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A Study on Development of a Conceptual Risk Management Framework: A Case Study on Addis Ababa City Roads Authority

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A Thesis submitted to

The School of Civil and Environmental Engineering

Presented in Fulfillment of the Requirements for the Degree of

Master of Science in Civil Engineering

(Construction Technology and Management)

Addis Ababa University

Addis Ababa, Ethiopia

December 2017 GC

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Declaration

I declare that this thesis entitled, A Study on Development of a Conceptual Risk Management Framework: A Case Study on Addis Ababa City Roads Authority is my original work. This thesis has not been presented for any other university and is not concurrently submitted in candidature of any other degree, and that all sources of material used for the thesis have been duly acknowledged.

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Acknowledgements

First of all, I would like to thank the Almighty Allah, for his help throughout my life and enabled me to further my academic carrier.

I would like to express my deep sense of gratitude for my advisor Dr. Alemayehu Ambo for his professional guidance, invaluable advice, his unlimited support and continuous encouragement to make this research possible as well as during the course work of this master's program.

My heartfelt thanks also go to all my graduate studies teachers. Particularly to Professor Abebe Dinku, for opening my eyes to see different perspectives and letting me acquire the knowledge of research execution and helping me through my research proposal.

I would like to express my appreciation to all organizations and individuals who contributed directly or indirectly to this thesis and provided the necessary materials and support for realization of this thesis. Specially, I would like to thank all the Addis Ababa Roads Authority and Ethiopian Roads Authority staffs in general and Eng. Habtamu Tegegn, Director General of the Addis Ababa City Roads Authority(AACRA) for permitting me to obtain relevant data for the execution of this study. I also would like to thank Eng. Semere Jelalu, Design, Implementation and Monitoring Directorate Director of AACRA and Eng. Firew Mitiku, Team Leader at the Contract Administration Department for providing me relevant data, documents, and in-depth discussions and comments.

I would also like to use this opportunity to convey my gratitude to the Ethiopian Roads Authority and Addis Ababa University for giving me this free scholarship to pursue my master's degree.

Last but not least, I want to express my utmost gratitude to my family and friends; especially to my mother W/ro. Medina Abrar and my father Ato. Hassen Abdu, for giving me courage and invaluable support.

Emran Hassen Abdu

Abstract

This research deals with developing a conceptual risk management framework for the Addis Ababa City Roads Authority (AACRA) after studying the current risk management practice in Addis Ababa and Federal public road construction sector. The conceptual risk management framework is developed for holistic approach and feasibility phase. In addition, the study has an objective of identifying the likelihood of key risk factors in AACRA, investigating their impact on project goals (i.e. Cost, Quality, and Time), analyzing and the degree of significance of the identified risk factors, studying the allocation of each identified risk factors based on stakeholders' perception, giving insight of risk management practice and key risk factors in Ethiopian Roads Authority's (ERA's) projects, providing practical suggestions and recommendations pointing toward upgrading the risk management practice in AACRA and ERA.

Various literatures were reviewed mainly to identify various risk factors, define risk management process, and review different risk management frameworks. Desk studies and case studies were conducted on AACRA and ERA projects. In addition, questionnaire survey was used as a data collection mechanism in order to acquire the required data.

The researcher concludes that the staffs of the major stakeholders in the Ethiopian construction industry are aware of risk management principles. However, the risk management practice in the industry is in its maturity stage. Currently, the Ethiopian public road construction sector is facing various hindrances and been adversely affected by various risk factors. The major challenges in the sector include: right-of-way obstacles, incomplete design and design problems, inadequate site or geotechnical investigations, scope and design changes, and unexpected weather conditions. The researcher also proves that there is poor practice of feasibility study in AACRA's projects. The researcher suggests to the Addis Ababa City Roads Authority to develop a risk management guidelines and policies based on the provided conceptual risk management framework. In addition, public authorities should practice a detailed risk allocation and mitigation plans. AACRA could conduct feasibility studies before executions for avoiding economic loss from projects execution. In addition, it will be better if AACRA could implement various project delivery and/or contract types according to the projects property.

