Risk transfer
  
- Risk reduction
  
- Risk retention/acceptance
  
- Risk postpone
  
- Risk split/divide
  
- Risk spreading

5.2 In your practice, how is risk treatment strategy developed? How and when is it applied?

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.....  
.....  
.....  
.....

**6. Risk allocation**

Risk allocation involves the allocation of risks and responsibilities between the contracting parties. The following questions enquire your views and experiences on the risk sharing and responsibility allocation of the LRT Project

6.1 In your practices, **to whom do you assign risks arising from unforeseeable difficulties?**

- Employer    Contractor    Both, Employer & Contractor
- Other, please describe .....

6.2 FIDIC forewarns that the EPC Turnkey conditions of contract are not suitable under the following conditions:

- Time and information are insufficient for the contractor to study employee's requirements and carry out and risk assessment study
- Construction involves substantial underground work
- The employer intend to supervise very closely and
- Each interim payment is to be determined by an official
- In your practice, how is each of above mentioned issues addressed? Please indicate your experiences and practices in each of them below.

a) Length of time and depth of information provided to Contractors during the tendering phase.

- Sufficient    Satisfactory    Insufficient

b) Extent of underground works

- Substantial    Moderate    Insignificant

c) Supervision by the Employer

- Very close    Moderate    Loose

d) Interim payment approvals by a minister or higher government official outside the management of the Employer

- Very common    Sometimes    Not at all

6.3 Based on your experience, what is the impact of items mentioned in question 6.2 above to risk allocation and project costs?

.....  
.....  
.....



## **Appendix D**

### **Research Proposal**

#### **Summary**

Light Rail Transit projects should be viewed as 'city-shaping' or 'city-changing' projects. These metropolitan electric railway systems are powered by overhead electrical wires and offer a frequent, fast, reliable, comfortable and high quality service that is often environmentally sustainable.

Light Rail Transit projects are among large construction projects that are exposed to uncertain environmental factors. Because of the concurrence of such factors during as well as presence of various interest groups (owner, consultants, contractors, suppliers, etc.), all the way from planning to design, construction and operation makes them exposed to various risks. Resources availability (manpower, materials, equipment, and funds), environmental constraints, the socioeconomic and political environment under which the project operates and statutory requirements also affect them.

This indicates that internal and external risks are involved in these construction projects. It is clear that these risks should be identified and managed and there should be a risk management system. Thus, there is a considerable need to incorporate risk management concepts into infrastructure construction practice in general so that success thwarting risks can be mitigated or possibly eliminated so that the performance of projects can be enhanced.

The introduction of this modern Light Rail Transit system to Addis Ababa and other Ethiopian cities will definitely come up with major technical and operational challenges to owners in the entire project life cycle. All stakeholders of these projects particularly owners need to get prepared in advance for managing these complex projects.

This thesis will try to identify the risks and risk management systems of Addis Ababa light rail transit system project. The research will mainly focus on studying archival documents and interviewing potential professionals in the field so that pertinent data that enable the researcher understand the facts, analyses the challenges and suggest plausible options to have safe, clean and efficient transit system.

## Introduction

Risks are uncertainties, liabilities, or vulnerabilities, which may cause a project to deviate from its defined plan. While risk in a project environment cannot be totally eliminated or transferred, it can be monitored and minimized or mitigated wherever possible. To succeed in project performance, addressing risk management throughout the project lifecycle is a must.

The objective of a risk management process is to minimize the impact of unplanned incidents on a project by identifying and addressing potential risks before significant negative consequences occur. Risk management incorporates the identification, analysis, and management of project risks. It is one of the thirteen construction related knowledge areas accentuated by the Project Management Institute of America. Risk management is all about maximizing the probability of positive events and minimizing the probability and consequences of adverse events.

There are uncertainties that cannot affect objectives, and which are therefore not risks. It is this relationship between risk, uncertainty and objectives that makes risk management such an important contributor to both project success and business benefits.

