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DEPARTMENT OF CONSTRUCTION TECHNOLOGY AND MANAGEMENT

ASSESSMENT OF RISK MANAGEMENT PRACTICES ON ROAD CONSTRUCTION PROJECTS
THE CASE OF ETHIOPIAN ROAD AUTHORITY

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DECLARATIOIN

I hereby declare that this thesis entitled*" Assessment of Risk Management Practices in Road Construction Projects: The Case of Ethiopian Roads Authority*" was prepared by me, with the guidance of my advisor. The work contained here is my personal except in which explicitly stated in any other case in the text, and that this work has no longer been submitted, in component, for some other expert qualification.

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ABSTRACT

In Ethiopia, road construction projects are means through which development strategies are achieved. In line with this, the road network is increasing significantly from time to time. These road construction projects are mainly administrated by the Ethiopian Roads Authority. Hence, the road construction industry and the authority are associated with a high degree of risk due to the vast size of the scope of the project and the complex nature of the construction process. The aim of this study was to assess the risk management practices on road construction projects carried out by Ethiopian Road Authority. The target population of the study was the Ethiopian Roads Authority, consultants, and contractors that have been participated in road construction projects. For the study, the data was collected from the respondents' using questionnaires and interviews. After collecting and analyzing the data, the findings of the study revealed that currently ERA implements risk management practices by developing a RM manual and work flow charts. The Authority also assigned the RM responsibility specially to the project engineers and the construction project management directorates as a department. The Authority also used a common and relevant tool as a risk management process strategy. On the other hand, the awareness of the contracting parties about risk management, and its process are somehow fair. Currently, the aforesaid responsible personnel also attending a RM training to improve and upgrade the awareness. The study further identified technical (related to construction), financial, design, and access to construction site risks as a type of risk which is highly probable to occur and with a relatively high impact on project cost. Similarly, technical (construction-related), design and access to construction site risks are a major risk are further recognized by the study as having relatively high impact on project time. And then from the quality matrix diagram, technical (construction-related) has been identified as a challenge for the quality of the project activities. Finally based on the finding, in order to improve the authority implementation of the risk management, it is suggested to take force measures mechanism to practice and apply the risk management guidance, specify a time for applying risk management - based on the project life cycle, provide continuous risk management training and practices, and involving the contracting parties to practice risk management are stated.

Key Words: risk management, risk management practices, risk awareness, Ethiopian Roads Authority

List of Acronyms and Abbreviations

EIA	Environmental Impact Assessment
ERA	Ethiopian Roads Authority
FIDIC	Fédération Internationale des Ingénieurs-Conseils / International Federation of Consulting Engineers/
ICB	International Competitive Biddings
KENHA	Kenya National Highway Authority
MDB	Multilateral Development Bank
OPAs	Organizational Process Assets
PLC	Project Life Cycle
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institution
PPA	Public Procurement Agency
RM	Risk Management
RMP	Risk Management process
RSDP	Road Sector Development Program
SBD	Standard Bidding Document
SIA	Social Impact Assessment
SOP	standard operating procedure
SPSS	Statistical Package for Social Sciences
SWOT	Strengths Weaknesses Opportunities & Treats
URRAP	Universal Rural Road Access Program

Table of Content

List of Tables

List of Figures

CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

The primary function of roads is to provide accessibility and mobility. Presently, developing countries around the world are prioritizing the improvement and linking of their road networks. Road projects are being listed as the primary focus in their national budget, given that a good road network contributes to the development of the economy and national growth (Ludwig et al.,2020). Road construction projects in Ethiopia are means through which development strategies are achieved. Development strategies which are fulfilled through successful road projects intend to improve accessibility of rural area; lower costs associated with transport maintenance and open more areas for development activities. Road projects, involving large amount of capital, also contribute to the total economy through job creation and in a ripple effect to other business activities (Mebrhit , 2018).

Like any construction project, the road cconstruction projects encounter a lot of risks due to the involvement of a large number of parties. Furthermore, the risks in road construction projects are amplified due to project size and duration and unforeseen underground conditions (Okate & Kakade). Risk can be defined as an event of known uncertainty and this uncertainty is measured in terms of its probability of occurrence. Risk has significant effect on any one of the aspects of a project namely cost, time or scope of the project. Understanding risks in the early stages of a project will help project managers to reduce its impacts and complete the project in an improved and more efficient manner. This can be achieved through proper Risk Management(Okate & Kakade). Project risk management is essential for successful project management and should be applied throughout a project's life cycle (PMI,2016).

According to the 6th edition of the PMBOK, risk management is one of the ten knowledge area propagated by the Project Management institution 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. Project objectives include time, cost, and quality (PMI,2016).

A thesis made by (Meazadingil, 2015) stated that ERA did not have formal guidelines to manage risk. However, in the past, the Authority has implemented risk management in

accordance with international and local condition of contract as FIDIC, PPA, etc. These conditions of contract have clauses that deal with common risk which identifies and expresses risks guidable ways of managing them to minimize their effect on project objectives. The Authority selected those clauses and included in the term of the contract and the general & particular conditions of the contract section to easily be managed during the project construction period. Similarly, As per (Emran, 2017) conducted study stated that even if the Authority did not have a formal risk management practice in the sector, the researched found out that, the Authority was given the task of risk assessment for the consultants. So that the purpose of the research is to assess the current developed risk management practice in the Authority.

1.2. Statement of the Problem

The road network of Ethiopia is increasing significantly from time to time. In line with this, the Ethiopian Roads Authority, as executive agency manages the huge budget allocated for road infrastructure development every year. In this light, the Government has launched the Road Sector Development Program (RSDP) in 1997. Since then, four phases of RSDP were implemented over the period of 1997 – 2015 and the fifth phase; RSDP V has been implemented since July 2015 to update. Phased Road Sector Development Programs (RSDPs) which provide a coordinated framework for intervention along with policy, institutional and regulatory reforms have been launched. These programs aimed at developing an efficient and self-sustaining construction industry and improving the management of the road (Mebrhit, 2018).

As stated in the RSDP 23 years performance assessment report, these twenty-three years performance of RSDP has brought significant improvement in the restoration & expansion of Ethiopian's road network. However, Over the twenty-three years performance of RSDP, physical works have been undertaken on a total of 159,218.4km of roads excluding routine maintenance and community roads out of the 244,210.1 km physical plan road works. The total budget for the planned works during this period amounted to 520.4 billion. The total amount disbursed including all maintenance work in the same period, in ETB 414.7 billion. Hence the physical and financial performance of RSDP over the past 23 years against plan is 65.2% and 80% respectively. This figure shows that the Authority could not construct the roads works as per the plan schedule for various reasons such as liquidated damage, cost

overrun, claims and disputes that are the major ones. And also, some of the causes of these challenges could be related to improper risk management practices. Accordingly, the failure of such physical plan by one or more eventuating risks will have adverse consequences to the country; national economy. So that in particular, risk management plays a key role in achieving this plan and completing road projects in timely with desirable quality and reasonable cost. Hence, the study aims to assess the project risk management practices of the road construction projects undertaken by ERA so that important lessons will be drawn and recommendations will be made for future project endeavor

1.3. Research Questions

The research questions include:

- ✓ How is the current risk management practice in ERA construction projects?
- ✓ How is the current status of different contracting parties' awareness about risk and risk management practices in ERA road construction projects?
- ✓ What types of risks are faced by ERA in the course of undertaking road construction projects?
- ✓ What mitigation suggestions could be suitable to manage risks associated with ERA road projects?

1.4. Objective of the Study

1.4.1. General Objective

The general objective of this study is to assess the risk management practices on road construction project undertaken by the Ethiopian Road Authority.

1.4.2. Specific Objectives

1. to determine the risk management practices implemented by ERA.
2. to assess the level of awareness of contracting parties participated in ERA road construction projects on risk management practices.
3. to identify the major types of risks based on their probability and impact matrix on ERA road construction projects.
4. to develop mitigation suggestions for risk management practices in ERA.

1.5. Scope of the Study

The study is limited to assessing risk management practice in road construction projects under the Ethiopian Road Authority. This is because; the road construction industry and ERAs are associated with a high degree of risk due to the complex character of the construction process. However, the research involves the contracting parties (consultants and contractors) that undertake road construction projects.

1.6. Significance of the Study

Currently one of the challenges facing the Ethiopian road construction industry is managing risk. Therefore, the output of this research will be significant to the Authority to manage and to take corrective actions based on the identified possible ways of improving project risk management practices by assessing the project risk management practices of road construction projects starting from the contractual stage and in turn making the projects to achieve their objectives effectively and efficiently

1.7. Organization of The Document

This thesis has five major parts: Chapter one of this research present the Introduction, statement of problem, objective, scope and significant of the study. While the second chapter is about literature review on the issue which is associated to risk management, risk management processes and risk management in construction stages on road projects. The Next chapter talks about a research methodology. Beside to that fourth chapter present the analysis of finding and discussion of the interpretation of data which is collected for the purpose of study. The last chapter is a concluding with recommendations regarding major thing that should be done on the effect of risk management on the Authority.

CHAPTER TWO: LITERATURE REVIEW

The literature review section focuses & discuss on the back ground concept that builds knowledge and ideas leading to achieving the project goals. It includes a vast evaluation of the prevailing frame of literature on risk Management, risk management processes, source and awareness of risk.

2.1 Risk Management

Risk management is one of the ten knowledge area propagated by the Project Management institution (PMI, 2017). Project risk management is essential for successful project management and should be applied throughout a project's life cycle (PMI, 2017). In practical terms, risk management is the process of minimizing, or mitigating, risk events, starting with the identification and evaluation of such events and extending on to the optimization of the resources used to monitor and minimize it (Goncalves & Heda, 2014). The objective of risk management is to maximize the potential of success and minimize the probability of future losses Effective risk management can help us to reduce the negative and increase the positive consequences of risk and to make informed decision (Andy, 2012).

The meaning of the term "Risk" must be understood clearly for effective project risk management (Goncalves & Heda, 2014). Therefore, let's see the general definition of the "risk" in different way from different references.

- Risk is an uncertainty that matters; it can affect project objectives negatively or positively (Tapping, et al., 2012).
- Risk – exist when a decision is expressed in terms of a range of possible outcomes and when known probabilities can be attached to the outcomes (Smith et al., 2006).

The definition of project risk given in the PMBOK Guide – Fourth Edition is as follows:

> "Project risk is an uncertain event or condition that, if it occurs, has a positive or a negative effect on a project's objectives.

This definition includes two key dimensions of risk: uncertainty and effect on a project's objectives. The uncertainty dimension may be described using the term "probability" and the effect may be called "impact" (PMI, 2009).

2.2 Impact and Probability in Risk

Based on the definition of the PMI, the concept of the risk probability & impact is the fundamental building block on which risk management is raised. According to (Hillson, 2001) risk is an umbrella term, with two varieties: opportunity and threat depend on the positive and negative effects of risk. However, uncertainty is the overarching time period, with varieties: threat referring solely to a hazard, i.e., an uncertainty with poor consequences and a possibility that's an uncertainty with tremendous outcomes.

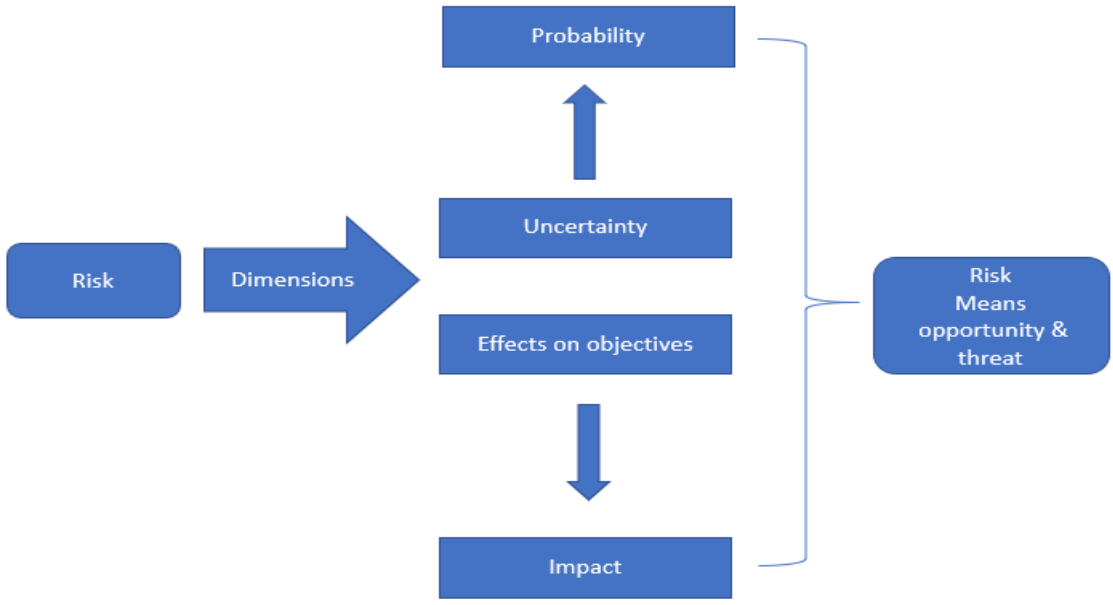


Figure 2.1: Understanding Risk Threats and Opportunities,
(Goncalves & Heda, 2014)

These terms will be discussed on the RM Process, risk analysis section in detail, for while let only define these terms related with the definition of risk.

In risk analysis, risk is traditionally defined as a function of probability and impact. Risk Probability is a likelihood of an event describes the potential for the risk event occurring (Curtis & Carey, 2012). The probability of a risk occurring can range anywhere between 0% and 100% or it can be expressed as a number between 0 to 1. Zero implies the event is impossible, one implies that it is certain (Raftery,1994). Besides, Risk Impact describes the effects or consequences the project will experience if the risk event occurs. The impact may be in terms of Cost, time, quality, scope, operation, safety and so on (Curtis & Carey, 2012).

2.3 Source of Risk

According to PMBOK 6th edition , extract from sample risk breakdown structure (RBS) categorized source of risks as technical risk , management risk, commercial risk and external risk. Different studies have made several classifications concerning risks passed off for the duration of production assignment undertakings for instant: -

Along with (Renuka et al., 2004) conducted a study that identified the major risk sources and their impact. Base on the study, risk source affecting the project success is grouped Engineering and non- Engineering which is Engineering risks are predictable and those non-engineering risks are non-predictable. The predictable factors should be forecasted during the earlier phase of the project whereas the non-predictable factors involve uncertainties; this should also be estimated for the effective achievement of the project because these risks will affect the cost, time, quality of the project. Engineering risks are client risk, design risk, project execution risk, resource, contract management risk and tendering risk. On the other hand, non-engineering risks are country risk, political risk, environmental risk, geological risk, natural hazards risk, and statutory compliance risk.

As stated by Andualem (2020), the critical risks related to construction projects through the project life cycle in Ethiopia were poor contract administration, incomplete contract documents, improper design, scope change, unexpected site conditions, political instability, lack approvals, lack of timely decision making, inflation, payment delay, and. Corruption.

For this study, major risk factors categorized into twelve depending on the common risk that affect the construction sector. These are technical (documentations and construction related), construction, physical, organizational, financial, socio-political, environmental, design, legal, material, access to construction site and experience of the staffs'. The details are discussed on Table 2.1.

Table 2.1:- Source of Risk in Road Construction Projects

NO.	RISK CATEGORIES	DESCRPTION
1	Technical Risks:	
1.1	Documentation	▪ Inadequate specification in terms of contract documents and reference
1.2	Construction Related	▪ Inadequate Site Investigation ▪ Change In Scope ▪ Construction Procedures ▪ Insufficient Resource Availability ▪ Inadequate aid availability
2	Construction Risks:	▪ Labor Productivity ▪ Labor Disputes ▪ Site Condition, ▪ Equipment Failures, ▪ Too High-Quality Standard ▪ New Technology
3	Physical Risks:	▪ Injury To Structure ▪ Injury To Equipment ▪ Labor Injuries ▪ Equipment& Material ▪ Fire ▪ Theft
4	Organizational Risks:	▪ Contractual Relations ▪ Contractor's Experience ▪ Attitude of Project Participants ▪ Inexperienced Work Force ▪ Communication
5	Financial Risks:	▪ Increased Material Cost ▪ Low Market Demand ▪ Alternate price Fluctuation ▪ Payment Delays ▪ Inappropriate Estimation Taxes
6	Socio-Political Risks:	▪ Deviations in Laws and Regulations ▪ Pollution And Safety Rules ▪ Bribery/Corruption ▪ Language/Cultural Barriers ▪ Law & Order ▪ War And Civil Disorder
7	Environmental Risks:	▪ Natural Disasters ▪ Weather Implications
8	Design Risks:	▪ Defective Design ▪ Design Changes ▪ Awarding Design to new Design

NO.	RISK CATEGORIES	DESCRPTION
9	Legal Risks:	▪ Ambiguity of labor legislation ▪ Difficulty to get work lets in ▪ Disputes among contracting parties
10	Material Risks:	▪ Material not compatible to description ▪ Loss of material availability
11	Access to Construction Site Risks:	▪ Right of Way Problems ▪ Compensation ▪ Demolition
12	Experience of staffs	▪ Staffs' turnover

2.4 Risk Awareness

According to Jen (2000) conference paper presented, the author develops a model that identify the risk awareness which as a similar format to the 'Input-Tools & Techniques-Outputs' structure provided by PMBOK Guide processes.