Key words: Addis Ababa City Roads Authority (AACRA), Ethiopian Roads Authority (ERA), Framework, Risk, and Risk Management

Abbreviations

AACRA	Addis Ababa City Roads Authority
ERA	Ethiopian Roads Authority
MoWUD	Ministry of Works and Urban Development
MoFED	Ministry of Finance and Economic Development
GDP	Gross Domestic Product
GDCF	Gross Domestic Capital Formation
IHA	Imperial Highway Authority
EPRDF	Ethiopian People's Revolutionary Democratic Front
U.S.	United States
UK	United Kingdom
DBB	Design Bid Build
DB	Design Build
EoT	Extension of Time
AAWSA	Addis Ababa Water and Sewerage Authority
EEPCo	Ethiopian Electric Power Corporation
RoW	Right of Way
RAP	Resettlement Action Plan
EIA	Environmental Impact Assessment
RMFW	Risk Management Framework

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CHAPTER ONE

INTRODUCTION

1.1 General

The first chapter gives insight of the key points of the research. The main discussion area of this chapter includes; nature of construction industry, role of construction industry role and position in gross domestic product (GDP) in Ethiopian economy, introduction of the road construction sector, discussion of road construction development generally in Ethiopia and particularly in Addis Ababa, risk management and risk management frameworks. Also, in this chapter the general and specific objectives of the research, significance and beneficiaries of the study and organization of the research are presented.

1.2 The Nature of Construction Industry

The term "construction" can be defined as the erection, repair, and demolition of things and diverse as residential construction, building construction, road construction, etc. (Hmaid, 2005: 1). A construction project is viewed as a complex sequence of activities to deliver clearly defined objectives (Kangari, R., and Riggs, 1989: 126). Additionally, Construction is well characterized by its fragmentation, sensitivity to economic cycles and external environments, specialists and suppliers, and bringing together many players from diverse disciplines during the various stages of a single project which make it a highly risk prone industry (Hmaid, 2005: 1; Ashan and Sakale, 2014: 162).

The Construction Industry plays a predominant role in economy, it has high share on gross domestic product (GDP) of any developed and developing Nation. Tebeje and Teka, 2015 (cited in Ayalew, Dakhli, Lafhaj: 2016: 2) indicated that, In Ethiopia the GDP contribution of the industry has been raised to 5.6% and approaches to the sub Saharan average (6%) during 2002/2003. According to National Bank of Ethiopia (2015:8), In 2014/15, Construction industry contributed more than half (56.1 percent) to industrial sector growth and 8.5 percent to GDP growth. This implies that construction sector is currently the leading industry due to expansion in construction of roads, railways, dams and buildings. Beyond its contribution to the nation, the industry was the 6th major contributor of the continent infrastructure stock during 2002/03 following South Africa, Egypt, Morocco, Algeria and Nigeria Tebeje and Teka, 2015 (cited in Ayalew, Dakhli, Lafhaj: 2016: 2).

1.3 Road Construction Sector

According to Wikipedia (2017: n.d.), "Road is a route, or way on land consisting of one or more carriageways, each with one or more lanes and any associated sidewalks, primarily for the use of road motor vehicles". The development of roads by human travelers around the world dated back to 10,000 B.C. Throughout the world, roads carry the bulk of goods being traded and people being transported. Similarly, the constructed road networks are helping our country, Ethiopia, by shortening transportation time, and carrying bulk of products from the farmer. However, a lot has to be done to benefit from the road sector.

A well-developed road transport sector in developing countries is assumed to fuel up the growth process through a variety of activities of the development endeavors of a nation (EDRI, 2011: 1). Contrary, poor infrastructure and high transportation costs are often identified as a key constraint for counties development (Bloom and Sachs, 1998) cited in Shiferaw et' al, 2013: 4. The development of infrastructure, especially road construction is one of the most important activity that can boost up various industries by linking different distinctions, thereby increasing the gross domestic product (GDP) of a country. Due to this fact countries stress on infrastructure development. According to ERA (2007: 1), the development of roads in Ethiopia has a very long history, according to written documents, building small road trails and foot paths started during the 17^{th} and 18^{th} centuries. During the reign of Emperor Tewodros II, planned road construction efforts were made. Similarly, Emperor Yohannnes IV, who succeeded Tewodros, was engaged in road buildings too. In addition, Emperor Menilik II was said to be a successful road builder participating himself in the construction. In 1903, the road between Asmara and Addis Ababa (about 1,080 km) and the road between Addis Ababa and Addis Alem (about 40 km) were built. In addition, it was during this time that the first Asphalt roads appeared in Addis Ababa.