The risks for infrastructure projects have a wide range of sources and can be classified into the following broad categories:

- ✚ Technical, quality or performance risk such as employment of inexperienced designers, changes to the technology used or to industry standards during the project.
- ✚ Organizational risks such as cost, time and scope objectives that are internally inconsistent, lack of prioritization of projects, inadequacy or interruption of funding, and resource conflicts with other projects in the organization.
- ✚ External risks such as shifting legal or regulatory environment including institutional changes, poor geological conditions and weather, force majeure risks such as earthquake and floods.
- ✚ Project management risks such as poor allocation of time and resources, inadequate quality of the project plan, poor use of project management disciplines.

Dealing with these risks involves planning for risk, assessing risk issues, developing risk handling strategies, and monitoring risks to determine how they have changed. The overall objective of the risk management process is to maximize the opportunities and minimize the consequences of a risk event.

## **Problem Statement**

The present transport system of Addis Ababa is entangled with several problems such as inefficiency and disorganization. The Light Rail Transit Project is expected to leverage the problems towards a city wide integrated transport system. The construction activities along the lines of the project and other adjacent allied infrastructure upgrading are posing tremendous risk for the entire public. Poor traffic management plan, dust, open excavations channels and the movement of heavy materials of construction are some of the risk invoking problems observed at the construction stage. Definitely, operation will come with its own challenges.

The problem statement of this thesis research focuses on the following key concept.

Addis Ababa Light Rail Transit project is exposed to several risk factors. The failure of such a large project by one or more eventuating risks will have adverse consequences to the city as well as the national economy. Thus identifying the risks, analyzing their impact, and suggesting mitigation strategies towards a comprehensive risk management system of the project are the main focus of the thesis research. In this regard attempt will be made in clearly stating those risks that thwart the implementation as well as the operation of Addis Ababa Light Rail Transit Project. The robustness of the risk management system, if any, will also be critically assessed.

## Literature Review

The PMBOK Guide [(PMBOK® Guide). 4th ed. Newtown Square: Project Management Institute; 2008] defines a project risk as “an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one project objective”.

Webster’s dictionary defines risk as “the possibility of loss, injury, disadvantages, or destruction”. The Random House College Dictionary defines risk as “exposure to the chance of injury or loss” (Hertz and Thomas 1983). Jaafari (2006) defined Risk as the exposure to loss/gain, or the probability of occurrence of loss/gain multiplied by its respective magnitude.

Risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives

Risk management is one of the thirteen construction related knowledge areas presented by the Project Management Institute (PMI). The PMBOK® Guide and its construction extension recognize thirteen knowledge areas. Typical the knowledge areas are:

1. Project integration management.
2. Project scope management.
3. Project time management.
4. Project cost management.
5. Project quality management.
6. Project human resource management.
7. Project communications management.
8. Project risk management.
9. Project procurement management.
10. Claims Management.
11. Financial Management
12. Environment Management and
13. Safety Management.

The benefits of the risk management process include identifying and analyzing risks, and improvement of construction project management processes and effective use of resources. Managing risks in construction projects has been recognized as a very important process so as to achieve project objectives in terms of time, cost, quality, safety and environmental sustainability [Zou PXW, Zhang G, Wang J. 2007]. Project risk management is an iterative process: the process is beneficial when it is implemented in a systematic manner throughout the lifecycle of a construction project, from the planning stage to completion.

A typical risk management process includes the following key steps [Nerija Banaitiene and Audrius Banaitis]:

- Risk identification;
- Risk assessment;
- Risk mitigation and;
- Risk monitoring.

Key risks that influence project objectives :(Patrik X.W Zou,Guomin Zhang,Jia-Yuan wang)

- ✚ Tight project schedule
- ✚ Design variations
- ✚ Excessive Approval procedures in administrative government departments
- ✚ High performance/quality expectations
- ✚ Inadequate program scheduling
- ✚ Unsuitable construction program planning
- ✚ Variations of construction programs
- ✚ Low management competency of subcontractors
- ✚ Variations by the client
- ✚ Incomplete approval and other documents
- ✚ Incomplete or inaccurate cost estimate
- ✚ Lack of coordination between project participants
- ✚ Unavailability of sufficient professionals and managers
- ✚ Bureaucracy of government
- ✚ General safety accident occurrence
- ✚ Inadequate or insufficient site information(soil test and survey report)
- ✚ Occurrence of dispute

- ✚ Price inflation of construction materials
- ✚ Serious noise pollution caused by construction

The risks that are stated above are associated with the following:

- ✓ Cost related risks
- ✓ Time related risks
- ✓ Quality related risks
- ✓ Environment related risks and
- ✓ safety related risks

The referred risks are associated with stakeholders in a project and are related to clients, designers, contractors, sub contractors, government bodies and external environment.