Table 2.2: Risk Awareness Input, Tool & Techniques & Outputs

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
Uncertainty	Experience	Accountability
Objectives	Technical Skill	Identification
Stakeholder	Risk Tolerance	Experience
Constraints	Communication Skill	Decisions
	Risk Management Knowledge	Appropriate Approach and Performance

(Jen, 2000)

As realized from the development model, to increase the awareness of the stakeholders by focusing on the Tools and Techniques listed. These are: -

- Experience level: - raising the experience level of the stakeholder's staff by simulation, case studies, lessons learned, examples, mentorship (Jen, 2000).
- Technical skill: - develop the technical skills of the stakeholders by technical training, mentorship, supervision, feedback (Jen, 2000).
- Risk tolerance: - develop a method to increase or decrease risk tolerance by probability-impact matrix, checklist/questionnaire, simulation, dictionary, risk level definitions, examples (Jen, 2000).

- Communication skill: - increase communication skills by simulation, training, coaching, status meetings. (Jen, 2000).
- Risk management knowledge: - increase the knowledge of rm of the stakeholders by training, risk planning involvement, status meetings, risk identification sessions (Jen, 2000).

2.5 Risk Management Process

Risk management process is simply offering a structured way to think about risk and how to deal with it (Tapping, et al.,2012). The risk management process has five basic stage that are plan risk management, risk identification, risk analysis, risk response, risk monitoring, and control.

Figure 2.2:-Risk Management Process

2.5.1 Plan Risk Management

Plan Risk Management is the process of defining how to conduct risk management activities for a project (PMI,2017). Risk management planning starts by developing and documenting an approach towards risk, responses and continuous monitoring (Goncalves & Heda, 2014). The Risk Management Plan (RMP) defines the level at which risk management will be performed for the project and the frequency of risk management meetings and risk register

updates (Tapping, et al.,2012). A written Risk Management Plan is not required for all projects. It depends on the project size and complexity and the amount of risk management effort that will be required (Tapping, et al.,2012). The objectives of the Plan Risk Management process are to develop the overall risk management strategy for the project, to decide how the risk management processes will be executed, and to integrate Project Risk Management with all other project management activities (PMI,2009). The inputs, tools and techniques, and outputs of this process are summarized in the table below.

Table 2.3:- Risk Planning Input, Tool & Techniques & Outputs

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
Project management plan	Analytical Techniques	Risk Management Plan
Project Charter	Expert Judgment	
Stakeholder Register	Meeting	
Enterprise Environmental Factors		
Organizational Process Assets		

(FME, 2014)

2.5.2 Risk Identification

Risk identification determines what might happen that could affect the objectives of the project and how those things might happen (Tapping, et al.,2012). Identify Risks is the process of identifying individual project risks as well as sources of overall project risk, and documenting their characteristics. (PMI, 2017). The purpose of risk identification is to identify risks to the maximum extent that is practicable (PMI, 2009). This information is documented in the risk register, a list of all of the identified risks, their root causes, categories and responses. Because the assessment of risk is an ongoing activity, the risk register will be updated continuously throughout the life of the project (FME, 2014). A risk register is a tool that project teams can use to address and document project risks throughout the project life cycle (Tapping, et al.,2012). Some risks are known risk and some are unknown risks. It is easier to identify and plan for known risks. However, the basic idea of risk management is to plan and prepare for both known and unknown contingencies (Goncalves & Heda, 2014). Participants in risk identification activities may include the following: project manager, project team members, project risk specialist (if assigned), customers, subject matter experts from outside the project team, end users, other project managers, operations managers, stakeholders, and risk management experts within the organization. (PMI, 2017). Once risks are identified, the project team can decide which risks need to be actively managed and which

risks they are going to live with (Goncalves & Heda, 2014). The inputs, tools and techniques, and outputs of this process are summarized in the table below.

Table 2.4**:-** Risk Identification Input, Tool & Techniques & Outputs

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
Project management plan	Expert judgement	List of identified risks
Project document	Data gathering: Discussion; observation; Brainstorming; Checklists; Manuals; interviews	Potential risk owners
Agreements		List of potential responses
Procurement documentation	Data analysis: Root cause analysis; Assumption and constraint analysis; SWOT analysis; Document analysis	
Enterprise environmental factors		
Organizational process assets		

(PMI, 2017)

2.5.3 Risk Analysis

Risk analysis is the second stage in the risk management process where collected data about the potential risk are analyzed. Risk analysis allows the decision making process of the managerial department to be more certain (Vaghela, June 2020). Risk analysis can be described as the process analyses each risk from the risk register in terms of its probability and impact on the project if it were to occur. It should be performed as soon as possible after risks have been identified so that appropriate time and resources can be allocated to the more serious risks. It uses the probability and impact matrix (PIM) to rank and prioritize risks, and this information is placed back on the risk register (FME, 2014).

Like all the processes within risk management, this one should be performed regularly because new risks will be identified and the characteristics of existing risks may change as the project progresses. The inputs, tools and techniques, and outputs of this process are summarized in the table below (FME, 2014).

Table 2.5:- **Risk** Analysis Input, Tool & Techniques & Outputs

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
Risk Management Plan	Risk Probability & Impact Assessment	
Scope Baseline	Probability & Impact Matrix	

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
Risk Register	Risk Data Quality Assessment	Project Documents Updates
Enterprise Environmental Factors	Risk Categorization	
	Risk Urgency Assessment	
Organizational Process Asset	Expert Judgment	

(FME, 2014)

In the analysis of the identified risk, two categories of methods developed; this are qualitative and quantitative methods. The qualitative methods are most applicable when risks can be placed somewhere on a descriptive scale from high to low level. On the other hand, the quantitative methods are used to determine the probability and impact of the risks identified are based on numeric estimations the methods should be chosen depending on the type of risk, project scope as well as on the specific method's requirements and criteria.

2.5.4 Qualitative Rik Analysis

Once the risks are identified and approved for management by the key stakeholders, they are processed through a more thorough evaluation process. The first step in this process is qualitative risk analysis (Goncalves & Heda, 2014). Qualitative Risk Analysis is the process of prioritizing individual project risks for further analysis or action by assessing their probability of occurrence and impact as well as other characteristics. The key benefit of this process is that it focuses efforts on high-priority risks (PMI, 2017). It should be performed as soon as possible after risks have been identified so that appropriate time and resources can be allocated to the more serious risks (FME, 2014).

Qualitative method analyses each risk from the risk register in terms of its probability and impact on the project if it were to occur (FME, 2014). Furthermore, risk impact on a project's objectives is assessed regarding its positive effects for opportunities, as well as negative effects which result from threats. The method should be performed as soon as possible after risks have been identified so that appropriate time and resources can be allocated to the more serious risks. It also uses the probability and impact matrix (PIM) to rank and prioritize risks, and this information is placed back on the risk register (FME, 2014).

Table 2.6:- Perform Qualitative Risk Analysis Input, Tool & Techniques & Outputs

Inputs	Tools & Techniques	Output
Project Management Plan	Expert Judgment	Project documents updates
Project documentation	Data gathering	
Enterprise environmental factor	Data Analysis	
Organizational process assets	Interpersonal & team skills	
	Risk categorization	
	Data representation (Probability and impact matrix)	
	Meetings	

(FME, 2014)

2.5.4.1 Probability and Impact Risk Matrix

Definitions of risk probability and impact levels are specific to the project context and reflect the risk appetite and thresholds of the organization and key. The project may generate specific definitions of probability and impact levels or it may start with general definitions provided by the organization. The number of levels reflects the degree of detail required for the Project Risk Management process, with more levels used for a more detailed risk approach (typically five levels), and fewer for a simple process (usually three). The scales can be used to evaluate both threats and opportunities by interpreting the impact definitions as negative for threats (delay, additional cost, and performance shortfall) and positive for opportunities (reduced time or cost, and performance enhancement) (PMI, 2017). According to PMBOK Guide 6th edition define probability and impacts as follow.

Table 2.7**:-** Probability and Impact Matrix

SCALE	PROBABILITY	+/- IMPACT ON PROJECT OBJECTIVES		
		TIME	COST	QUALITY
Very High	>70%	>6 months	>$5M	Very significant impact on overall functionality
High	51-70%	3-6 months	$1M-$5M	Significant impact on overall functionality
Medium	31-50%	1-3 months	$501K-$1M	Some impact in key functional areas
Low	11-30%	1-4 weeks	$100K-$500K	Minor impact on overall functionality
Very Low	1-10%	1 week	<$100K	Minor impact on secondary functions
Nil	<1%	No change	No change	No change in functionality

(PMI,2017)

The risk impact assessment investigation and the level of probability for each risk and its impact on each objective is evaluated during: -

- The practitioners are going to be requested to evaluate the probability of risk occurrence.
- The practitioners will also be evaluated the impact of risk factor on project time, cost and quality.
- The scale to be utilized for assessing probability is from 0.1 (low probability) to 0.9 (high probability) and the possible choices would be 0.1, 0.3, 0.5, 0.7, and 0.9. Whereas impact will be evaluated in a range from 0.05 (low impact) to 0.8 (high impact) and the possible choices would be 0.05, 0.10, 0.20, 0.40, and 0.80.

Table 2.8**:-** Probability vs Impact Scale

Identified Risk	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Probability	0.1	0.3	0.5	0.7	0.9
Impact	0.05	0.10	0.20	0.40	0.80

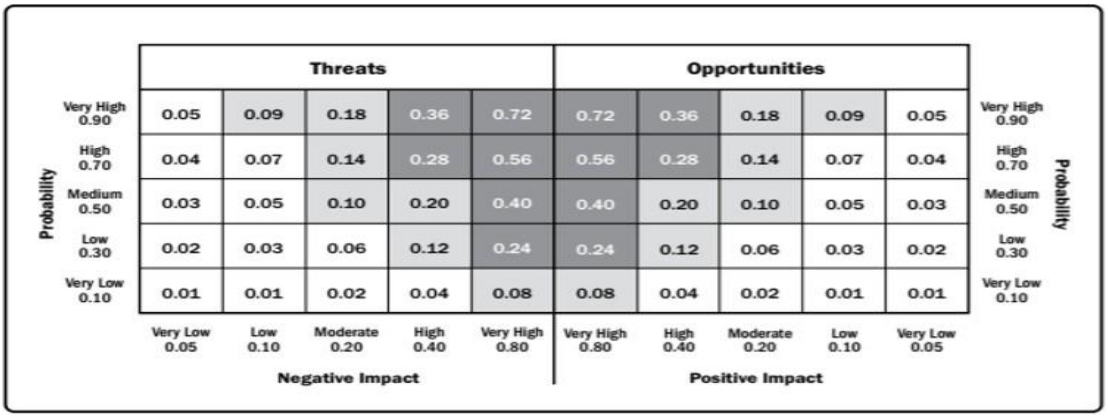
Noted that, the same scale is supposed to be used to evaluate impact on all three project objectives.

Depending on the type of probability, a rate between 0 and 1 is assigned to the risk. This number is multiplied together with the rate of impact in order to get a result. The results will later be combined in a matrix and used for further analysis.

Probability and impact matrix with scoring scheme

The risk matrix helps us to rate the significant of our identified risks based on the likelihood of the risk materializing and the impact if it does (Andy, 2012).

Table 2.9**:-** Probability X Impact Matrix



(PMI,2017)

Risks marked in the middle (Dark gray color) are the risks with the greatest negative impact on the project performance. On the other hand, risks marked in the left bottom corner on both side (white color) are categorized with low influence on the project. The remaining risks in the matrix are classified as a moderate level where the risks should be concerned, but not as extreme as the most negative risks. From this matrix, it is easy to reflect over which action to take against an evaluated risk. All risks will be ranked which facilitates to alert the most critical ones.

2.5.5 Quantitative Risk Analysis

Once the high impact risks are identified through qualitative risk analysis, these risks are processed through a quantitative risk analysis process so a numerical value can be assigned to them (Goncalves & Heda, 2014). This is the process of analyzing the effect of those risks identified in the previous process as having the potential to substantially impact the project. It may be used to assign a numerical rating to those risks individually or to evaluate their aggregate effect (FME,2014).

Table 2.10**:** Perform Quantitative Risk Analysis Input, Tool & Techniques & Outputs

Inputs	Tools & Techniques	Output
Risk Management Plan	Data Gathering & Representation Techniques	Project documents updates
Cost Management Plan	Quantitative Risk Analysis & Modeling Techniques	
Schedule Management Plan	Expert Judgment	
Risk Register		
Enterprise Environmental Factor		
Organizational Process Assets		

(FME, 2014)

2.5.6 Risk Response

Risk response is the process of developing strategic options, and determining actions, to enhance opportunities and reduce threats to the project's objectives (Tapping, et al.,2012). Risk Responses process determines effective response actions that are appropriate to the priority of the individual risks and to the overall project risk (FME, 2014). Planning of risk response is the process of developing options and actions to strengthen the opportunities and

reduce the threats to project objectives (Vaghela, 2020). It takes into account the stakeholders' risk attitudes and the conventions specified in the Risk Management Plan, in addition to any constraints and assumptions that were determined when the risks were identified and analyzed (FME, 2014).

The key to mastering risks response controls is to identify what constitutes the triggering event, by analyzing, qualifying, and quantifying risks to minimize threats and maximize opportunities. (Goncalves & Heda, 2014). Risk response control is the process of keeping track of the identified risks, monitoring residual risks and identifying new risks, ensuring the execution of risk plans, and evaluating the plans' effectiveness in reducing risk (Goncalves & Heda, 2014).

Common and possible strategies for negative risks or threats: - The response aims to modify the "size" of the positive risk. The opportunity is enhanced by increasing its probability and/or impact, thereby maximizing benefits realized for the project. (Andy, 2012)

Avoidance/Prevention/Manage: - if risk with a higher likelihood but low impact may be managed by improving process, documentation, training, education and monitoring (Andy, 2012). This involves taking action to either reduce the probability of the risk and/ or its impact to zero. In either case this response enables the risk to be circum- vented entirely (FME, 2014). Risk can be avoided by removing the cause of the risk or executing the project in a different way while still aiming to achieve project objective. Not all risks can be avoided or eliminated and for others, this approach may be too expensive or time consuming. However, this should be the first strategy considered (Tapping, et al.,2012).

Reduction/Mitigation: - for risk with a high likelihood and high impact, risk reduction measures are absolutely essential. This kind of risk cannot be ignored (Andy, 2012) Risk mitigation reduces the probability and / or impact of an adverse risk events to an acceptable threshold (Tapping, et al.,2012). Taking early action to reduce the probability and/or impact of a risk occurring is often more effective than trying to repair the damage after it has occurred. Adopting fewer complex processes, conducting more tests, or choosing a more stable supplier are examples of mitigation actions (FME, 2014).

Transfer: - for risks with a low likelihood but a high impact, contingency plans should be developed (Andy, 2012). This involves transferring the risk to a third party so that they are responsible for its management and impact. (FME, 2014). The aim is to ensure that the risk

is owned and managed by the party best able to deal with it effectively (Tapping, et al.,2012). It does not eliminate the risk it simply transfers the liability to someone else. This can be done by:

- Taking out insurance (the insurance company is now liable) or
- Having the work done under a fixed-price contract (the contractor is now liable) (FME, 2014).
- Risks with a low likelihood but a low impact may be managed by improving processes, documentation, training, education and monitoring (Andy, 2012)

Accept: - if the likelihood is low and the impact is low, it may be a perfectly reasonable decision to do nothing and to accept certain risk. (Andy, 2012) This strategy is adopted when it is not possible or practical to respond to the risk by the other strategies, or a response is not warranted by the importance of the risk (Tapping, et al.,2012). The common acceptance strategy is to establish a contingency reserve, including amounts of time, money, or resources to handle the risks. It is usually chosen either because:

- Risk is low in terms of impact or probability, or
- Cost and effort of taking a different action is out of proportion to the risk itself (FME, 2014)

Similarly, the Common and possible strategies for positive risks or opportunities (FME, 2014)

Exploitation: -is directly exploiting responses include assigning an organization's most talented resources to the project to reduce the time to completion or to provide lower cost than originally planned (FME, 2014). The aim is to ensure that the opportunity is realized (Tapping, et al.,2012).

Sharing: - sharing a positive risk involves allocating some or all of the ownership of the opportunity to a third party who is best able to capture the opportunity for the benefit of the project. Examples of sharing actions include forming risk-sharing: Partnerships, Teams, Special-purpose companies, or Joint ventures (JVs). These can be established with the express purpose of taking advantage of the opportunity so that all parties gain from their actions (FME, 2014).

Enhance: -This response aims to modify the "size" of the positive risk. The opportunity is enhanced by increasing its probability and/or impact, thereby maximizing benefits realized for the project (Tapping, et al.,2012). Examples of enhancing opportunities include adding more resources to an activity to finish early (FME, 2014).

Accept: -accepting an opportunity is being willing to take advantage of it if it comes along, but not actively pursuing it (FME, 2014).