During the Italian occupation, roads were built even if, the roads lacked most of the modern design and construction features desirable for present day and they were built mainly to meet their requirements of military control. The roads and trails built and improved during the 5-year Italian occupation were about 6,000km. However, when Ethiopia regained its independence, the Italians in their fleeing attempt almost undid what they created by blasting bridges and dynamiting roads. The decade (1941-1951) after the Italian occupation is considered a period of stagnation for the construction and maintenance of the roads and it is because of lack of funds, equipment and expertise. Significant magnitude of Italian built road network was deteriorated within a period of 10 years. In 1951 only 1,000 km of road was traffic worthy of the total stock of about 6,000 km (ERA, 2007:1).

Following the eviction of the Italian occupiers, in 1951 G.C. the Imperial Ethiopian Government was convinced that a Road Agency solely responsible for rehabilitating/restoring and expanding the road network throughout the country had to be established. Accordingly, the Imperial Highway Authority (IHA) was established under proclamation No. 115/1951 as a semi-autonomous agency with specific duties to plan, design, construct, and maintain roads. Responsibilities for construction and maintenance of roads remained under a single autonomous authority (IHA) for 26 years. In 1980, the Military Government that took power in 1974 reformed the agency into the Ethiopian Transport Construction Authority (ETCA) by expanding its task to incorporate the construction of Airports, Seaports, Railways, and Municipal Roads. Following the shift from a command-based economy to a market oriented one in 1991, Ethiopian Roads Authority (ERA) was reestablished in 1993 with a view of providing a strong administration under the leadership of a Board (ERA, 2007:1-2).

Ethiopian Roads Authority started road sector development program in 1997 and continued to date. The program are planned to be continued until 2020. According to ERA (2015: 6), the programs include: RSDP I (1997-2002); RSDP II (2002-2007); RSDP III (2007-2010); RSDP IV (2010-2015); and RSDP V (2015-2020). It has been discussed by Shiferaw, et' al' (2013: 5-6) that between 1997 and 2011, the road network expanded from 26,550 km to 53,997 km, while the fraction of roads in good and serviceable conditions increased from 22% to 57% . The road network increased from 26,550 km in 1997 to 110,414 km in 2015 (ERA, 2015:1).

The Addis Ababa's modern road construction is highly interlinked with Emperor Haile Selassie's ruling period. The first office to be established by the Emperor Haile Selassie's government to construct roads was Public Works Department. It was established to construct roads in Addis Ababa and in its surroundings and Addis Ababa also got the chance to establish its road development organizational structure (AACRA, 2016:3).

In 1942, it was decided for Addis Ababa to have a mayor and council. The city roads construction and maintenance was organized under the municipality, to fulfill the road construction activities together with building works the "Road and Building Works" department was established. This department stayed till the replacement of the Haile Selassie's regime by the Derge Regime performing its duties.

But no fundamental organizational change of the department was observed during the Derge Regime. In 1993, the existing government, the Ethiopian People Revolutionary Democratic Front (EPRDF) established regional governments and gave them power to administer their regions with autonomy. During this time, Addis Ababa was also established as one of the regions. The Addis Ababa administration during this period established the “Bureau of Works and Urban Development” and the Bureau organized a department under it to carry out the road construction and maintenance works. The newly established road department constructed and maintained the city roads till the establishment of the Addis Ababa City Roads Authority in March 15, 1998 by regulation no 7/1998 to be administered by board of directors to construct, maintain and administer the road works in Addis Ababa by the city administration. The total length of road constructed in the city till the establishment of the authority was 4148 kms the road network coverage has reached 15.64% compared with the built plot area of the city (AACRA, 2016: 4). Currently AACRA is under reformation to satisfy the public demand in road infrastructure and to make Addis Ababa more compatible international city.