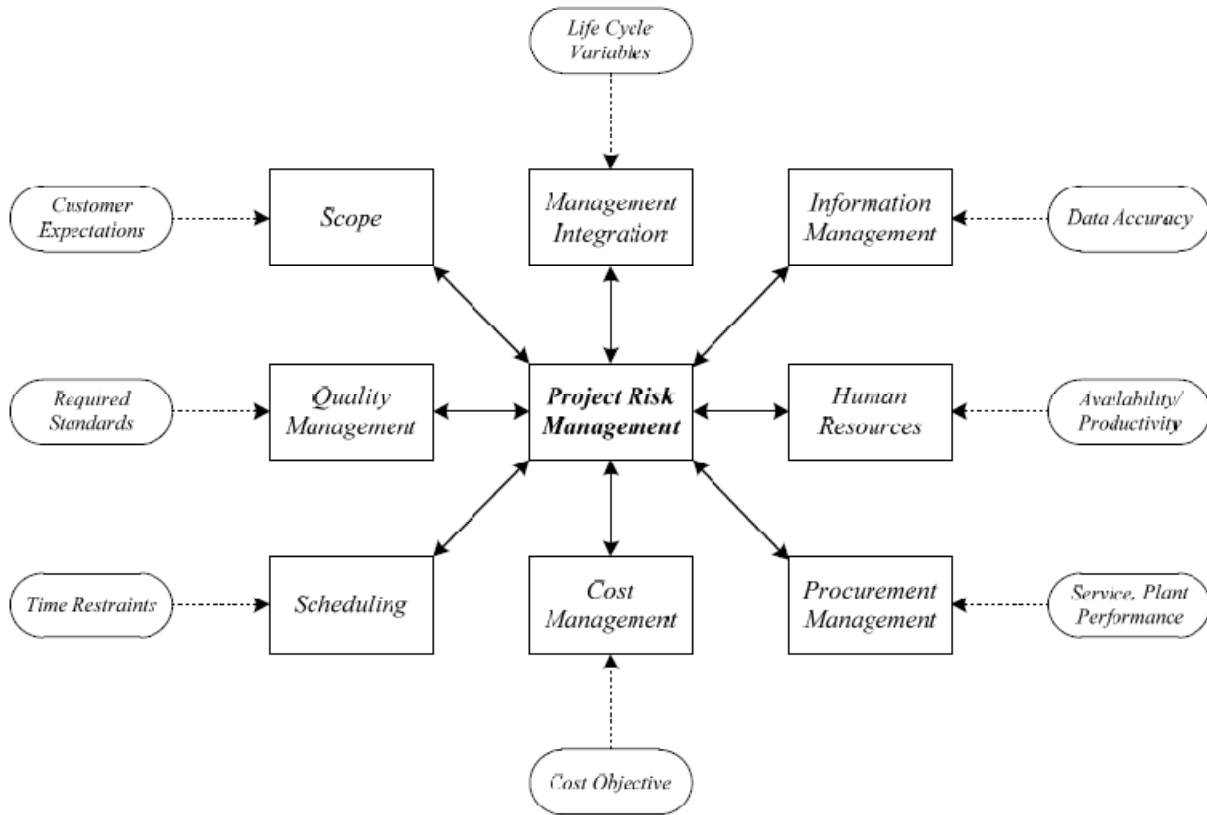


Fig. 1 – Integrating risk with other project management functions.