2.5.7 Risk Monitoring & Control

The risk monitoring and control process acts as a risk police monitoring the progress of defined risk responses in mitigating identified high impact risks, re-evaluating the risk priorities, monitoring the risk register for changes in the list of potential risks and evaluating the effectiveness of the various tools and techniques used in mitigating (Goncalves & Heda, 2014)Risk control is the process of implementing the risk response plan and monitoring and reviewing the effectiveness of the response developed (Vaghela, 2020).

According to PMBOK Guide 6th edition states that the assumptions for monitoring and controlling are to supervise the status of the risks and take corrective actions if needed (PMI, 2017). Tools and techniques used to risk monitor and control may be

- Risk reassessment – identification of new potential risks. This is a constantly repeated process throughout the whole project.
- Monitoring of the overall project status – are there any changes in the project that can effect and cause new possible risks
- Status meetings – discussions with risk's owner, share experience and helping managing the risks.
- Risk register updates

By managing the whole RMP, the process can be evaluated. This is also a way to improve the project work, since the advantages and disadvantages will be brought up. Response developed for the control of risk should be fully documented for future reference and project plans (Vaghela, 2020).

2.6 Risk Management in Construction Sector

The construction industry has marked rapid growth all over the globe and innovative techniques have been added in the 20 years. But at the same time, the construction industry is at high risk because of the dynamic nature of the project environment (Vaghela, 2020). Risk has adverse effects on construction projects such as time, cost, scope, and quality and because of the rapid change in the construction industry in the last 10 years, projects are faced with more risks and uncertainties than ever before. In the past few months, COVID-19 has had a

huge impact on the economic activity of the construction industry (Vaghela, 2020). This means, risk management becomes essential for project success. So, let's take a look at few review articles to find risks related with the construction sector.

(Serpella et al. 2014), stated that using a knowledge-based approach, has been able to solve risk issues in construction projects. It was mentioned in the study that usually, the measurement of risk mitigation implements concerning both project cost and project schedule. This is because it completes most of the time the project with a cost overrun and delay. However, in many cases, the study noted that an inadequate cover the risk participated during project awareness. So that the paper suggests forming effective risk management by developing suitable techniques, awareness, and exercises to implementation on the projects. Therefore, the study proposed a method for the application of risk management, evaluation of the practice, and best practice on the models.

As stated in (Selleh, et al., 2020), the article's main aim was to review and study the application of risk management in the construction industry. In the study, the risk management process was found particularly essential to implement during the existence of risk in the project. It also mentioned that risk has a significant impact on the success of construction projects, especially during a crisis. So that RM play a key role in making the right decision in the planning phase of construction. Consequently, after the application of risk mitigation practices and approaches to recognize instability, a clear trend has been identified and to recommend this process to companies that have not yet implemented.

2.6.1 Reviewing Risk Management on Road Construction Projects

Road construction projects carry a significant amount of risk due to its spread over a wide geographical area and threats from underground conditions (Okate & Kakade). Risks that occur in highway projects will lead to the inability to achieve desired project objectives. Delays, cost overruns, and reduction of availability of resources are the negative effect of risk inherent to highway projects (Singh & Chugh, 2016). Globally, road construction projects are faced with challenges of risk management (Kirira et al., 2019).

According to (Okate & Kakade), the study focus and risk management in road construction that is conducted for high-volume roads. The study identified the major risk through survey questionnaires and the risk assessment was analyzed based on the probability and impact of

risk occurrences. Hence the allocation of the risk was done towards the client, consultant, and contractor. From the survey analysis result, the major five identified essential risks in the sectors are delay in payments, owner bankruptcy, Unclear project scope, lack of quality management by the project manager, and poor site management. This study would help project managers better anticipate risks before initiating a project and will help to develop effective mitigation measures in the early stages of the project.

As stated by (Singh & Chugh, 2016) the aim of the article was to identify the exact process of risk management in construction projects and to determine the impact of risk management on the implementation of construction projects over time and cost. Due to the nature and complexity of the construction process, the construction sector and the client-facing high risks. However, these construction employees who were involved in risk management were not aware of the RM process. So that the study recommended, to provide adequate training for contracting parties with respect to the objective of the project. The following sections summarized a review of various studies global, regional, and national levels regarding the subject.

2.6.1.1 Risk Management in Malaysia and Sri Lanka

As stated by (Razi et al., 2019) the delay risk becomes assessed quantitatively with the assistance of listing the risk suspension issues and realizing sensitivity analysis in defining the serious construction phase in Malaysia. They have a look at identifying the peak five most prioritized factors. These are technical, natural hazards, economic and financial, contractual, and socio-politics. The worldwide weight obtained was ranked and fund risk, flood, heavy rain, unexpected ground condition, and present utility issues were determined as the highest five of most listed sub-factors. Sensitivity analysis simplified that the construction phase faced most of the risk, followed by the planning stage, project design, and project closeout takes less chance of occurrences.

According to (Perera et al., 2009), the main objective of the research was to find and recognize the obligation of the contracting parties regarding risk based on the analysis outcome to improve the RM strategies in Sri Lanka. Hence, road construction projects in Sri Lanka were defined many risk sources even most risks are identified by parties who had been assigned with risks over contractual clauses. However, parties that had been not assigned with the identified risks too occurred to suffer the consequences of the risks. Lastly, it was

concluded that there is no way to respond to risk and different risk-handling strategies should be accepted to deal effectively with risks.

2.6.1.2 Risk Management in Kenya and Nigeria

(Kirira et al., 2019) focused on examining the impact of risk management strategies on the implementation of road construction projects specifically focus on KeNHA. The main objective of the papers was to ensure the impact of risk identification, awareness of practical risk assessment, performance risk reduction perspectives and performance risk management, and awareness on road construction project implementation. The study found that risk identification, analysis, control, and monitoring, and mitigation views affect the performance of KeNHA road construction projects effectively, and meaningfully. Then it concluded that risk identification had the best impact on the performance of KeNHA road construction projects followed by awareness of risk assessment then risk mitigation viewpoints whilst risk control and monitoring understandings had the least effect on the performance of KeNHA road construction projects. it then recommends project managers to increase their role in capacity-building and construction project management. Additionally, a higher level of participation in construction industry specialists leaded with providing professional guidance and assistance on the application of risk management strategies. Finally, it concluded that Risk Management is an essential aspect that critically controls the performance of construction projects in the KeNHA, and the Construction industry.

As per (Fabi & Awolesi, 2015) the conducted study showed that in order to ensure a successful project that meets project goals and objectives, adequate attention should be paid to the construction risk management and the risk management practices in highway projects in Nigeria. The analysis result show that lack of an acceptable industry model for risk is considered a major factor in the application of risk management practices in Nigeria, followed by human/ organizational resistance. Additionally, it showed that the practice of risk management in Nigeria is low. Then the study recommended that all the contracting parties in the highway construction sector should have an adequate training programs, quality, resource, health and safety values and acceptable standards to improve risk manner.

2.6.1.3 Risk Management in Ethiopia

A thesis made by (Addis, 2014) stated that most standard construction contracts in Ethiopia have clauses deals with common risks such as force major risks (i.e., war, enemies . . .). However, identify risks that may delay the project from achieving its objective are not well-known and managed using clearly defined terms of the clauses. The concerned that most of the construction projects are faced a delay, cost overrun and poor quality, this indicated that these contracts require some improvement and additional clauses to control risk. Unknown and unexplained risks have a major impact on the project objective. Therefore, the contract contains identified risks and suggests way to manage them to reduce the impact on the project objective.

As stated by (Meazadingil, 2015) conduct a thesis that discusses about assessment of risk management in road project. During the discussion it stated that the main carrier of risks in a construction project falls between the contract and the ERA. So that the thesis tries review risk management practices with respect to international & local applicable laws concerning both employers' and contractor's sides. The paper shows that according to MDB, FIDIC, expresses accountabilities belonging to the contractor and the employer. Moreover, PPA, Standard Bidding Document (SBD) For Procurement of Works: For International Competitive Biddings (ICB) also defines contractor's and employer's risk. The Application laws in Ethiopian 's road construction sector address some of the common risk in road construction projects. And in most cases, only the risks included in these standard documents are included in the contracts. However, it is recommended that unique risks be identified and included in particular circumstance under the control without incident or after any effort. It's also identifying that risk management is not practiced in road projects in a structured way but some of its components exist in terms of Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), Quality Management System and insurance. However, in order to avoid failures to achieve project objective, it must have a proper risk management structure. Therefore, the research has made recommendations for the road construction industry, to develop a risk management manual that would be prepared including basic theoretical information as well as ready-to-use guidance for each risk management process to be an effective method for project managers in displaying priorities and display places of success and failure to maximize profit.

As per (Emran, 2017) stated on the case study conducted on ERA, that the staffs of the major stakeholders in the Ethiopian construction industry are aware of risk management principles. However, the practice of risk management in the industry is at a mature stage. It's also mentioned the most important challenges in the sector such as right-of way obstacles, incomplete design, and design problems, inadequate site or geotechnical investigations, scope and design changes, and unexpected weather conditions. In addition, ERA staff were also aware with risk management techniques. However, there is no formal risk management practice in the sector. As well as, at that time, the researcher found out that, the Authority was given the task of risk assessment for the consultants.

2.6.1.4 Risk Management in Ethiopian Roads Authority

The road construction industry and the authority (ERA) are associated with a high degree of risk due to the vast size of the scope of the project and the complex nature of the construction process (ERA, 2019). In Ethiopian, the road sector mainly administrated by the Ethiopian Roads Authority that is the largest road construction employer in the country. Ethiopian Roads Authority (ERA) is responsible for the management, development, rehabilitation, and maintenance of the federal roads' projects in Ethiopia. The Authority to perform its duties efficiently and responsibilities organized its activities under four Major functional (ERA, 2020). These are: -

i. Project Development- focuses on pre-construction Phase
ii. Construction Projects Contract Administration - focuses on road projects construction implementation phase
iii. Road Asset Management - focuses on road asset administration & preservation
iv. Corporate Services - Mainly focuses on providing necessary support like human, financial and other administrative support across the functional areas and
v. office of Director General - directorates which have most advisory roles are organized under this umbrella and managed by Deputy Director General

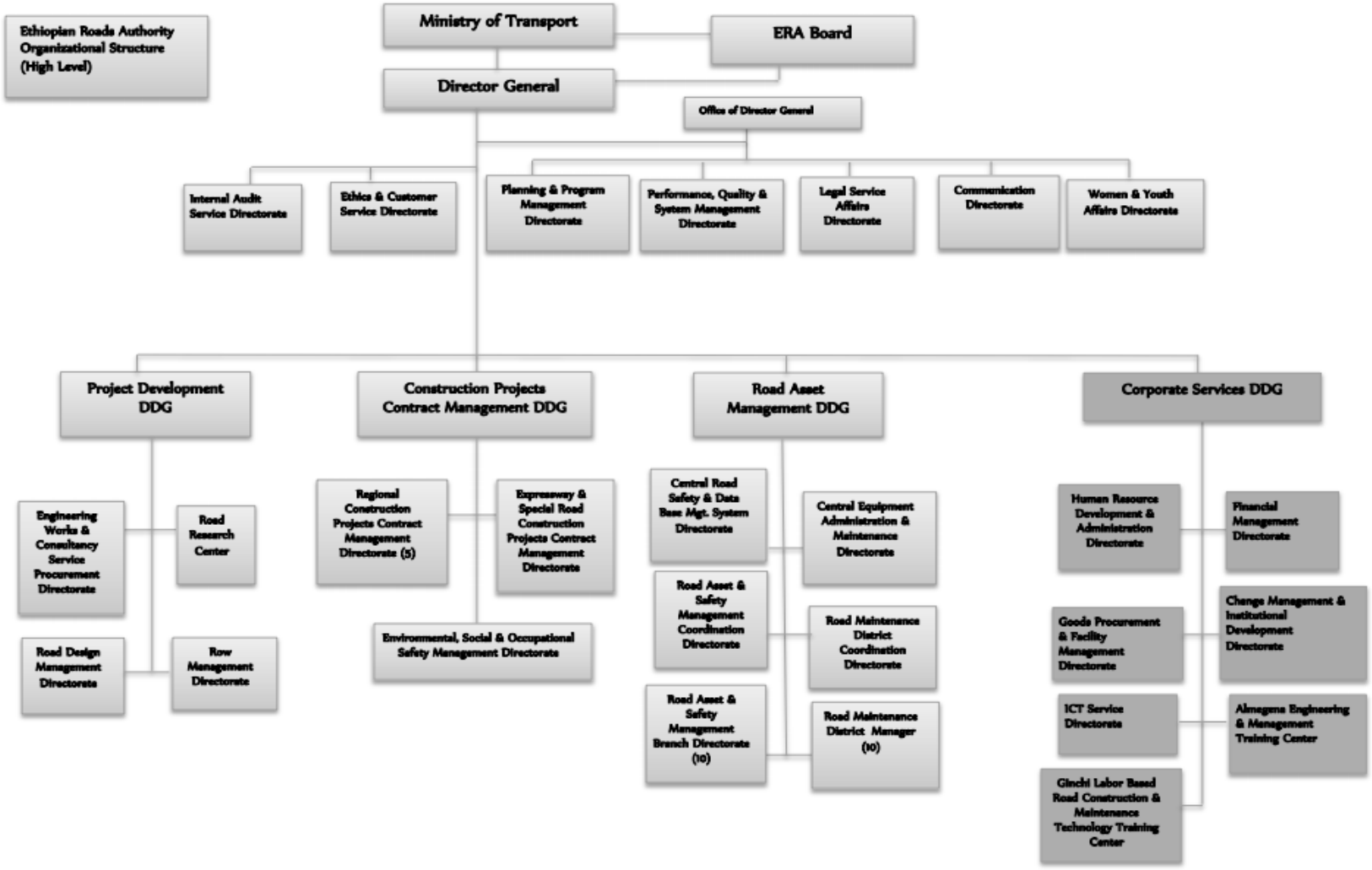


Figure 2.3:- The Ethiopian Roads Authority organizational structure (ERA, 2020)

On the other hand, Organizational Process Assets (OPAs) are the plans, processes, policies, procedures, and knowledge bases specific to and used by the performing organization. Processes, Policies, and Procedures are key element of the performing organization which includes, but not limited to Standard Operating Procedures (ERA, 2020). A standard operating procedure (SOP) is a set of step-by-step instructions compiled by an organization to help workers carry out routine operations (ERA, 2020). The Purpose of this procedure is to show work flow chart for Construction projects management in order to ensure that the Construction projects are executed effectively and efficiently with regard to time, cost and quality (ERA, 2020). This Standard Operating Manual lists activities for Construction Projects Management stream. Among this lists "Activity 10" indicate the risk management plan. Hence, the work flow chart for RMP presented in the fig, below.

Table 2.11:- Work Flow Chart for Risk Management Plan

የድርጅቱ ስም / Company Name:- የኢትዮጵያ መንገዶች ባለስልጣን Ethiopian Roads Authority			
ርዕስ / Title: CPM Standard Operating Procedure	Core Process: Construction phase	Name of Activity: Risk Management Plan	Activity No. 10

10.1 Process flowchart

Input	Process	Output	Responsibility
Contract Document/General Condition of Contract	The Contractor shall prepare and submit Risk management/response plan to Engineer	Risk management/Response plan	Contractor
General/specific condition of the service contract	The Engineer has to review contractor's RMP and forward the same to the Employer	Risk management/Response plan which have Engineer's consent	Engineer
Quality Assurance System	Follow-up of the Implementation of Risk management/response plan in the day to day activities of the Project		Engineer. ERA

10.2 Process Description

FN	Process Description
1	The Contractor shall submit to the Engineer Risk Management/Response Plan.
2	The Risk Management/Response Plan at lease shall have the following contents, ✓ Introduction ✓ Brief Executive summary ✓ Potential risk area ✓ Potential remedial measures for the expected risks ✓ Source of the potential risks like, Lists of Landslide prone area ✓ Expected damage due to the risks ✓ Remedies to minimize and/or eliminate the potential risks ✓ Recommendation

(ERA, 2020)

As per the conducted mechanism report stated that the consultancy named SMEC had been assisted the Authority to develop a proactive contract management mechanism through the introduction of best construction project management practice. With the assistance of this consultancy, since January 2019 the authority prepared a risk management mechanism document as a guideline to assess and analyze risk and to undertake appropriate remedial measures on the road construction on cost and time efficient manner. As well as the report stated that it assists the staff of ERA to have awareness regarding the principle of risk management. On the following section, discussed ERA's risk management applied practice & techniques developed by the mechanism report.

2.6.1.5 Risk Management Practice implemented by ERA

As stated in (ERA, 2019) mechanism report, the first step should be to arrange an initial risk management meeting at the stage of transferring the project from engineering procurement to the construction phase. This aids to transfer the identify construction risk and developed knowledge of the project from the procurement team to the delivery team. Furthermore, this helps to take the necessary preventative actions in the early stage. The personnel who attend the meeting are representatives from Engineering Procurement, deputy director General Engineering Operations, director of the Construction Directorate, project engineer, risk Manager, construction engineers, risk assessment facilitator. With the fundamentals of ERA risk policy, risk management includes the following steps: establish the context, identify the risks, analyze the risks, evaluate the risks, treat the risks, and monitor and review.

I. *Establish the Context:-* this phase aims to plan and set measurements on how to be managing risk and the scope for the rest of the process by considering the factors that affect the objective of the construction projects. This measurement would be taken regarding the internal & external situation of the construction directorate. Factors that affect the authority construction operation in internal & external environments are presented in the table below.