1.4 Risk Management

It has been discussed by Petravičius (2005: 108) that Construction projects face a broad array of uncertainties which have the potential to affect achievement of their objectives and project outcomes. Risk has significant impact on a performance of any construction project i.e. it is an uncertainty that affects project objectives. The construction industry is renowned as a high-risk industry, with complex and dynamic project environments creating an atmosphere of high uncertainty and risk. The industry is vulnerable to various technical, sociopolitical, business and other type of risks. The track record of construction industry is very poor in terms of coping with risks, resulting in the failure of many projects to meet time schedules, targets of budget and sometimes even the scope of work. As a result, a lot of suffering is inflicted to the clients and contractors of such projects and also to the general public. (Hatush, Z., and Skitmore, 1998: 105; Nadeem et ‘al, 2010: 16).

Since construction projects involve in a great deal of time and capital, so effective construction project risk management skills are required if the projects are to be completed within the established timeline to meet cost limitations and quality requirements (Kangari, R., and Riggs, 1989: 126). Risk management can give an important contribution and benefits to effective project management (Petravičius, 2005: 108). By implementing risk management, projects can reduce unexpected and costly surprises and effective allocation of resources could be more effective. It improves communication and provides a concise summary of threats, which can be faced by the project, thus ultimately helping them in better decision making (Saleem, 2008: 258). Risk and opportunity management is a way of thinking and a philosophy that should span the entire extent of project activities. Systematic analysis of risk exposure can lead to better and efficient allocation of resources. The process of breaking a project into its sources of risk and then examining them systematically gives the estimator a realistic feel for the project and its possible outcomes (Ashan and Sakale, 2014: 166). It has been agreed by Godfrey (1996: 9), that everyone should be concerned with risk management, because risk and uncertainty with potentially damaging consequences are inherent in construction projects. The success and failure of a project depends on the approach to risk. Chia and Daniel (2009:9), argue that although the application of risk management has been growing over the years in several types of businesses and industries, the use of a standard methodology being represented by a framework with critical elements is more able to improve the efficiency of managing risks in different types of organizations. Therefore, organizations need to operate their risk management in the context of a risk management framework.

1.5 Importance of Risk Management

Managing risks in construction projects has been recognized as a very important management process to achieve the project objectives in terms of time, cost, quality, safety and environmental sustainability (Zou, Zhang and Wang, 2005: 1). Application of risk management in construction industry has been motivated by increasing complexity of the construction projects and by pressure for cost savings and for construction time reduction (Špačková, 2012: 21). It has been discussed by Dale et' al (2005: 1) that risk management facilitates better business and project outcomes. It is because of risk management help us to give better decisions for preventing or avoiding risks, capturing opportunities, planning contingency, dealing with risks and their impacts, better allocation of resources, and better decisions about the best allocation of risk amongst the parties involved in a project activity. Smith, Merna and Jobling (2007:3), summarized benefits of risk management according to the following:

- ✓ Project issues are clarified, understood and considered from the start;
- ✓ Decisions are supported by thorough analysis;
- ✓ The definition and structure of the project are continually monitored;
- ✓ Clearer understanding of specific risks associated with a project; and
- ✓ Build-up of historical data to assist future risk management procedures.

Risk management helps project organizations to achieve performance and profitability and at the same time prevents loss of resources. It provides a positive potential return on investment for organizational management, project stakeholders, project management, and team members and helps an entity get to where it wants to go and avoid pitfalls and surprises along the way (Dan et' al, 2011:151). Nadeem et' al' (2010: 19), discussed that risk management is advantageous for Achievement of objectives, shareholders reliability, reduction of capital cost, less uncertainty, and creation of value. Furthermore, managing risk in projects is important to:

- ✓ Managers, because it improves the basis for making decisions to meet operational requirements and achieve project and program objectives;
- ✓ Project staff, because it helps to identify things that can go wrong in the project process and offers ways to address them effectively;
- ✓ End users, because it contributes to satisfying needs and achieving value for money in acquiring major assets and capabilities;
- ✓ Suppliers and contractors, because a sensible approach to risk in projects leads to better planning and better outcomes for sellers as well as buyers;
- ✓ Financiers, who must ensure they obtain a financial reward commensurate with the risks involved; and
- ✓ Insurers, who require comfort that risks are being managed prudently within the project prior to determining whether and how much to charge for financing residual risks.