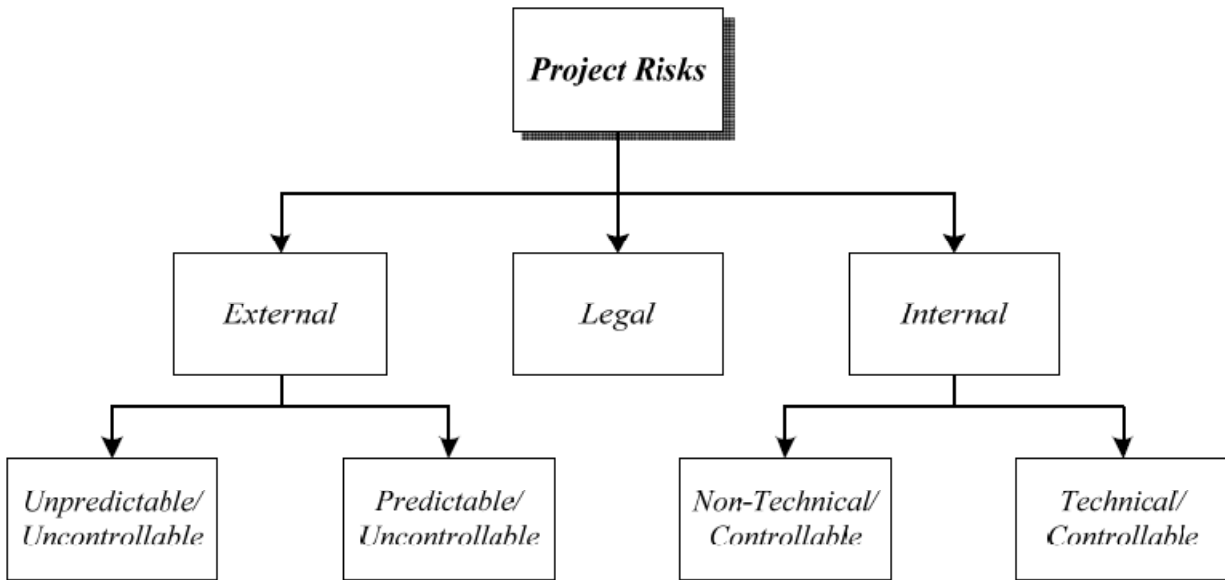


Fig. 2 Specific Project risks

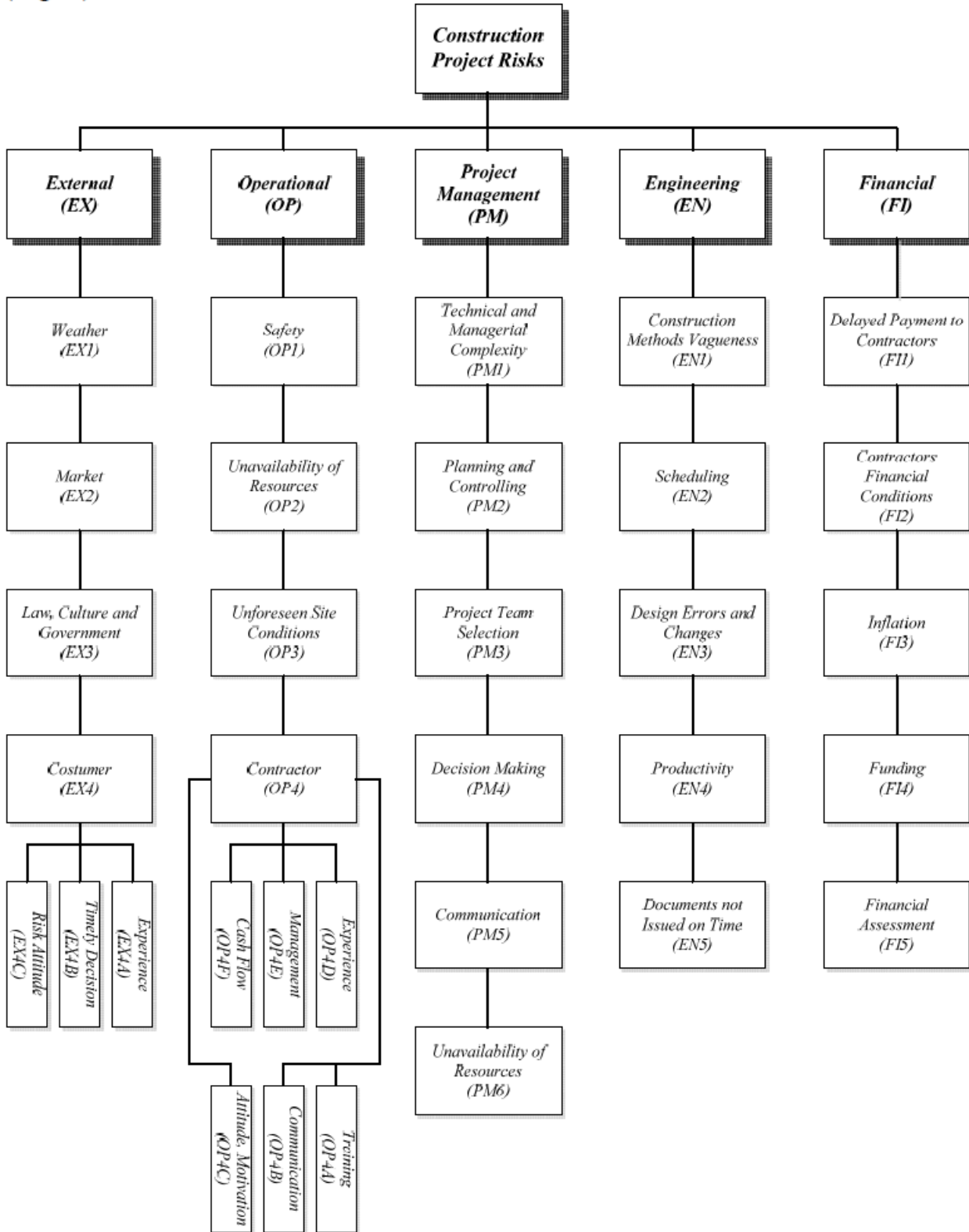


Fig. 3 – Suggested hierarchical risk breakdown structure for construction projects.

## **Research Questions**

The following research questions are to be addressed in the thesis:

- i) What are the risks in railway projects specifically the Addis Ababa Light Rail Transit Project?
- ii) What are the risks that prevail between the contracting parties?
- iii) What are the relations of the risks between the stakeholders of the project?
- iv) How are railway project construction risk managed?
- vi) What are the sources of risks in railway construction projects, how are they analyzed and mitigated?
- vii) How are risks allocated? Are there options to better allocate the risks?

## Objective of Study

### General Objectives:

- ✚ Minimize the impact of unplanned incidents on a project by identifying and addressing potential risks before significant negative consequences occur.
- ✚ Identifying and reducing risks to an acceptable level
- ✚ Maximizing the probability of positive events and minimizing the probability and consequences of adverse events

### Specific Objectives:

- ✚ to identify the risks in Addis Ababa light rail transit system project
- ✚ to find out the sources of risks of Addis Ababa LRT project and assessing for the risk management practices to enhance achievement of project objectives, thereby contributing to effective implementation of the country's railway system infrastructure development program.
- ✚ to assess the existing practices of risk reduction/mitigation.