Table 2.12**:-**:- Factors in the Internal and External Environments

Internal environment factors	External environment factors
Strategy: the plan devised to maintain and build competitive advantage over the competition.	Political
Structure: the way the organisation is structured and who reports to whom.	Economic and financial
Systems: the daily activities and procedures that staff members engage in to get the job done.	Socio-cultural
Shared Values: the core values of the organisation evidenced in the corporate culture and the general work ethic.	Technological
Style: the style of leadership adopted.	Legal and regulatory
Staff: the employees and their general capabilities.	Environmental
Skills: the actual skills and competencies of the employees working for the organisation.	Key drivers impacting the organisation
	Relationships with, perceptions and values of key external stakeholders.

(ERA, 2019)

II. Risk identification: - involves recognizing the possible risk events, causes, and consequences by raising a question of what, why, when, and how things may or may not happen on construction projects. Risk identification involves the following steps:

- Identify Possible Risks: - is the process of determining which risks may affect the project and documenting the characteristics. The Authority prepared a uniform risk identification format for the factors that affect the projects. This written format is: -

  "*There is a risk that [something may happen] due to [these cause/s] resulting in [these consequence/s]"*

- Categorize the Risk: - the risk category could be used to analyses the risks within the register to identify common risk themes, to check for patterns across the project, to trace back to primary root causes of the risks, to better identify causes and effect relationship and identify extreme level risks that should be brought to the attention of the construction director

- Determine the Risk Owner: - following the risk identification, there should be selected a single risk owner. The risk owner must to ensure accurate and complete risk information is recorded in the risk register, ensure risk is managed to target level and ensure risk is regularly reviewed and reported.

For the most part, in ERA the risk management responsibilities are assigned to the risk manager as a part-time position for each construction project or project engineer. This person is assigned the responsibility for coordinating the risk management activities and to be in charge of maintaining the risk register, convening risk meetings, and following up on actions.

- Flag whether the risk relates to fraud or corruption: - Where the risk relates to the potential for fraud and corruption, this will be flagged within the risk register to allow all fraud and corruption risks to be identified, reported, and monitored ERA's Register identifies risk prepared and kept up to date by the designated project Risk Manager in the following form shown.

Table 2.13**:-**:- ERA'S Risks registration format

Organisation Name **Project Risk Register**

Project Name		Original Register Start Date		Rev No.	
Project Number		Date Of Latest Review		Owner	

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
No	Status	Category	Description	Impact	Consequence	Likelihood	Risk Rating	Trigger Point	Mitigation Measures	Owner	Estimated Cost (million Br)			
											Low	Medium	High	Provision
												Total Provision		0

(ERA, 2019)

Additionally, based on the consultant observation, the main possible and sources of risks that affect the project identified by considering all parties that participate in the contract. The table below presented the main risks that are identified on a construction project by each employer, contractor, and consultant.

Table 2.14:- ERA/ Employer's Main Risks

Contractor	Consultant	Contractual	Legal	Financial
Resources	Resources	Warranties and bonds	Change of law	Rates
Competency	Competency		Taxation	Deductions
Financial Soundness	Decision-making		Standards	Cash Flow
Honesty	Honesty		Licences	Advance payments
				Retention
				Inflation and exchange rate changes

Design	Technical	Physical	Internal	Resources
Completeness	New technology	Geology / ground conditions	Staff	Availability
Competency	Specialist materials	Water table		Delivery times
Designers	Reliability	Climate		Supply chain
Scope Creep	Availability			International procurement
Quantities				Quality

Programme	3rd Parties	OHS	Quality	Social and Environment
Timeliness of preparation	Land ownership	Temporary traffic management	Systems	Resettlement
Sufficiency	Service providers	Security	Testing	Endangered species
Key dates	Compensation	Public interface	Specification	Waterways
Constraints	Access			Dust
Assumptions				Noise and vibration
				Spills and pollution
				Site rehabilitation

(ERA, 2019)

Table 2.15:- Contractor's Main Risks

Employer	Consultant	Contractual	Legal	Financial
Funding	Resources / capacity	Contract conditions	Change of law	Deductions
Approvals	Competency	Payment terms	Taxation	Cash Flow
Delegation	Decision-making	Inflation	Availability of ROW	Advance payments
	Honesty			Retention

Design	Technical	Physical	Internal	Resources
Completeness	Subcontractors	Location	Staff competency	Availability
Competency	Availability	Terrain	Staff numbers	Delivery times
Scope Creep		Working room	Labour	Supply chain
Quantities		Geology / ground conditions	Plant Materials	International procurement
		Water table		Quality
		Barriers		Subcontractors
		Climate		

Programme	3rd Parties	OHS	Quality	Social and Environment
Timeliness of preparation	Land ownership	Training	Systems	Resettlement
Sufficiency	Service providers	Temporary traffic management	Testing	Endangered species
Assumptions	Access	Security	Production	Waterways
Resource levels		Public interface	Training	Dust
		Employer requirements		Noise and vibration
				Spills and pollution
				Site rehabilitation

(ERA, 2019)

Table 2.16:- Consultant's Main Risks

Contractor	Employer	Contractual	Legal	Financial
Competency	Funding	Contract conditions	Change of law	Deductions
Honesty	Approvals	Payment terms	Taxation	Cash Flow
Capacity	Delegation	Inflation	Standards	Advance payments
	Decision-making		Licences	
			Availability of ROW	

Design	Technical	Physical	Internal	Resources
Completeness	New technology	Location	Staff competency	Availability
Competency	Specialist materials	Terrain	Staff numbers	Office and equipment,
Scope Creep	Reliability	Geology / ground conditions		Communications and transport
	Availability	Water table		
		Climate		

Programme	3rd Parties	OHS	Quality	Social and Environment
Timeliness of preparation	Land ownership	Training	Systems	Resettlement
Sufficiency	Service providers	Temporary traffic management	Testing	Endangered species
Assumptions	Compensation	Security	Production	Waterways
Review	Access	Public interface	Training	Dust
		Employer requirements		Noise and vibration
				Spills and pollution
				Site rehabilitation

(ERA, 2019)

This listed major risks may have a chance to change in different project and the passage of time.

III. Risks Assessment: is the process of evaluating risk by determining the risk level/ rating for the identified risk on the construction projects. It involves developing an understanding of each risk, its consequences, and the likelihood of the risk occurring. Consequently, it provides to take a measurement for the identified risks to be treated and to select the appropriate risk treatment strategy. ERA used qualitative risk assessment on all its projects. Qualitative risk assessment is a process of ranking risks for further analysis by combining the probability of occurrence and impact. Many tools could be used for risk assessment but the common and relevant to the ERA construction projects are brainstorming, structured or semi-structured interviews, SWOT, Check listing, Scenario analysis, Business impact analysis, and consequence X likelihood Matrix. Risk analysis involves:

Identify the existing controls:- are those controls that currently exist and that are in some way already reduce the overall risk. This could include controls or strategies that may not be set up to address this risk specifically but still influence the likelihood and/or consequence of the risk occurring.

- Determine the likelihood of the risk occurring: - which is determined by evaluating a subjective consideration. In this situation, the authority should consider existing controls and the effectiveness of the risk mitigation from the effectiveness of the risk-mitigating, previous experience & records, and any results of research or consultation. The likelihood of a risk occurring can be addressed on a scale as presented in the table below.

Table 2.17:- Risk Likelihood Scale

Descriptor	Description	Indicative Return Period	Indicative probability (over the timeframe or activity of interest)
Almost certain	The consequence expected to occur on an annual basis	Every year or more frequently	>0.9
Likely	The event has occurred several times in your career	Every three years	>0.3 and <0.9
Possible	The event might occur once in your career	Every ten years	>0.1 and <0.3
Unlikely	The event does occur somewhere from time to time	Every thirty years	>0.03 and <0.1
Very unlikely	Heard of something like that occurring elsewhere	Every 100 years	>0.01 and <0.03
Extremely unlikely	Have never heard of this happening	Every 1 000 years	>0.001 and <0.01
Incredibly rare	Theoretically possible but not expected to occur	Every 10 00 years	<0.001

(ERA, 2019)

- Determine the consequence of the risk occurring:- The consequences of a risk eventuating in two steps. The first step determines by considering the impact of the risk on the owner (ERA). This would be financial, service delivery, reputation, health and safety, and environmental. The second step is defining the consequence using a consequence level schedule as guidance. The table below gives a basis for assessing consequences for ERA.

- Calculate the risk rating (likelihood x consequence):- The risk rating is the combination of the likelihood of the risk occurring and the size of the consequence of the risk event. Its purpose is to determine how to treat risk and used it for reporting the data in escalation form. For ERA, the risk rating could be assigned to a scale of ‘low’, ‘moderate’, ‘high’, ‘very high’ or ‘extreme’ as shown in the firer below.

Table 2.18:- Risk Assessment Matrix

Likelihood rating							
	Almost certain (G)	Moderate	High	Very High	Extreme	Extreme	Extreme
	Likely (F)	Moderate	High	Very High	Very High	Extreme	Extreme
	Possible (E)	Moderate	High	Very High	Very High	Extreme	Extreme
	Unlikely (D)	Moderate	High	High	Very High	Very High	Extreme
	Very unlikely (C)	Low	Moderate	High	High	Very High	Very High
	Extremely unlikely (B)	Low	Low	Moderate	High	High	Very High
	Incredibly rare (A)	Low	Low	Moderate	Moderate	High	High
		Negligible (1)	***Minor (2)***	***Moderate (3)***	***Major (4)***	***Severe (5)***	***Catastrophic (6)***
		Consequence Rating					

(ERA, 2019)

IV. Evaluate the Risks: - based on the result of the risk assessment, the risk evaluation makes a decision which risk should be acceptable, need treatment, and/ or get a priority. The risk evaluation stage involves the following main steps:

- Determine Treatment Actions Using Risk Rating Responses

- Determine the Risk Target: - is the level of risk after treatment that is tolerable to ERA. The following major points should be considered to identify the risk target. These are: - the risk appetite and the acceptable level for each risk. The acceptable level for each risk determines by the nature of risk and the level of risk control over the cause, and also the effort to mitigate the risk effectively.

- Determine the Treatment Decision*:* - is dependent on the relationship between the current risk rating and the target risk rating i.e., if the current risk rating is higher than the target risk rating, the risk treating by reducing the risk to the required target. On the other hand, if the current risk rating is lower/equal to the target risk rating, the risk treating by accepted and monitored. The identified risks must be treated by the following considerations and the decision processes outlined in the Table below. These are the causes of the risk and whether they are within ERA's ability to manage, the effectiveness of existing detective and preventative controls to manage the causes of the risk, to identify what resources would be required to

implement treatment actions and what is the expected change in risk level, and the cost of implementing each treatment option against the benefits derived from it the gap between the current risk rating and the risk target. The following treatment decisions are possible.

Table 2.19:- Possible Risk Treatment Decisions

Treatment	Definition
Reduce	Apply a risk treatment that reduces either the likelihood or consequence of the risk occurring. Also known as risk mitigation or modify.
Avoid	An informed decision not to be involved in, or to withdraw from, an activity in order not to be exposed to a particular risk. Alternatively, a risk may be avoided by taking a different course of action.
Transfer	Risks may be transferred to other 3rd parties. It does not eliminate the cause of risk but only passes the implications of risks on to third parties, usually at an additional cost. Opportunity for transfer, post-contract, is limited.
Share	The agreed distribution of risk with other parties. ▪ legal or regulatory requirements can limit, prohibit or mandate risk sharing. ▪ risk sharing can be carried out through insurance or other contracts. ▪ the extent to which risk is distributed can depend on the reliability and clarity of the sharing arrangements. ▪ risk transfer is a form of risk sharing. **Note:** The accountability for meeting business objectives or achieving outcomes cannot be transferred.
Accept	Acceptance of the potential benefit of gain or burden of loss from a risk. The risk is monitored in case the risk rating changes, possibly resulting in the need for a different treatment strategy.

V. Risk Monitoring and Review: - This step aims to ensure the risk are effectively managed, appropriately reported and to account that the changing nature of risk. It has to be also regularly managed the risks by considering the existing and new occurrence of the risk.

- *Reviewing the Risk Register:* - At a minimum the following elements of risks should be reviewed to ensure the risk register remains current and accurate:

Risk cause/s	are these still relevant? are there any additional causes?
Risk consequence/s	Has this changed from last review?
Controls	Are these still in place and effective? Are there any additional controls?
Status and effectiveness of treatments	Has there been any progress? are the treatment actions still effective or has something changed

	that would mean another action may be more effective?
Consequence rating	has the completion of risk treatment actions or any other factor reduced the consequence of the risk or have additional causes or impacts been identified which have increased the risk?
Likelihood rating	has the completion of risk treatment actions or any other factor reduced the likelihood of the risk or have additional causes or impacts been identified which have increased the risk? Additional risks have any new risks emerged since the last review?

- *Recording and Reporting:* - The methods used to assess risks should be documented together with the results of the assessment. All documentation or records should be in a form that can be understood by those who will read it but should also provide the necessary technical depth for validation, and sufficient detail to preserve the assessment for future validation. The purpose of records is to communicate information about risks to decision-makers and other stakeholders, provide a record and justification of the rationale for decisions made, preserve the result of assessment for future use and reference, to enable verification of the assessment and provide an audit trial. Finally, after all these steps and procedures a risk review meeting should be held every month. Following the meeting, the risk register should be updated and distributed. The purpose of the meetings would be to review the register and actions from previous meetings, to decide if new actions are requiring for any item on the register, to identify if new items need to be added and close items where possible.

2.7 Research Gap

Regarding the above discussion, the review of risk management on road construction projects indicates that the theory of risk management has been well studied, although its application in the Ethiopian road construction industry has been very poor and immature. Similarly, the conducted studied concerning the Authority shows that ERA staff were aware of the risk management principles and it had no formal guidance to manage risk.

However, in the previous time, the Authority managed the effect of risk with respect to the international and local laws. Since January 2019 the Authority has prepared a risk management document as guideline for assessing risks on the construction project and taking the appropriate action. These studies indicated that it has no specified time intervals to implement like other major activities within the organization i.e., there are some basic points that have been missed. Therefore, this research is done to find out the following: -

- Impact of failure to implement risk assessment mechanism and its remedial measurement
- To implement risk management conditions and procedures within the Authority.
- To implement the desire and actual level of risk management performance.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Study Area

The study was conducted on the Ethiopian Road Authority focusing on risk management practices in road construction projects.

Following the evacuation of the Italian occupiers, the Imperial Ethiopian Highway was established in 1951 under the proclamation No.115/1951 as a semi- autonomous agency with the specific duties to plan, design, construct and maintain roads. It had lasted for 26 years with these duties unchanged (1951-1977). In 1978 the Authority's main responsibility on highways had been enlarged to incorporate the construction and maintenance of rural roads which had been authorized by proclamation No.133/1978. Few years' later duties and responsibilities of the Authority had further stretched to embrace the construction of air-ports, Sea-ports, Railways and municipality roads which were vested on it by proclamation No.1989/1980. After 10 years following the orientation of Command Economy to the Market oriented one it was reestablished with proclamation No.63/1993 with a view to provide strong administration under the Leadership of Board. During this time very significant change has been made to the structure which devolves the duty and administration of rural roads to National Regional States and made the Authority to focus mainly on federal highways. After 18 years, in 2011 significant organizational change which separated road construction and maintenance own force operational wing from the Authority had been occurred. However, after identifying the deficiencies of the then restructuring the government has decided and reinstated the own-force road maintenance wing in the Ethiopian Roads Authority since December 2020 (ERA, 2020).

3.2 Research Type

The study used is descriptive research. It's descriptive research because it is finding out the current risk management practice undertaken by ERA and, it also describes the current status of the contracting parties' awareness about risk management practice undertaken by ERA. In addition, it also describes the major risk faced by ERA in the course of undertaking road construction projects and a mitigation suggestion that could be suitable to practice risks management in the Authority. This descriptive research type helped to use both qualitative and quantitative data analysis.

3.3 Data Type

The study was based on both Quantitative and Qualitative data types. The qualitative data includes the opinions of respondents and the quantitative data was that can be expressed in terms of numerical values

3.4 Data Source

The data for this study was collected from primary and secondary sources. The primary data were collected from various respondents through questionnaires, interviews, and key informant interviews. The respondents were selected purposively from ERA, contractors, and consultants. Secondary data was collected by reviewing archival records, contract documents, published works, journals, and related articles.

3.5 Sampling Design

3.5.1. Sample Population

The population for this research was ERA, Consultants, and Contractors who have been directly participated in road construction projects.

The study distributed the questionaries for the Ethiopian Roads Authority staff, consultants, and contractors in participated in road construction projects.

Ethiopian Roads Authority has five directorate directors that control and monitor the construction projects. These five direct directorates are named Norther, Eastern, Southern, Western and Central regional directorates. Each of these five directorates has one director, three team leaders and twenty-seven project engineers.

On the other hand, based on the summary of contractor performance evaluation on the month of April 2021 posted on ERA website, there are 73 local & international Contractors who have been actively participated. Similarly, 73 active Consultants were taken based on the data gathered from the Authority. Therefore, the sample size is summarized in tabular form as follows.