1.6 Objective of the study

1.6.1 General Objective

The general objective of this research work is to study the practice of risk management throughout the project cycle of AACRA's and ERA's road construction projects and develop conceptual risk management framework for AACRA.

1.6.2 Specific Objectives

The specific objectives of the thesis are intended:

(i) To identify the degree of significance of various risk factors in AACRA's project based on their likelihood and impact on cost, quality, and time of a project;

(ii) To study the allocation of each identified risk factors based on stakeholders' perception;

(iii) To give insight of risk management practice and key risk factors in federal road projects; and

(iv) To provide practical suggestions and recommendations pointing toward upgrading the risk management practice in AACRA and ERA.

1.7 Significance of the Research

The vastness of construction projects leaves a lot of scope for various environmental, socio- political and other unforeseen problems during conceptual phase, design, procurement, execution, and turnover and startup leading to time and cost overruns in projects and compromise in quality. The cost overruns can be of huge magnitude in a project involving a large amount of money (Nadeem et' al, 2010: 16). In order to tackle this challenge and achieve the project objectives in terms of time, cost, quality, safety and environmental sustainability, there must be a formal risk management system (Zou, Zhang and Wang, 2005: 1).

In Addis Ababa a lot of city roads have been constructed in recent years and some are under construction by Addis Ababa City Roads Authority. However, these projects are facing different challenges in distinct phases of their project life cycle. Scope change, design problem, right of way problem, delay, and quality problems are some of the challenges that will lead to additional cost and loss of value. Nadeem et' al (2010: 16), claimed that the loss of services given by the project during the time in which the project overruns can be enormous if put into monetary terms. In addition, it will lead to dissatisfaction of the client and public. Hence, to reduce the losses, efficient management of a construction project is required. Application of various project management techniques have to be made from the conception to the completion stage, which include managing various risks associated with the project in its every stage. The study provides a conceptual risk management framework for managing risks in AACRA projects after studying current risk management practice, likelihood and significance of different risk factors, application of risk management process and their allocation's in AACRA projects and it also gives a practical suggestions and recommendations for upgrading the risk management practice. Thus, these can lead to high performance execution of the projects. Therefore, this study will be mainly significance for AACRA and the general public.

1.8 Scope and Limitations of the research

(i) Due to time limitation, the study only focuses on road construction projects only and does not cover other categories like building, dam, industrial …etc. construction projects;

(ii) The study mainly focuses on AACRA projects and realized through questionnaire, desk studies, case studies, and development of risk management framework;

(iii) Only outsourced AACRA projects are considered for the study. Since outsourced projects have higher project amount and the degree of their impact is believed to be greater than own force construction projects; and

(iv) Since AACRA is executing its out sourced projects with Design Bid Build (DBB) arrangement, the study focuses on this specific delivery system.

1.9 Organization of the Research

Necessary research sections are organized in this study. The research report is generally organized in seven chapters, references, and appendices. The organization of the research is presented in figure 1.1.

Chapter 1: Introduction

The introduction of the research includes background on construction industry, road construction sector, and risk management. It also states research objectives, significance of the study, statement of the problem, and organization of the research.

Chapter 2: Literature Review

The section holds extensive literature review. The materials used includes various books, published researches, journals, and different guidelines and standards.

Chapter 3: Materials and Research Methodology

The third chapter comprises the research design, methodology, including the research approach, the research design, data source, population, sampling technique, and data analysis methodology.

Chapter 4: Desk and Case Studies

Chapter four presents desk studies of Addis Ababa City Roads Authority and Ethiopian roads Authority. In addition, it presents selected case studies of projects under there supervisions.

Chapter 5: Questionnaires Data Analysis and Discussions

The data's obtained through questionnaires are analyzed and discussed in this chapter.

Chapter 6: Conceptual Risk Management Framework

The proposed risk management framework is presented in Chapter 6.