## **Research Methods, Materials and Procedures**

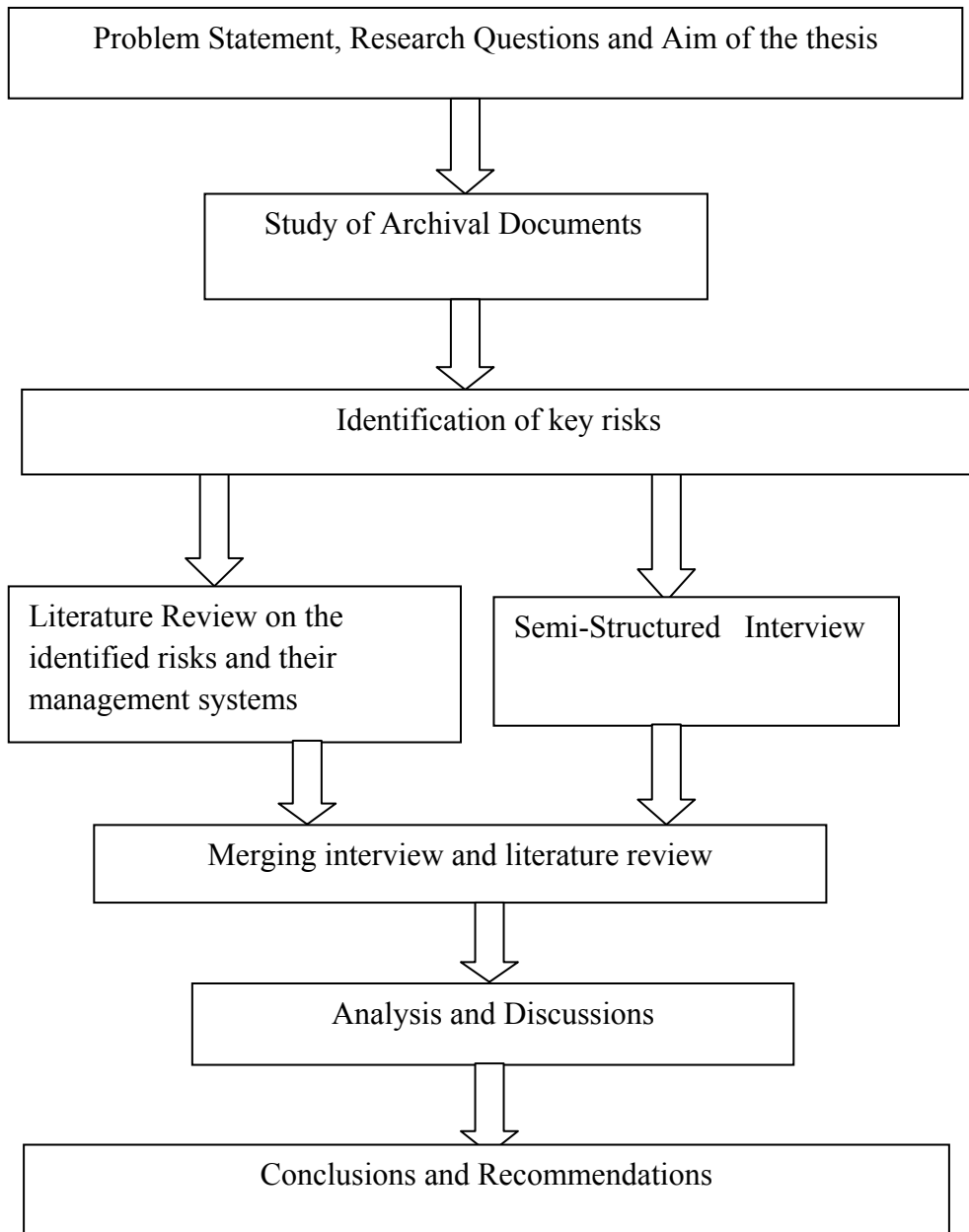
### **Study area**

The study area will be the East -West and North-South LRT sections of Addis Ababa.

### **Study Design**

The thesis is qualitative research of exploratory type which diagnoses a situation, assess alternatives, and discover ideas by studying archival documents with supported interviews with potential professionals in the field.

### Methodology Chart



**Work Plan**

No.	Task	Four Months (16 Calendar Weeks)															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Final Proposal Submission	■															
2	Comment by Advisor																
3	Final Proposal Submission to AAiT		■														
4	Research Proposal Defense		■														
5	Conduct Literature Review		■														
6	Identification of Relevant Data								■								
7	Conducting Interview										■						
8	Analysis and Discussions													■			

9	Conclusion and Recommendation				■
10	Submission of Draft thesis paper for advisor				■
11	Comment by Advisor				
12	Final thesis submission to AAiT				■
13	Thesis defense				

**BudgetPlan**

No.	Item	Unit	Quantity	Unit rate	Total cost in Birr
1	Stationary Cost (paper, pens, Note books, CD RW...)		Lump sum		800
2	Transportation Cost for data and material investigation		Lump sum		1800
3	Cost for telecommunication and internet		Lump sum		1700
4	Photocopy, printing and binding		Lump sum		2300
5	Contingency (10%)		Lump sum		620
6	Total				<b>7260</b>