Table 3.1:- Sample size of the research

Respondents	No. of questionnaire distributed
ERA (ERA Employees)	155
Consultants	73
Contractors	73
Total	**301**

3.5.2. Sample Technique

A simple random sampling technique was used to select respondents to this study. A simple random sampling technique was used to give equal chances for each contracting parties represented proportionally within the sample unit and adequate data for the analysis.

3.5.3. Sample Size

The study was used Yamane's (1967) simplified formula to determine the sample size.

Formula: $n= N /1+N (e^2)$

Where:

n = Required sample size

N =Total population (in this case, 301)

e = the percentage of allowance in accuracy for making sampling errors. The level of the common confidence level is 90%,95%, and 99%. In this study, the accuracy or sample error rate was estimated to be $\pm$ 0.1.

Formula: $n= 301 /1+301 (0.1^2)$

n=75.062

$\underline{n= 75}$

3.6 Data Collection Techniques

The information needed for the study was collected through interviews, questionnaires, and Key informant interviews. Structured questions were prepared ahead of time and distributed to respondents. The main contents of the questions include the respondent's general profile, risk awareness, a major type of risk undertaking in road construction projects, risk management practice in ERA, and mitigation strategies.

The questionnaire included completed questionnaires near the 5-point Likert scale to collect data from sample responders. The questionnaire has 5 rating levels from 1 = Very low, 2 = Low, 3 = Medium, 4 = High, 5 = Very High. The information gathered through questionnaires was simple and clear to analyses and it allowed to collect the views of the respondents related to risk management. For these questions, the following formula is used.

Formula: $\underline{X} = \sum FS / N$

Where:

$\underline{X}$ = Mean Score

F =frequency of response foreach result S = score for each factor (1-5)

N =Total number of responses

The details of the questionnaires for respondents were presented under **Annex 1.**

3.7 Data Analysis Techniques

Descriptive analytical technique was used with the help of Statistical Package for Social Sciences (SPSS) and Microsoft excel to analyze the data collection with the use of questionnaires. This analyzed data was presented using statistical tools such as graphs, and Tables.

3.8 Data Validity and Reliability

Reliability and validity are parameters used to measure the quality of research. They predict how properly a method, technique or test measure something. Reliability refers the uniformity of a measure, and validity refers the precision of a measure.

For this study the validity of the questionnaire was conducted using Pearson Product Moment Correlations on SPSS. This validity test was done by Pearson correlations in each item questionnaires score with the critical value and significance value. After

checking the validity of the research, the next step was to determine the consistency of the data reliability. The reliability of the data obtain were checked using Cronbach's Alpha coefficient. This Cronbach's Alpha test also run using the reliability command in SPSS. The Cronbach's Alpha reliability coefficient would be valid when it is greater than 0.6. Hence, during the analysis the gained result for reliability was 0.828.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Socioeconomic Description and Response Rate of Respondents

4.1.1 Socioeconomic Description

The survey questions were prepared and distributed by considering various socioeconomic factors such as contracting parties' educational levels, and work experiences. The summary of the socioeconomic description of the respondents participated in this study is presented in Table 4.1.

Table 4.1:- Summary of the socioeconomic description of respondents

No	Categories	Classification
1	Contracting Parties	ERA
		Consultant
		Contractor
2	Education	BSc
		MSc
3	Experience	1-5 Years
		5-10 Years
		>10Years

(Survey Analysis, June,2021)

4.1.2 Response Rate

A total of 75 survey questionnaires were distributed to three stakeholders. Of these, 61 (81%) of the questionnaires were returned. A summary of the respondents' details is presented Table 4.2.

Table 4.2: Summary of response rate of the respondents

Categories		Frequency			Total	Percent (%)
		Type of Stakeholder				
		ERA	Consultant	Contractor		
Questionnaire	Distribute	39	18	18	**75**	
	Returned	32	15	14	**61**	**81.30%**
	Unreturned	7	3	4	**14**	**18.70%**
Percent (%)		***52.50%***	***24.60%***	***23.00%***	***100%***	
Education	BSc	13	6	5	**24**	**39.30%**

Categories		Frequency			Total	Percent (%)
		Type of Stakeholder				
		ERA	Consultant	Contractor		
	MSc	19	9	9	**37**	**60.70%**
Total		**32**	**15**	**14**	**61**	
Experience	1-5 years	2	2	4	**8**	**13.10%**
	5-10 years	13	4	4	**21**	**34.40%**
	>10 years	17	9	6	**32**	**52.50%**
Total		**32**	**15**	**14**	**61**	
Respondent Position	Middle level Managers	5	3	2	**10**	**16.39 %**
	Engineers	27	12	12	**51**	**83.60%**
Total		**32**	**15**	**14**	**61**	

(Survey Analysis, June,2021)

As shown from table 4.2, out of the 75 questionnaires prepared, 39 questionnaires were distributed to ERA, 18 questionnaires to both Consultants and Contractors. Of these broadcasts, 32 (52.5 %) respondents were collected from the ERA; 15 (24.6 %) questionnaires were collected from consultants, and 14 (23.0 %) questionnaires were collected from contractors.

Accordingly, these questionnaires were presented to respondents' counter with different disciplines and work experiences. As shown in table 4.2, above, 24 (39.3 %) of the surveys were BSc holders and the remaining 37 (60.7%) were MSc holders. Similarly, 32 (52.5%) respondents had more than 10 years of experience in the sector while the remaining 21 (34.4 %) and 8 (13.1 %) had 5 to 10 years of experience and 1 to 5 years of experience respectively.

In addition, various professionals who are involved in road construction projects who are attending the civil engineering or construction management have participated in the study. For this study purpose, the respondents' positions are classified into middle-level managers and Engineers. Hence as observed from Table 4.2, 10 (16.4%) respondents

were middle-level managers. While the remaining 51 (83.6 %) were engineers. Hence, on the ERA side, both the Team leaders and project engineers participated in the survey. The Team leaders were categorized in middle-level management, and the project engineers were categorized in the engineers' section. Similarly, on the Consultant side, the Resident Engineer, Assistance Resident Engineer, and Project coordinator were categorized in middle-level management. And also, the Assistance project manager and Chief Engineer were categorized in middle-level management on the Contractor side. On the other hand, the claim engineers, contract engineers, highway engineers, senior office engineers and construction engineers are categorized in the Engineers section.

4.2 Risk Management Practices Implemented by ERA

According to the responses obtained from ERA respondents, the authority has been implementing risk management practices using risk management manual and developed work procedure. The practice is undertaken by assigning a responsible department and expert to work with risk management. Currently, construction project management directorates are the ones who took the responsibilities for managing risk as a department. As well, the RM responsibility is also assigned to project engineers, team leaders and regional directors for construction project. The assign experts assess all potential risks during the implementation of each road construction projects. Further the respondents have mentioned that some of the risk management techniques that applied with the ERA are document review, data gathering, expert judgments, checklist analysis, risk categorization, and probability and impact matrices. Similarly, they commonly used risk transferring and mitigation tools as a risk response strategy. On the other hand, even if the RM recording method has to be improved and well organized, currently the Authority implement a risk identification and risk register form as a recording system. These respondents also said that practicing and implementing RM helps the Authority in knowing the risk in advance and to be able to implement the protective measures which ultimately will reduce the cost of the construction. In addition, they also said that it is used to prevent common risks which will face in the future. On the contrary, since implementation of RM is at early stage, the Authority is facing an obstacle to identify the gaps extensively, taking the necessary measure and finding the previous risk record.

In view of the above, implementation of practicing risk management in the authority help ERA to meet their obligations and reduce negative impact on the construction project performance in relation to the project objective (cost, time and quality). In addition, developing both the RM guideline and work flow chart, support the Authority to practice best construction management system. Furthermore, assigning a responsible department helps to facilitate the full engagement of the professionals with department and the Authority to manage all potential risks at each construction phase. Besides, assigning an officer to risk management assist to enable effective communication between the teams. Likewise, practicing the RM process tools guide the Authority to identify the major risks before they occur, so that risk handling activities may be planned and refer to as needed across the project phase to mitigate adverse impact on achieving objectives. In addition, identifying the advantage and the obstacles facing during the RM practice, guide ERA to improve and upgrade its implementation. And also, it guides the Authority to make a mitigation measurement in early stage.

Moreover, the practices of risk management during road construction in Kenya and Nigeria agree with the findings of this study as these countries have RM practices and techniques. According to (Kirira et al., 2019), the study focuses on examining the impact of risk management strategies on the implementation of KeNHA road construction projects. The study revealed that practices of risk management in road construction will advantage on detecting risks and create awareness on risk assessment followed by risk mitigation on the performance of their road construction projects. Likewise, as stated by (Fabi & Awolesi, 2015) the conducted study showed that in order to ensure a successful project that meets project goals and objectives, adequate attention should be paid to the construction risk management and the risk management practices in highway projects in Nigeria. This implicates that how RM is an essential aspect that critically controls the performance in road construction projects.

4.3 Level of Risk Awareness of Contracting Parties

According to the responses obtained from the respondents, the awareness of the contracting parties about risk management is summarized in Figure 4.1.

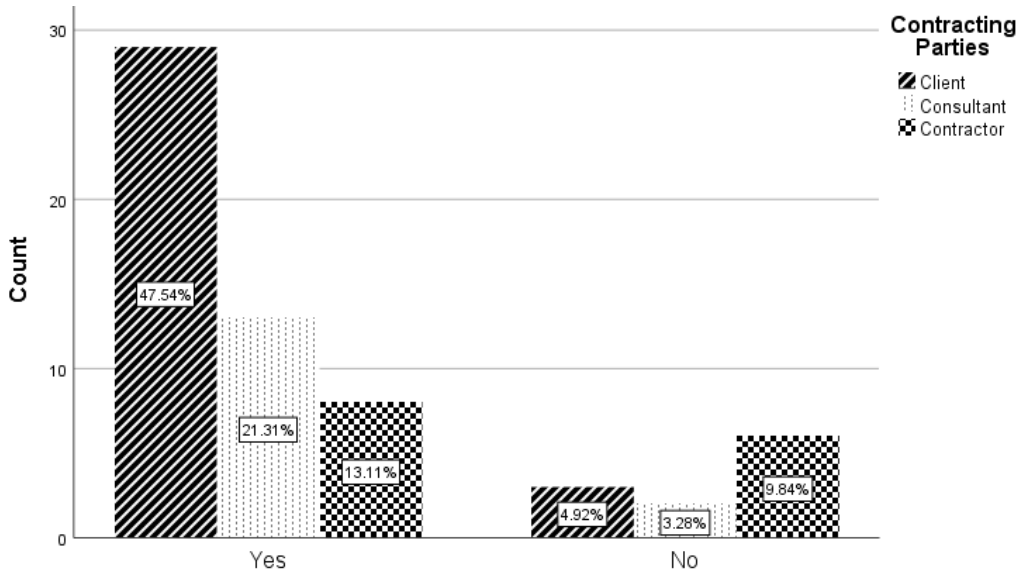


Figure 4.1:- Respondents summary on risk management awareness
(Survey Analysis, June,2021)

As indicated on the above table most of the participants in the study replied that they have an awareness on the RM theoretical concept. In associated with this the summary of the contracting parties' responses on evaluating the level of awareness of the RM concept is presented in Figure 4.2.

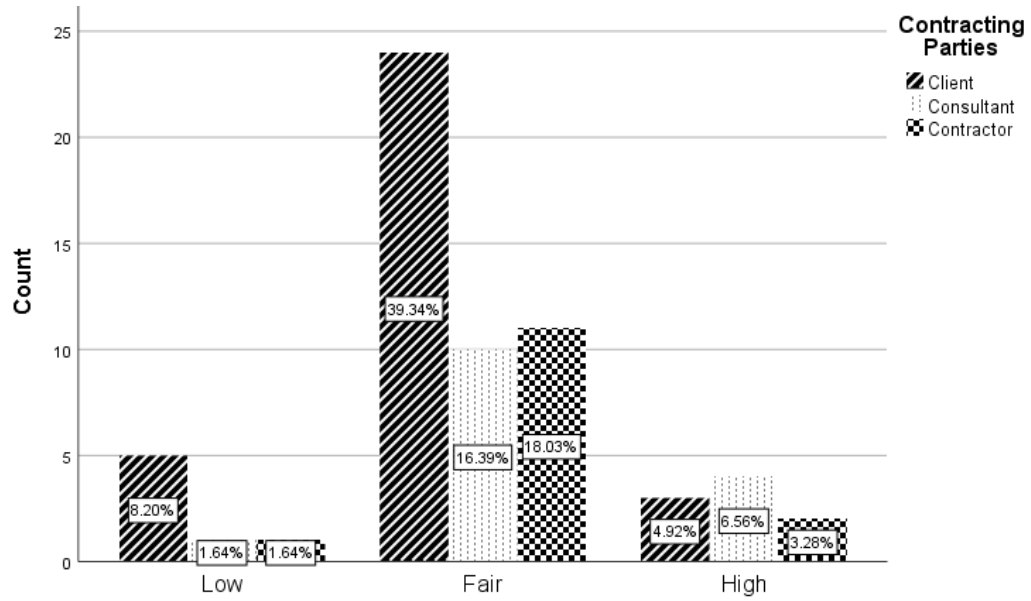


Figure 4.2**:-** Respondents summary on the evaluating a risk management awareness
(Survey Analysis, June,2021)

Based on the level of awareness respondents, 45 (73.8 %) of the fair stage level, ERA holds 24 (39.3 %), the consultant holds 10 (16.4 %), and the remaining 11 (18.0 %) hold the contractor. These data implicated that somehow the contracting parties have a fair level of awareness.

The implications of contracting parties having awareness towards RM helps to identify at least the majority of the risks during road construction and to develop a plan to minimize the risk in the early stage.

In order to improve the awareness of risk management in the contracting parties regard to the implementation of the concept, techniques, and tools, they should increase their level of risk awareness components according to Jen (2000) developed model presented in "Table 2.2". So that here the following discussions related with those develop tools and techniques.

Based on the responses attain from the respondents the aspect of RM training, 68.9 % of respondents had an opportunity to attend training. Out of this percentage the ERA holds 44.3 %, the Consultant holds 11.5 % and the contractor holds 13.1 %. The summary of the above information is presented in Figure 4.3 as follows.

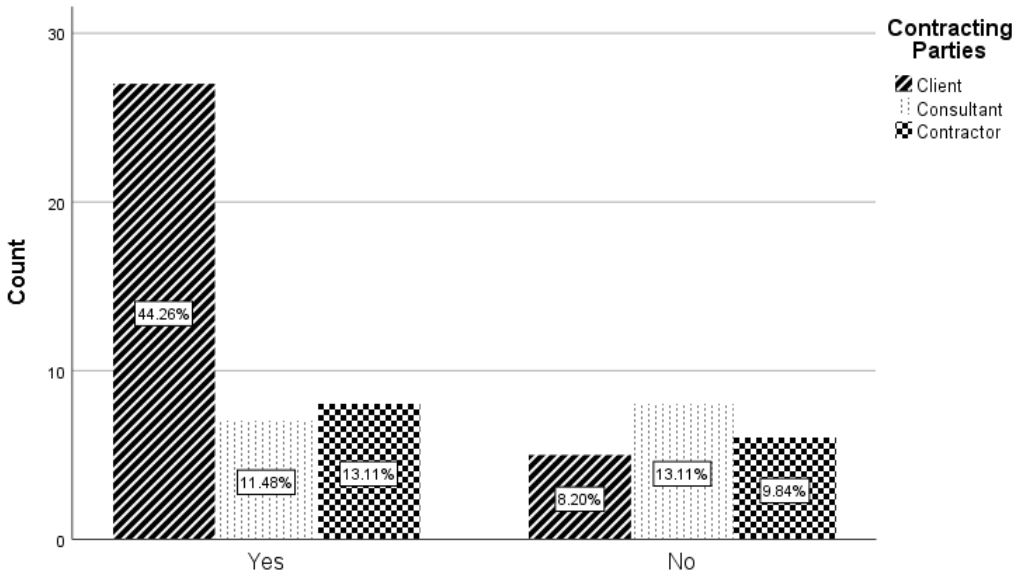


Figure 4.3:- Respondents' summary who were attending RM training

(Survey Analysis, June,2021)

As indicated from Figure 4.3, among those 68.9 % respondents who had attended RM training, 23 (54.8%) hold the RM training organized by ERA. Hence, these respondents were the employees of the Authority. The summary respondents who took the ERA training and development program are presented in Figure 4.4 as follows.