Chapter 7: Conclusions and Recommendations

Conclusions and recommendations of the study is presented; in addition, proposed future research areas are forwarded.

References and Appendixes

All the referred materials are presented, and necessary appendixes are included.

Figure 1.1: Organization of the research

CHAPTER TWO

LITERATURE REVIEW

2.1 Risk and Uncertainty

Many writers go to great lengths to explain the difference between risk and uncertainty. Certainty exists only when one specifies exactly what will happen during the period covered by the decision. Uncertainty might be defined as a situation in which there is no historic data or previous history relating to the situation being considered by the decision maker. The word risk originated from the French word risqué, and began to appear in English language, in its anglicized form, around 1830, when it was used in insurance transactions. Risk can be, and has been, defined in many ways and assessed in terms of fatalities and injuries, in terms of probability of reliability, in terms of a sample of a population or in terms of the likely effects on a project. Those who distinguish uncertainty from risk define risk as outcome of an event, or set of possible outcomes, can be predicted based on statistical probability. This understanding of risk implies that there is some knowledge about a risk as a discrete event or a combination of circumstances, as opposed to an uncertainty about which there is no knowledge (Flanagan and Norman, 1993:22; Smith, Merna and Jobling, 2007:3). Table 2.1 presents the distinction between risk and uncertainty.

Table 2.1: Distinction between risk and uncertainty

Risk	Uncertainty
• Subjective, derived either deductively or inductively.	• Subjective happens due to lack of knowledge.
• Involves numerical probabilities and can be calculated.	• Probabilities cannot be calculated.
• Involves classification of unknown outcome; a priori probabilities and statistical probabilities.	• Does not involve mathematical probabilities and cannot be analyzed.
• Outcome is known through general principles or empirical and recurrent observation.	• Outcome is uncertain, can only be anticipated based on instinct or other subjective forms.

Source: Saipol, (2014:68-69).

Both main project management professional institutions, the PMI and APM, have defined project risk. The Project Management Institute (PMI) defines project risk as “an uncertain event or condition that, if it occurs, has a positive or negative effect on a project objective and project risk includes both threats to the project’s objectives and opportunities to improve on those objectives. Organizations perceive risk as it relates to threats to project success.” (PMI, 2000: 128-129). The APM’s project risk analysis and management guide states that a risk is "an uncertain event or set of circumstances which, should it occur, will have an effect on achievement of the project's objectives, with clear understanding that risk can affect achievement of project objectives either positively or negatively" (Association for Project Management, 2006: 26).

Different authors have different perspectives on risk consequences on projects. i.e. negative and positive and negative effects on achievement of a project. The definition of project risk by Chapman and Ward is used for the thesis to avoid ambiguity which is “Risk means possible unfavorable outcomes” (Chapman & Ward, 2011:3). Chicken and Posner (cited in Hmaid, 2005: 9-10) provides their interpretation of a risk constituents using equation 2.1:

- Risk = Hazard x Exposure ………………………………………………. *[Equation 2.1]*

In the following equation hazard is interpreted as the impact of risk factors on a project objectives. While exposure is the likelihood of the risk factors in a project. In this study the hazard or impact of the risk factors is studied based on their negative impact on cost, quality, and time of a project.

2.2 Risks in Construction Projects

In the context of construction industry, risk is the likelihood of the occurrence of a definite event or combination of events which occur during the entire process of construction. The accumulation, or combinations of risks can be termed project risk and the construction industry is often considered as a risky business due to its complexity and strategic nature. It incurs numerous project stakeholders, influenced by internal and external factors which will lead to enormous risks (Smith, Merna and Jobling, 2007:1; Renuka, Umarani and Kamal, 2014: 31).

The construction industry has had a very poor reputation for coping with the adverse effects of change, with many projects failing to meet deadlines and cost and quality targets. This is not too surprising considering that there are no known perfect engineers, or managers any more than there are perfect designs or that the forces of nature behave in a perfectly predictable way. Change cannot be eliminated, but by applying the principles of risk management, engineers and project managers are able to improve the effective management of this change (Smith, Merna and Jobling, 2007:1).