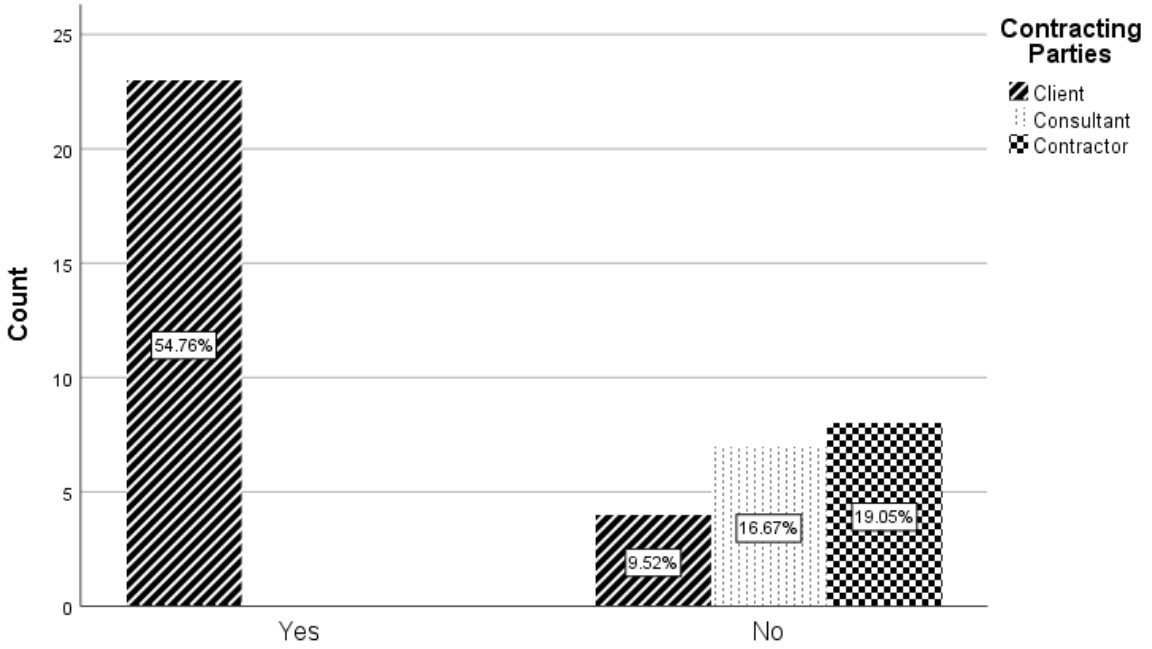


Figure 4.4:- Respondents' summary who were conducting RM training which organized by ERA
(Survey Analysis, June,2021)

Among the techniques and tools implemented for the awareness of risk would be attending workshops and training holds the primary stage. Hence an average percentage of the respondents were attending the training. However, among these respondents, ERA staff took a large percentage. This implicated that the only ERA moves the major step on improving the awareness of RM in the sector rather than others contracting

This implies that the contracting parties while getting RM training in terms of the risk and its process will be benefited by improving their performance and expert knowledge. Therefore, like the Authority, the Consultant and Contractors also have to participate and play their role to enhance the awareness.

Other tools that used for upgrading of the awareness of risk would be the implementation of risk management. According to the respondent's response, the implementation of RM guideline in the contracting parties is summarized in Figure 4.5.

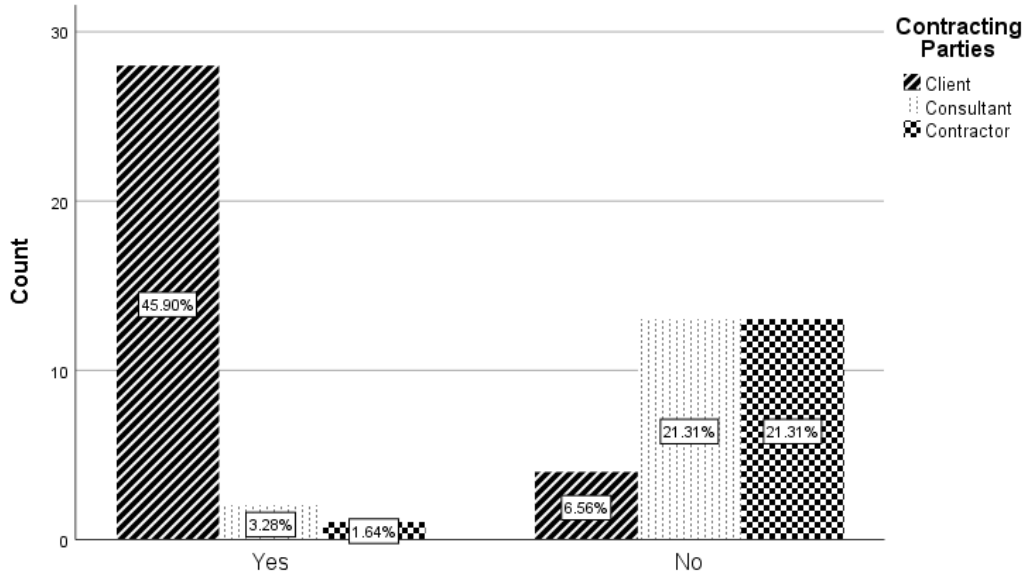


Figure 4.5:- Respondents summary on the implementation of RM instruction manual in contracting parties

(Survey Analysis, June,2021)

As indicated around 49.2% of the respondents replied that the contracting firms does not practice the RM guidelines. Among those percentage the Consultants and Contractors holds 21.3%. This indicates that almost all the Consultant and Contractors as a firm does not implement a RM guideline. However, the respondents inform that they mostly deal with different risks by using;

- personal educational background
- informal communication with the ERA,
- short-term planning for a specific project to manage risk
- Generic ways of handling risks implemented company wise
- ERA RM manual& other manuals

Therefore, in order to enhance their awareness, it would be helpful to practice the RM process on their project or in the firm policy based on the RM guideline implementation. This helps the contracting parties to provide an instruction for all level of staffs, to aware any critical risk that the firms/projects may face, to implement the appropriate decision making and establish confidence levels on budgets and schedule. Additionally, it's also used to develop a mitigation strategy and support major decisions.

Furthermore, the other way to develop the awareness of the personals in the road construction sector would be to involve the concerned personals to participate and practicing the RM process mechanism as experts. The summary of the contracting parties' respondents who get participated in the project risk management decision process is presented graphically in the Figure 4.6.

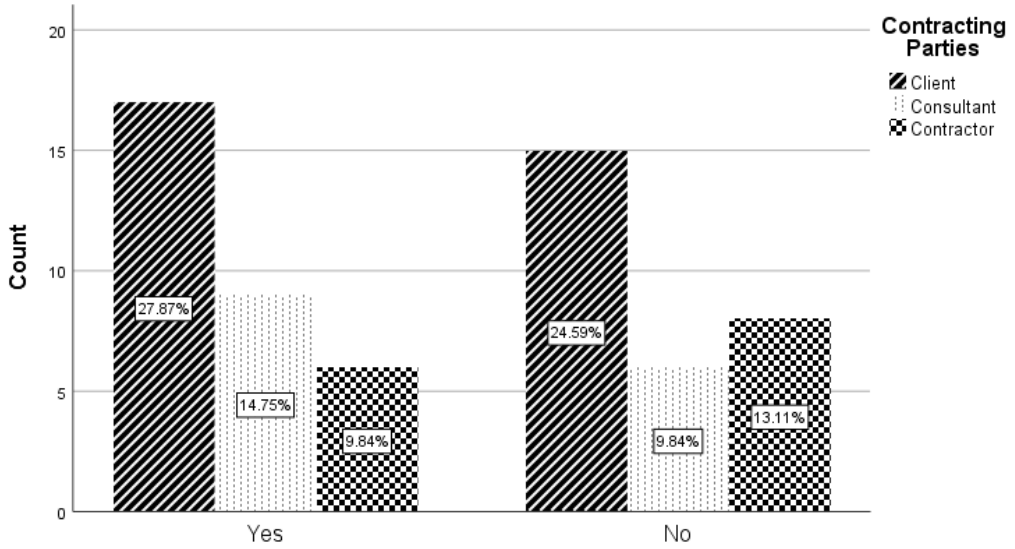


Figure 4.6:- Respondent's summary who were participated in project risk process

(Survey Analysis, June,2021)

As summarized in the above-indicated Figure 4.6, the respondents who get participated in the project risk management mechanism decision process in ERA or with other stakeholders were 32 (52.5%). The rest 29 (47.5%) respondents did not participate. Out of 32 (52.5%) of the respondent who gets participated in the project risk management decision process the ERA accounted for 17 (27.9%), the consultants accounted for 9 (14.8%) and the contractor accounted for 6(9.8%).

As observed from the presented data, the participation of both the Consultant and Contractor as experts in the risk management mechanism decision process is very low level. This also, opened a gap in the awareness of the contracting parties. Here also it implicated that making a RM decision is a challenge process. However, participating on the risk management decision process guide the contracting parties to make a wise strategi decision to achieve the project objective.

Correspondingly, communication and RM awareness is a key component and also have a direct relation on the development of the awareness of RM. This means, if there is

communication among the parties, there will be an open discussion and a common understanding among the involved parties. According to Figure 4.6, from the percentage of respondents, 20 (32.8%) agreed that risk would be communicated across the authority and contracting parties. While 41 (67.2 %) respondents respond with neutrality. Summary on risks communicated across the ERA and contracting presented in Figure 4.7.

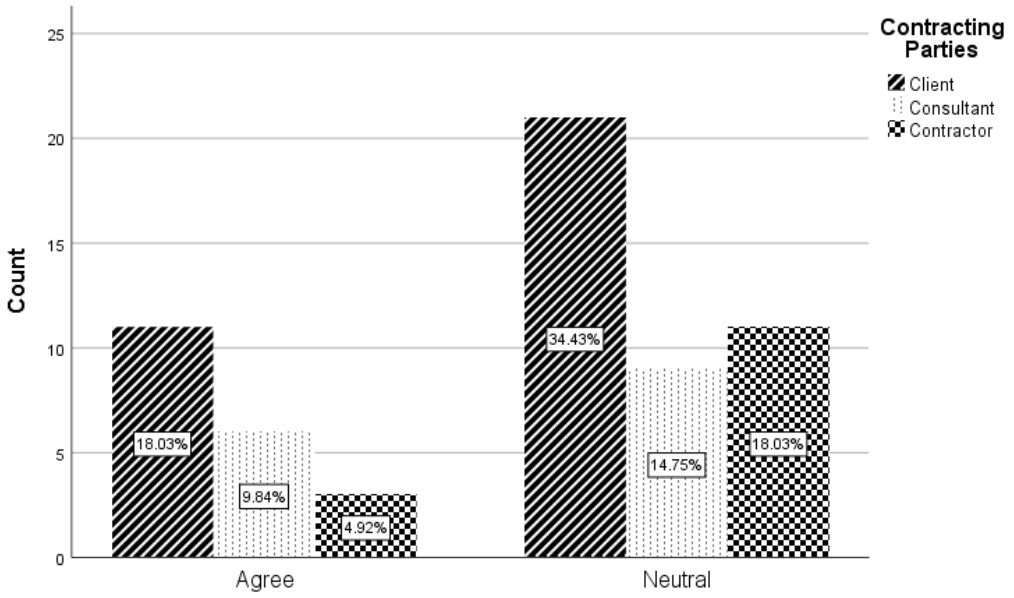


Figure 4.7:- Respondents' summary on risks communicated across the ERA and contracting parties (Survey Analysis, June,2021)

As observed from the presented data, there was no clear communication among the involved contracting parties. The implication of the communication among the contracting parties is essential to promote understanding and guiding everyone to work together. Additionally, it will increase the contribution of the contracting parties and the communication level at every stage. This makes the contracting parties to plan an essential role that can impact risks and develop confidence to manage risks in their projects.

4.4 Major Types of Risk Performing in Road Construction Projects

For this study, major risk factors categorized into twelve depending on the common risk that affect the construction sector. These are technical (documentations and construction related), construction, physical, organizational, financial, socio-political, environmental, design, legal, material, access to construction site and experience of the staffs'.

The rating scale for the probability of the risk's occurrence as well as the impact on time, cost and quality of the listed major risks provide based on the respondents' observation and experience. This rating scale is arranged from very low to very high used. This levels reflects the degree of detail requirement for the Project Risk Management process.

After the respondents obtain the rating scale, the SPSS analyzes the frequency and percentage of these major risks based on their rating scale. Then the mean score was used to analyze the respondent of the Likert scale question as explained in the methodology to get the average value. According to the responses collected from the respondents, the frequency, percentage and mean value of the major road construction probability and impact of the risk's occurrence is summarized in Table 4.3, Table 4.4, Table 4.5 and Table 4.6.

Table 4.3:- Respondent's frequency and percentage on probability of the risk's occurrence

Major Risk	Probability of risk occurrences							
	Level	Very Low	Low	Medium	High	Very High	Total	Mean
Technical Risks-Documentation	Frequency	3	13	21	19	5	61	3.16
	Percent	5	21	34	31	8	100	
Technical Risks-(construction related)	Frequency	2	7	9	21	22	61	3.89
	Percent	3	11	15	34	36	100	
Construction Risks	Frequency	8	16	21	11	5	61	2.82
	Percent	13	26	34	18	8	100	
Physical Risks	Frequency	7	19	21	9	5	61	2.77
	Percent	11	31	34	15	8	100	
Organizational Risks	Frequency	9	11	17	15	9	61	3.07
	Percent	15	18	28	25	15	100	
Financial Risks	Frequency	2	5	14	23	17	61	3.79
	Percent	3	8	23	38	28	100	
Socio-Political Risks	Frequency	9	13	18	18	3	61	2.89
	Percent	15	21	30	30	5	100	
Environmental Risks	Frequency	16	20	21	3	1	61	2.23
	Percent	26	33	34	5	2	100	
Design Risks	Frequency	5	5	13	19	19	61	3.69
	Percent	8	8	21	31	31	100	
Legal Risks	Frequency	5	22	7	16	11	61	3.10
	Percent	8	36	11	26	18	100	
Material Risks	Frequency	5	21	17	15	3	61	2.84

Major Risk	Probability of risk occurrences							
	Level	Very Low	Low	Medium	High	Very High	Total	Mean
	Percent	8	34	28	25	5	100	
Access to Construction Site Risks	Frequency	-	8	21	13	19	61	3.70
	Percent	-	13	34	21	31	100	
Experience of staffs, staff's turnover etc.	Frequency	5	9	21	17	9	61	3.26
	Percent	8	15	34	28	15	100	

As indicated in the Table 4.3, looking into the Mean values for the scores of probabilities of occurrence of each risk; technical (construction related), financial, design and access to construction site risks are marked by the respondent with a high probability of occurrence with Mean Scores of 3.89, 3.79,3.69 and 3.7 respectively. This implicates the possibility of risk event occurring.

Table 4.4:- Respondent's frequency and percentage on cost impact of the risk's occurrence

Major Risk	Risk impact on project cost							
	Level	Very Low	Low	Medium	High	Very High	Total	Mean
Technical Risks-Documentation	Frequency	3	11	21	19	7	61	3.26
	Percent	5	18	34	31	11	100	
Technical Risks-(construction related)	Frequency	-	10	16	23	12	61	3.61
	Percent	-	16	26	38	20	100	
Construction Risks	Frequency	-	15	23	17	6	61	3.23
	Percent	-	25	38	28	10	100	
Physical Risks	Frequency	-	18	21	11	11	61	3.25
	Percent	-	30	34	18	18	100	
Organizational Risks	Frequency	5	11	21	17	7	61	3.16
	Percent	8	18	34	28	11	100	
Financial Risks	Frequency	-	9	12	21	19	61	3.82
	Percent	-	15	20	34	31	100	
Socio-Political Risks	Frequency	3	19	21	13	5	61	2.97
	Percent	5	31	34	21	8	100	
Environmental Risks	Frequency	3	13	19	21	5	61	3.20
	Percent	5	21	31	34	8	100	
Design Risks	Frequency	-	7	13	23	18	61	3.85
	Percent	-	11	21	38	30	100	
Legal Risks	Frequency	6	16	23	14	2	61	2.84
	Percent	10	26	38	23	3	100	
Material Risks	Frequency	4	16	18	15	8	61	3.11

Major Risk	Risk impact on project cost							
	Level	Very Low	Low	Medium	High	Very High	Total	Mean
	Percent	7	26	30	25	13	100	
Access to Construction Site Risks	Frequency	-	13	17	21	10	61	3.46
	Percent	-	21	28	34	16	100	
Experience of staffs, staff's turnover etc.	Frequency	6	10	20	25	-	61	3.05
	Percent	10	16	33	41	-	100	

As indicated in the Table 4.4,regarding the Mean Scores for frequency of weights assigned on each risk based on their impact on project cost; technical (construction related), financial, design and access to construction site risks are marked by the respondent as having a high impact on project cost with Mean Scores of 3.61, 3.82, 3.85 and 3.46 respectively. This mean that this listed major risk increase the project cost with respect to the estimated project cost which led to perform a cost overrun. This affects the quality and the scope of the work to stay within the budget.

Table 4.5:- Respondent's frequency and percentage on time impact of the risk's occurrence

Major Risk	Risk impact on project time							
	Level	Very Low	Low	Medium	High	Very High	Total	Mean
Technical Risks-Documentation	Frequency	-	12	17	18	14	61	3.56
	Percent	-	20	28	30	23	100	
Technical Risks-(construction related)	Frequency	-	10	10	28	13	61	3.72
	Percent	-	16	16	46	21	100	
Construction Risks	Frequency	4	7	13	20	17	61	3.64
	Percent	7	11	21	33	28	100	
Physical Risks	Frequency	2	13	21	20	5	61	3.21
	Percent	3	21	34	33	8	100	
Organizational Risks	Frequency	2	11	15	16	17	61	3.57
	Percent	3	18	25	26	28	100	
Financial Risks	Frequency	10	15	23	13	-	61	2.64
	Percent	16	25	38	21	-	100	
Socio-Political Risks	Frequency	-	12	20	25	4	61	3.34
	Percent	-	20	33	41	7	100	
Environmental Risks	Frequency	3	19	21	16	2	61	2.92
	Percent	5	31	34	26	3	100	
Design Risks	Frequency	-	8	18	23	12	61	3.64

Major Risk	Risk impact on project time							
	Level	Very Low	Low	Medium	High	Very High	Total	Mean
	Percent	-	13	30	38	20	100	
Legal Risks	Frequency	3	13	25	10	10	61	3.18
	Percent	5	21	41	16	16	100	
Material Risks	Frequency	-	9	15	24	13	61	3.67
	Percent	-	15	25	39	21	100	
Access to Construction Site Risks	Frequency	-	5	15	23	18	61	3.89
	Percent	-	8	25	38	30	100	
Experience of staffs, staff's turnover etc.	Frequency	-	15	13	28	5	61	3.38
	Percent	-	25	21	46	8	100	

As indicated in the Table 4.5, based on the mean score values of the impact of the listed risks on project time; technical (both documentation and construction related), construction, organizational, design and access to construction sites risks are specified by the respondents as having a high impact with mean scores of 3.56, 3.72, 3.64,3.57, 3.64, 3.67 and 3.89 respectively. This means that those mentioned risks has an effect on the project to delay from the designed period. This has a direct relation with the cost. Because if the project requests the extension of time, it also revised the project budget.

Table 4.6:- Respondent's frequency and percentage on quality impact of the risk's occurrence

Major Risk	Risk impact on project quality							
	Level	Very Low	Low	Medium	High	Very High	Total	Mean
Technical Risks-Documentation	Frequency	5	12	22	13	9	61	3.15
	Percent	8	20	36	21	15	100	
Technical Risks-(construction related)	Frequency	6	10	12	15	18	61	3.48
	Percent	10	16	20	25	30	100	
Construction Risks	Frequency	6	23	12	17	3	61	2.80
	Percent	10	38	20	28	5	100	
Physical Risks	Frequency	13	15	23	6	4	61	2.56
	Percent	21	25	38	10	7	100	
Organizational Risks	Frequency	24	17	13	5	2	61	2.08
	Percent	39	28	21	8	3	100	
Financial Risks	Frequency	3	21	11	17	9	61	3.13
	Percent	5	34	18	28	15	100	
Socio-Political Risks	Frequency	9	19	17	10	6	61	2.75

Major Risk	Risk impact on project quality							
	Level	Very Low	Low	Medium	High	Very High	Total	Mean
	Percent	15	31	28	16	10	100	
Environmental Risks	Frequency	11	14	22	9	5	61	2.72
	Percent	18	23	36	15	8	100	
Design Risks	Frequency	7	7	15	18	14	61	3.41
	Percent	11	11	25	30	23	100	
Legal Risks	Frequency	7	23	19	7	5	61	2.67
	Percent	11	38	31	11	8	100	
Material Risks	Frequency	3	9	15	21	13	61	3.52
	Percent	5	15	25	34	21	100	
Access to Construction Site Risks	Frequency	9	19	21	9	3	61	2.64
	Percent	15	31	34	15	5	100	
Experience of staffs, staff's turnover etc.	Frequency	3	5	18	15	20	61	3.72
	Percent	5	8	30	25	33	100	

As indicated in the Table 4.6, based on the mean score values of the impact of the listed risks on project quality; technical (construction related), material and experience of staffs risks are specified by the respondents as having a high impact with mean score of 3.48, 3.52 and 3.72 respectively. Hence those major risks affect the project quality by reducing the project life time. This led to both cost and time risks.

After that depending on the mean score, the level and probability-impact scale rating assigned. This mean score and probability-impact scale were used to rate the level of occurrence of the major risks on the respondents' perspective. According to PMBOK 6th edition, probability-impact scale used to evaluate both threats and opportunities by interpreting the impact definitions as negative for threats (delay, additional cost, and performance shortfall) and positive for opportunities (reduced time or cost, and performance enhancement). Hence the probability-impact scale is rating based on "Table 2.8 as discussed in the literature review. The summary of the level of degree and probability scale is presented on table 4.7 as follow.

Table 4.7:- Probability and Impact of the risk's occurrence

Major Risk	Probability		Impact					
			Cost		Time		Quality	
	Level	Prob. Scale	Level	Imp. Scale	Level	Imp. Scale	Level	Imp. Scale
Technical Risks- Documentation	Medium	0.5	Medium	0.2	High	0.4	Medium	0.2
Technical Risks- (construction related)	High	0.7	High	0.4	High	0.4	High	0.4
Construction Risks	Medium	0.5	Medium	0.2	High	0.4	Medium	0.2
Physical Risks	Medium	0.5	Medium	0.2	Medium	0.2	Low	0.1
Organizational Risks	Medium	0.5	Medium	0.2	High	0.4	Low	0.1
Financial Risks	High	0.7	High	0.4	Medium	0.2	Medium	0.2
Socio-Political Risks	Medium	0.5	Medium	0.2	Medium	0.2	Medium	0.2
Environmental Risks	Low	0.3	Medium	0.2	Medium	0.2	Medium	0.2
Design Risks	High	0.7	High	0.4	High	0.4	Medium	0.2
Legal Risks	Medium	0.5	Medium	0.2	Medium	0.2	Medium	0.2
Material Risks	Medium	0.5	Medium	0.2	High	0.4	High	0.4
Access to Construction Site Risks	High	0.7	High	0.4	High	0.4	Medium	0.2
Experience of staffs, staff's turnover etc.	Medium	0.5	Medium	0.2	Medium	0.2	High	0.4

(Survey Analysis, June,2021)

And then based on the discussion on the literature review in section 2.6.14.1, the risk factor is calculated by multiplying the probability and impact scales. The results of the risk analysis are presented in the Table 4.4 below.

Table 4.8:- Probability and impact matrix, evaluation results

Major Identify Risks	Project Objective	Probability	Impact	Matrix
Technical Risks-Documentation	Cost	0.5	0.2	0.10
	Time		0.4	0.20
	Quality		0.2	0.10
Technical Risks-(construction related)	Cost	0.7	0.4	0.28
	Time		0.4	0.28
	Quality		0.4	0.28
Construction Risks	Cost	0.5	0.2	0.10
	Time		0.4	0.20
	Quality		0.2	0.10
Physical Risks	Cost	0.5	0.2	0.10
	Time		0.2	0.10
	Quality		0.1	0.05
Organizational Risks	Cost	0.5	0.2	0.10
	Time		0.4	0.20
	Quality		0.1	0.05
Financial Risks	Cost	0.7	0.4	0.28
	Time		0.2	0.14
	Quality		0.2	0.14
Socio-Political Risks	Cost	0.5	0.2	0.10
	Time		0.2	0.10
	Quality		0.2	0.10
Environmental Risks	Cost	0.3	0.2	0.06
	Time		0.2	0.06
	Quality		0.2	0.06
Design Risks	Cost	0.7	0.4	0.28
	Time		0.4	0.28
	Quality		0.2	0.14
Legal Risks	Cost	0.5	0.2	0.10
	Time		0.2	0.10
	Quality		0.2	0.10
Material Risks	Cost	0.5	0.2	0.10
	Time		0.4	0.20
	Quality		0.4	0.20
Access to Construction Site Risks	Cost	0.7	0.4	0.28
	Time		0.4	0.28
	Quality		0.2	0.14

Major Identify Risks	Project Objective	Probability	Impact	Matrix
Experience of staffs, staff's turnover etc.	Cost	0.5	0.2	0.10
	Time		0.2	0.10
	Quality		0.4	0.20

(Survey Analysis, June,2021)

Based on the above analyses, the graphs below are drawn to show the most significant risks which impact time, cost, and quality respectively. The graphic analysis refers to the matrix representation of Probability X Impact Matrix in "Table 2.9". Therefore, the risks that fall in the triangle section indicate that they are significant for the negative effects by rating from high to extreme. In terms of Probability- Impact Matrix, Figure 4.8 below show the cost matrix. Figure 4.9 show the time matrix and Figure 4.10 show the quality matrix.

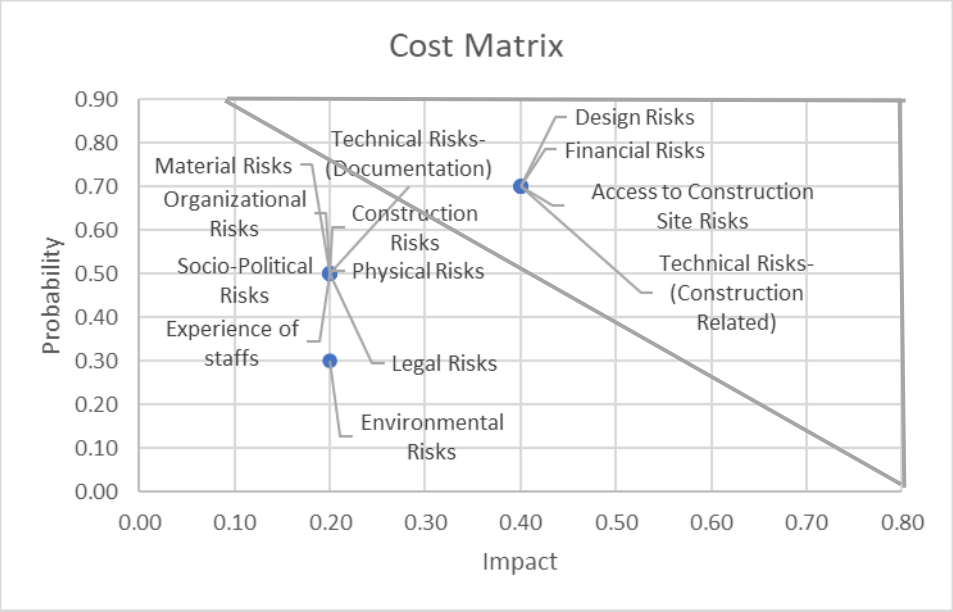


Figure 4.8:- Probability vs Impact Matrix; Cost Diagram

(Survey Analysis, June,2021)

As noted in the above cost matrix, the most significant factor affecting the cost aspect is technical (related to construction), financial, design and access to construction site risks.

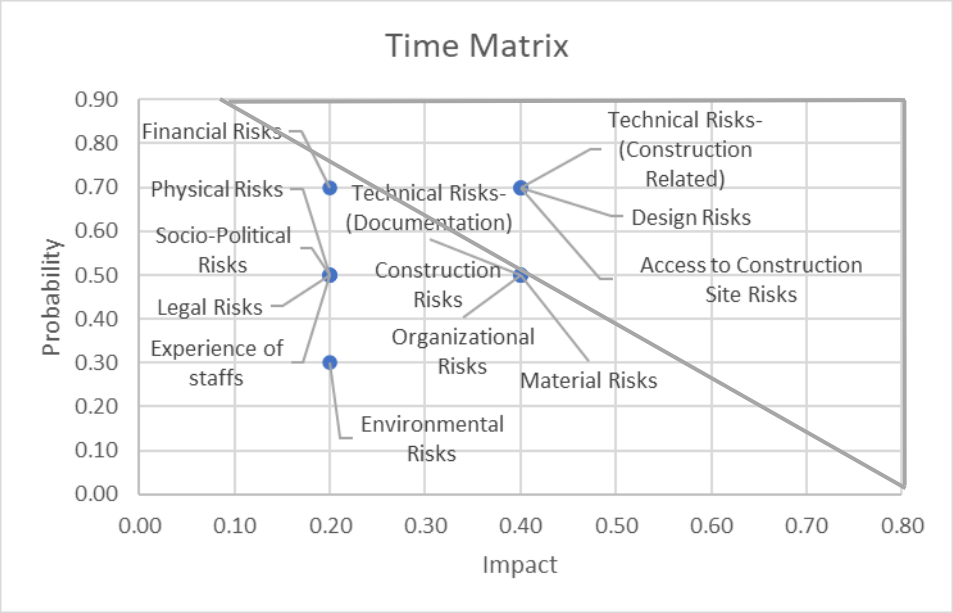


Figure 4.9:- Probability vs Impact Matrix; Time Diagram
(Survey Analysis, June,2021)

Similarly, in terms of time matrix, technical (construction related), design and access to construction site risks are a major risk that delays the project.

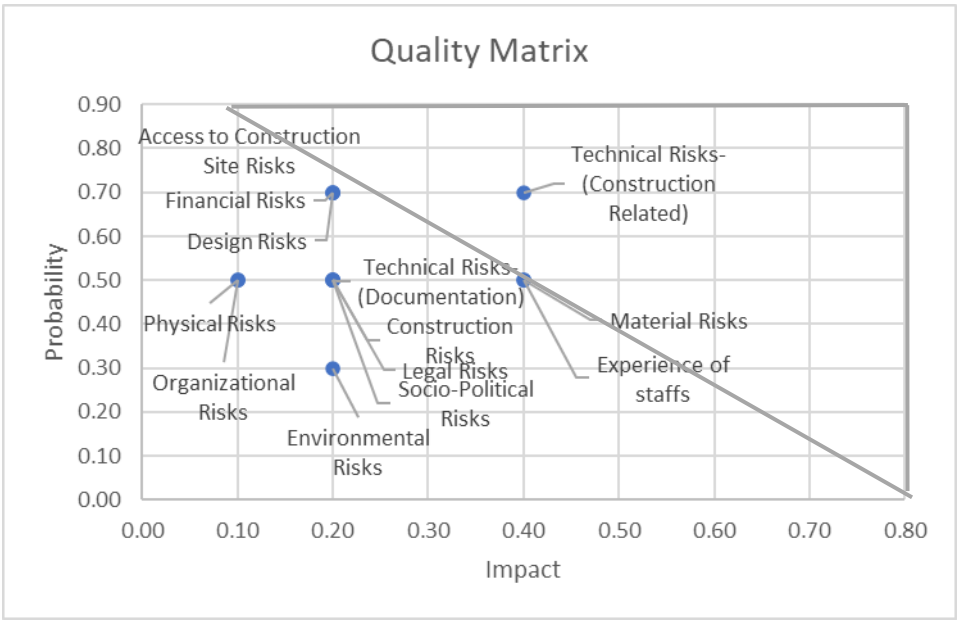


Figure 4.10:- Probability vs Impact Matrix; Quality Diagram
(Survey Analysis, June,2021)

As seen from the quality matrix diagram technical (construction-related), has been identified as a challenge for the quality of the project activities.

The above discussion and analysis indicated that how the construction sector would face

the difficulty in handling the projects as requirements and expectations. These level a high degree in both probability and impacts on the cost, time and quality implicate the construction sectors should have to take a priority action and make a mitigation measurement. So that in order to meet the needs on project objective, the sector should have to deal with these critical identify risks.

4.5 Mitigation Suggestions for Risk Management Practices on Road Projects

In this section, derived from the finding that has been carried out through questionnaires, identified gap within the road sector and respective suggestions the respondents provided their rate based on their observation and experience on practicing the RM practices in ERA projects.

As shown in the Table 4.9 and Table 4.10, the mean score is used to analyze the respondent of the Likert scale questionnaires and rating from very low to very high-level scales. Respondents' summary was displayed in the Table 4.9 and Table 4.10.

Table 4.9:- Respondents summary on basic gap faced by the authority to implement the risk management guidance

Basic Gap	Level of agreement	Frequency	Percent	Cumulative Percent	Mean	Level
RM Manual/guidance insufficient to apply	Very Low	9	14.8	14.8	3.09	Medium
	Low	8	13.1	27.9		
	Medium	17	27.9	55.7		
	High	22	36.1	91.8		
	Very High	5	8.2	100.0		
	Total	61	100.0			
Contacting parties not participate/ involve	Very Low	1	1.6	1.6	3.78	High
	Low	8	13.1	14.8		
	Medium	11	18.0	32.8		
	High	24	39.3	72.1		
	Very High	17	27.9	100.0		
	Total	61	100.0			
RM work procedure	Very Low	4	6.6	6.6	3.21	Medium
	Low	1	1.6	8.2		
	Medium	34	55.7	63.9		
	High	22	36.1	100.0		
	Total	61	100.0			
Knowledge / awareness of the	Low	5	8.2	8.2	3.89	High
	Medium	15	24.6	32.8		
	High	23	37.7	70.5		

Basic Gap	Level of agreement	Frequency	Percent	Cumulative Percent	Mean	Level
contracting parties	Very High	18	29.5	100.0		
	Total	61	100.0			

(Survey Analysis, June,2021)

Accordingly, as indicated in Table 4.9, from the listed effects the basic gap faced by the authority to implement the risk management, the awareness of contracting parties hold a high rating scale with a mean of 3.89 as replied by the respondents. This is to mean that understanding the level of the contracting parties in terms of risk and the practicing of the RM process on their coordinating projects has an effect on the implementation of the RM in the Authority.

Besides, 3.787 of the mean of the respondents stated that less participation of contracting parties in the implementation of the RM process become the second higher main cause of the identified problem. Related to this issue, the advantage of participating in the contracting parties is to generate a better understanding of term risk and to build trust and reliability in decision making. Additionally, it has also a benefit to improve the communication level across the contracting parties at every stage. Otherwise, it will open a gap in the implementation of the RM guidance.

Furthermore, 3.213 of the mean of the respondents responded that poor implementation of RM work procedure is said to be the other causal factor contributed for gap facing by the authority to implement the risk management. This holds a medium rating scale comparing to others. In relation to this, for the critical and effectiveness of implementing the risk management, the Authority and the counterparts have to take the responsibility to follow and regarding risks to implement the developed work procedure by practicing properly on specifying the steps from the commencement to closeout stages on identifying, operating and controlling the occurrence risks in their projects.

Additionally, the remaining respondents rating medium with a mean of 3.098, mention that lack of experience on insufficiently applying the RM manual is the other reason for not implementing the risk management guidance. This is related to the unawareness and lack of practicing the implemented RM manual. So that to improve the implantation of the RM guideline the Authority has to provide sequential training for their staff and practice the RM instruction manual actively.

From the perspective of the respondents, this data indicates that the primary gap for implementing the risk management in the Authority would be the poor involvement of the contracting parties and their awareness.

Likewise, to reduce these mentioned gaps and improve the implementation of the risk management in the Authority, the respondents rate a high level on applying the RM guidance and implement forced measure, specify a time for applying the RM based on the project life cycle, provide continuous RM training and practices, and involving the contracting parties to practice RM.

Correspondingly, as indicated on Table 4.10, the suggestions on improving an implementation on the risk management in the ERA is mentioned as the following.

Table 4.10:- Respondents summary on suggestion to improve the implementation of the risk management in the ERA

Suggestion	Level of agreement	Frequency	Percent	Cumulative Percent	Mean	Rate
Force measurement to apply the guidance & practicing by incorporating on contract document as clauses and submitted as delivery reports	Low	3	4.9	4.9	4.131	High
	Medium	9	14.8	19.7		
	High	**26**	**42.6**	62.3		
	Very High	23	37.7	100.0		
	Total	61	100.0			
To arrange time frequency based on the project life cycle	Low	8	13.1	13.1	3.754	High
	Medium	15	24.6	37.7		
	High	**22**	**36.1**	73.8		
	Very High	16	26.2	100.0		
	Total	61	100.0			
Provide training and practices	Medium	5	8.2	8.2	4.459	Very High
	High	23	37.7	45.9		
	Very High	**33**	**54.1**	100.0		
	Total	61	100.0			
Involving the contracting parties to practice	Low	1	1.6	4.9	4.262	Very High
	Medium	8	13.1	19.6		
	High	**26**	**42.6**	62.3		
	Very High	**26**	**42.6**	100.0		
	Total	61	100.0			

(Survey Analysis, June,2021)

In regard to this, most of the respondents replied that providing training and involving the contracting parties to practice are the major two factors very highly valued as a main means of recommendations to improve the implementation of risk management in the ERA. This suggests that, for the Authority to improve and better practice the RM, they should take a measurement by providing sequential training and request the contracting parties to incorporate with them to practice the RM in their projects.

Likewise, the other factor is force measurement on practicing and applying the guidance. And to arrange time-frequency based on the project life cycle. This means that, risk management guidance must incorporate with the contract documents clauses and also include the delivery reports to submit to the project scenario. In addition, they have to try to arrange a routine RM process based on the specific project type and project lifecycle.

This implicated that identifying the basic gaps and applying the suggestion mitigation strategies would guide ERA to improve the implementation of risk management in its construction projects.

Depend on the above discussion, in Table 4.11, a risk management practice handling framework is developed by considering the allocation of the risk between the contracting parties and risk response.

Table 4.11:- Risk management practice Handling Framework

I/No	Identify Risk	Risk Allocation	Risk Response	Risk handling action
1	Manual/guidance insufficient to apply	ERA	Prevention	▪ Force measurement to apply the guidance & practicing by incorporating on contract document as clauses and submitted as delivery reports. ▪ Arrange time frequency based on the project life cycle
2	ERA work procedure	ERA	Prevention	
3	Contacting parties not participate/ involve	ERA Consultant & Contractor	Prevention	▪ Involving the contracting parties to practice
4	Knowledge / awareness of the contracting parties	ERA Consultant & Contractor	Prevention	▪ Provide training and practices

(Survey Analysis, June,2021)

As observed from Table 4.11, almost all of the identify risks that affect the risk management practice in the Authority are preventable. To ensure the implementation and practice of the RM manual and work procedure, ERA would take a responsibility to follow it by making a force measurement to apply the guidance & practicing it by incorporating on contract document as clauses and submitted as delivery reports. In addition, the Authority also would improve the implementation and practice of the RM manual and work procedure by arranging time frequency based on the project life cycle. On the other hand, ERA, Consultants and Contractors would take the responsibility to improve the involvement of the contracting parties and their awareness. This will help them to develop general risk mitigation strategy to create a strong communication culture around risk management and facilitate the identify new risk immediately.

The above mention mitigation action provided to establish a risk management strategy and an operative team among the contracting parties who plan and make decision with projected timelines. Additionally, it's also established a clear communication about the subject matter among the contract parties This aligning the Authority objective with the project timeline and help the contracting parties to reduces the cost overrun and deliver the project successfully which could be caused by poor risk management practices.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

Based on the survey results and discussion, the thesis includes four basic sections to answer the objective of the study. Therefore, based on the findings, this section summarizes the major finding of the thesis and draws conclusions and suggestion.

5.1 Conclusions

The conclusions are made based on the specific objectives and the findings of this study.

According to the analysis of the survey, currently, ERA implements risk management practices by developing a RM manual and work flow charts. The Authority also assign the RM responsibility specially to the project engineer and the construction project management directorates as a department. The common and relevant tools used by the Authority are document review, expert judgments, checklist analysis, risk categorization, and probability and impact matrices. Similarly, they commonly used risk transferring and mitigation tools as a risk response strategy. The Authority also applied a risk identification and risk register form as a recording system.

The awareness of the contracting parties about risk, risk management, and process are somehow fair. Currently, most of the ERA staff have been taking RM training which is organized by Authority itself. But still, it is insufficient since the training could not involve the consultants and contractors and improve the communication of RM across ERA and the contracting parties.

As stated in the survey analysis, most of the contracting parties do not have a RM guideline. However, the contracting parties' firms managed the risks using personal educational backgrounds, informal communication with the ERA, developing short-term planning to manage risk for a specific project, company wise implementation of handling risks on a generic way and using ERA or another RM manual. On the other hand, as discussed on the analysis section, the participation of the contracting parties on the RM mechanism decision process is very poor.

As stated in the survey, respondents were asked to evaluate the Probability and impact of the listed major risks based on their experience with construction projects in ERA. Hence, based on the number of frequencies selection the participants valued, a high

probability of risk occurs in technical (construction-related), financial, design, and access to construction site risks. Likewise, in terms of the impact of the project objective, high impact of cost occurs on technical (construction-related), financial, design, and access to construction site risks. And then a high impact of time occurs in technical, construction, organizational, design, material, and access to construction site risks. Finally, the high impact of quality occurs in technical (construction-related) and material risks.

On the other hand, based on probability-impact matrix analysis, and the key factors affecting a cost aspect are technical (related to construction), financial, design, and access to construction site risks. Similarly, in terms of time matrix, technical (construction-related), design and access to construction site risks are a major risk that delays the project. And then from the quality matrix diagram, technical (construction-related) has been identified as a challenge for the quality of the project activities.

The basic gaps that affect the authority for not efficiently practicing the risk management would be lack of experience on sufficiently applying the RM manual, less participate of contracting parties on the implantation of RM process, lack of work procedure develop, low awareness of ERA staff and contracting parties on implementation of the RM in the construction project. Among the above-mentioned gaps, participation of contracting parties and awareness of ERA staff took the highest level.

As stated also on the survey analysis, force measures to practice and apply the RM guidance, specify a time for applying RM - based on the project life cycle, provide continuous RM training and practices, and involving the contracting parties to practice RM are rating high level as a suggestion to improve the implementation of the risk management in the Authority.

5.2 Recommendations

In order to improve the implementation of risk management by ERA and the road construction sector, the following recommendations shall be taken into considerations.

- Apply a thorough discussion followed by a force measurement mechanism on practicing a risk management guidance by incorporating clause a relevant provision within contract documents, assigning experts, and applying the submit as delivery reports based on the project scenario.

- ERA would need to improve the practice of the development work procedures by specifying the steps to direct its staff and contract parities through construction activities in each project life cycle on risk management.

- ERA would need to improve the implementation and practicing of risk management through collaborating regional directorates, and related departments including both planning and procurement interrelated with organization policy. And also, the Authority would delegate the consultants to manage the risks with full responsibility and authorization.

- ERA would better involve the contract parties to practice the risk management process.

- ERA would need to give special attention to technical, financial, design, and access to construction site risks which have a high-level in both probability of occurrence and impacts on the project objective and to anticipate risks before initiating a project and develop effective mitigation measures in the early stages of the project.

- Although the complex nature of the road construction sector and the Authority's construction process are associated with high risk, the Authority would need to develop a common risk treatment at least for major known and frequently occurred risks to reduce the impact of risk on the specific project objective.

- ERA would need to develop an effective communication method to improve the risk exchange method among contract parties.

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Annexes

Annex I

Interview Question

Addis Collage

Department of Construction Technology and Management

Interview Question

Dear Participant:

This study is being conducted as partial fulfillment of a Master's Degree in Construction Technology and Management entitled "***Assessment of Risk Management practices on Road Construction Projects: The case of Ethiopian Road Authority".***

The purpose of the thesis is to assess the practices used by the Ethiopian Road Authority to manage risks in road projects by identifying the risk management practice implemented by the Authority, assessing the level of awareness of contracting parties, identifying the major types of risks participated in performing road construction projects based on their probability and impact matrix and to develop a mitigation strategy.

The interview question includes the respondent's general profile and the risk management implemented by ERA.

Your feedback is very valuable and contributes to the research results. I assure you that your answers will be kept confidential and will only be used for this academic study.

If you would like any clarification on the questionnaire, please contact me at +251-911-34 64 34 or ninimeku@gmail.com.

Thank you so much for your precious time and support.

Lidya Mekonnen

Post Graduate Student, Construction Technology and Management

Addis Collage,

Addis Ababa, Ethiopia

Section-I: - Respondent's General Profile

1. Name: - _____
2. Department: - _____
3. Position: - _____

Section-II: - Respondent's General Profile

1. Does the Authority implement risk management practice? Yes ☐ No ☐
2. Does ERA have a risk management instruction manual? Yes ☐ No ☐
3. Does the Authority develop a work procedure for the risk management? Yes ☐ No ☐
4. Which department is responsible in your organization for handling risk management on construction project?

   _____

   _____

   _____
5. Which professional position is responsible in your organization for handling risk management on construction project?

   _____

   _____

   _____
6. What are the common tools used for plan risk management methods?

   _____

   _____

   _____
7. What are the common tools used for risk identification methods?

   _____

   _____

   _____
8. What are the common tools used for risk analysis methods?

   _____

   _____

   _____
9. What are the common tools used for risk treatment methods? `

_____

_____

_____

10. Does the Authority have an organized risk management recording methods for construction projects? If it does, please mention the common methods?

_____

_____

_____

11. What advantages and obstacles does the organization face after practicing and implementation of risk management in the Authority?

_____

_____

_____

_____

_____

12. What measures is the authority taking against the obstacles it faces?

_____

_____

_____

13. How do you evaluate the efficiency of the overall risk management practicing in the Authority?

_____

_____

_____

Annex II

Questionnaire

Addis Collage

Department of Construction Technology and Management

Questionnaire

Dear Participant:

This study is being conducted as partial fulfillment of a Master's Degree in Construction Technology and Management entitled "***Assessment of Risk Management practices on Road Construction Projects: The case of Ethiopian Road Authority".***

The purpose of the thesis is to assess the practices used by the Ethiopian Road Authority to manage risks in road projects by identifying the risk management practice implemented by the Authority, assessing the level of awareness of contracting parties, identifying the major types of risks participated in performing road construction projects based on their probability and impact matrix and to develop a mitigation strategy.

The questions include the respondent's general profile, risk awareness, major risk factors in road construction projects, and mitigation strategies.

Your feedback is very valuable and contributes to the research results. I assure you that your answers will be kept confidential and will only be used for this academic study.

If you would like any clarification on the questionnaire, please contact me at +251-911-34 64 34 or ninimeku@gmail.com.

Thank you so much for your precious time and support.

Lidya Mekonnen

Post Graduate Student, Construction Technology and Management

Addis Collage,

Addis Ababa, Ethiopia

Section-I: - Respondent's General Profile (please mark your answer in the box)

1. Name of the firm you are working in _____
2. Type of stakeholder: - ERA ☐ Consultant ☐ Contractor ☐
3. Position: - _____
4. Education status

   BSc. ☐ MSc. ☐ PhD ☐ other ☐
5. Work experience in road construction

   <1 year ☐ 1-5 years ☐ 5-10 years ☐ >10 years ☐

Section-II: - Risk Awareness of Contracting Parties

This section is intended to assess the current status of different contracting parties' awareness regarding risk & risk management practices in Ethiopian road construction projects (Please mark your answer in the box)

1. Do you have an awareness about risk management and its Process?

   Yes ☐ No ☐
2. How do you rate your awareness risk management theoretical concept?

   Low ☐ Fair ☐ High ☐
3. Have you attended project risk management training?

   Yes ☐ No ☐
4. If your answer to the above question is "Yes"; does the training organized by ERA?

   Yes ☐ No ☐
5. As one of ERA road project contracting parties, does your organization have an authorized risk management manual and /or techniques?

   Yes ☐ No ☐
6. If your answer is "No" to the above question, how do your organization handle various risk issues during construction projects

   _____

   _____

   _____
7. Have you ever get participated in project risk process mechanism decision process in ERA/ with other stakeholders?

Yes ☐ No ☐

8. Are risks communicated across the ERA and contracting parties?

   Agree ☐ Neutral ☐ Disagree ☐

9. If your answer is " Disagree" to the above question, please specify the possible reasons_____

   _____

   _____

Section-III: - Major Type of Risks Performance in Road Construction Projects

Depend on your experience and observation, please identify the major source of risks in road construction projects undertaking by ERA in terms of probability and impact of occurrence. (Please mark your answer in the table)

NO.	RISK CATEGORIES	Probability					Impact of Risk														
							Cost					Time					Quality				
		Very Low	Low	Medium	High	Very High	Very Low	Low	Medium	high	Very Hight	Very Low	Low	Medium	high	Very Hight	Very Low	Low	Medium	high	Very High
1	**Technical Risks**																				
1.1	Documentation (Inadequate specification in terms of contract document and reference)																				
1.2	Construction-related (Insufficient site examination, change in scope, construction procedures, new technology, reliability, availability)																				
2	**Construction Risks:** (labor productivity, labor disputes, site condition, equipment failures, too high-quality standard and new technology)																				
3	**Physical Risks:** (geology/ground conditions, water table, climate etc.)																				
4	**Organizational Risks:** (no project manual, inadequate communications infrastructure, poor quality control, contractual relations, contractor's																				

NO.	RISK CATEGORIES	Probability					Impact of Risk														
							Cost					Time					Quality				
		Very Low	Low	Medium	High	Very High	Very Low	Low	Medium	high	Very Hight	Very Low	Low	Medium	high	Very Hight	Very Low	Low	Medium	high	Very High
	experience)																				
5	**Financial Risks:** (rate, deduction, cash flow, advance payments, retention, inflation and exchange rate changes)																				
6	**Socio-Political Risks:** (resettlement, deviations in laws and regulations, effluence and safety rules, bribery/corruption, language/cultural barriers)																				
7	**Environmental Risks:** (natural disasters and weather implications.)																				
8	**Design Risks:** (completeness, competency, designers, scope creep, quantities)																				
9	**Legal Risks:** (change of law, taxation, standards, licenses)																				
10	**Material Risks:** (availability, delivery times, supply chain, international procurement, quality)																				
11	**Access to Construction Site Risks**: (Right of way problems, compensation, demolition…)																				
12	**Experience of staffs**, staff's turnover etc.																				

Section-IV: - Mitigation strategies for Risk Management Practices on Road Projects

i. Depend on your experience and observation, what are the basic gap to practicing the risk management guidance in the ERA? Please identify from the list. (Please mark your answer in the box)

Where: -

- Very low = 1 Low =2 Medium =3
- High = 4 Very high =5

NO.	BASIC GAP	IMPORTANT OF RISK MANAGEMENT LEVEL				
		Very Low	Low	Medium	High	Very High
1	Manual/guidance insufficient to apply					
2	Contracting parties not participate/ involve					
3	ERA work procedure					
4	Knowledge / awareness of ERA staff					
5	Others (Please Specify)					

ii. Depend on your experience and observation, what will you suggest for ERA to do as an organization to improve the poor practicing of the risk management? Please identify from the list. (Please mark your answer in the box)

Where: -

- Very low = 1 Low =2 Medium =3
- High = 4 Very high =5

NO.	SUGGESTION	IMPORTANT OF RISK MANAGEMENT LEVEL				
		Very Low	Low	Medium	High	Very High
1	Force measurement to apply the guidance & practicing (by incorporating on contract document as clauses and submitted as delivery reports)					
2	To arrange time frequency based on the project life cycle					
3	Provide training and practices					
4	Involving the contracting parties to practice					
5	Others (Please Specify)					