A project risk can be identified as individual risk to one of activity inside the project or as overall project risk. Individual risks/opportunities are those risks that might positively or negatively affect one or more of the project tasks objectives. Defining and understanding individual risks can help to decide and make a strategy about how to apply efforts and resources to enhance the chances of project success. Overall project risk refers to the effect of uncertainty on the project. To lead to successful achievement of objectives is necessary to set realistic targets for the cost and duration of a project (Dan et' al, 2011:147).

According to Zou, Zhang and Wang (2005: 8-10), clients have the greatest influence in determining the success and failure of a construction projects more than any other stakeholder. It is because they have the higher power to decision makings and highly related to project risks. Clients are responsible for financing and bringing stakeholders together to the project. Variations by the client can directly result in changes in the planning, design and construction. Variations possibly result from two reasons, the change of mind by the clients or the misunderstanding /misinterpretation of the clients' needs in the project brief. For the former cause, the clients will bear the responsibility; for the latter one, a knowledgeable initial project team should be established as early as possible to define the project scope and functions precisely. Incomplete approval and other documents usually occurs due to management weakness of the project routines or the bureaucracy of government.

There are several factors that will expose one project to risk than the other. Nadeem et' al (2010:18) investigated the following factors that affect exposure of a project to risk:

- History
- Management Stability
- Staff expertise and experience
- Team Size
- Resource Availability
- Time Compression
- Complexity

Furthermore, it has been agreed by Zou, Zhang and Wang (2005: 8-10) that project risks can be associated to:

- Designers/ consultants
- Contractors
- Subcontractors
- Government bodies
- External bodies

2.3 Project Management

Management is a process concerned with the achievement of objectives (Moder, phillips, and Davis, 1983: 3). Organizations work generally involves either operational or project activity, although the two may overlap. Operations and projects differ primarily in that operations are ongoing and repetitive while projects are temporary and unique temporary endeavor undertaken to create a unique product or service. Operations and projects share many characteristics; for example, they are (PMI, 2000:4):

- Performed by people;
- Constrained by limited resources; and
- Planned, executed, and controlled.

Since construction projects are unique and temporary undertakings based on assumptions and constraints, delivering project results to multiple stakeholders with different requirements, uncertainty is inevitable. Project management can be seen as an attempt to control this uncertain environment, using structured and disciplined techniques such as estimating, planning, cost control, task allocation, earned value analysis, monitoring, and review meetings. Each of these elements of project management has a role in defining or controlling inherent variability in projects (Dan et' al, 2011:142).

The history of project management is often associated with Abyssinia's civilization, Greek's civilizations, Roman's civilizations, Egyptian Pyramids and the Great Wall of China. They were certainly large complex structures, built to high standards that have stood the test of time and must have required an enormous workforce (Burk: 2003: 14). Modern day project management started way back in the 1900s and 1950s and was applied long before the existence of its profession (Saipol, 2014:68-73). Project management is the science which applies skills, tools and techniques to fulfill project activities in a way that the expectations and requirements of stakeholders are fulfilled or exceeded (Nadeem et' al, 2010:16). Saipol (2014: 74-78), compared the definition of project management by referring six documents published by respective bodies, representing the practitioners and professional bodies in project management and summarize the definition of project management as "A defined or structured process that organizes, manages or delegates the required activities of planning, monitoring, controlling, delivering, motivating, reporting, and reviewing to achieve the project objectives, mission and goals. It involves the application of relevant knowledge, skills, tools and techniques by the project team".

2.4 Project Life cycle

Every project, not just those in the construction industry, goes through a series of identifiable phases, wherein it is 'born', it matures, it carries through to old age and it 'expires' (F. Lawrence, 2003: 7). Organizations performing projects will usually divide each project into several project phases to improve management control and provide for links to the ongoing operations of the performing organizations. Collectively, the project phases are known as the project life cycle. (PMI, 2000: 11-12). Different scholars suggest different classification of a project phase. According to Burke (2003, 28) there is a general agreement that project life cycle incorporate four phases namely; Feasibility, Planning and Design, Construction, and Turnover and startup. However, as shown in figure 2.1, construction project life cycle can be classified in to five phases; feasibility, planning and design, tendering, construction, turnover and start up.

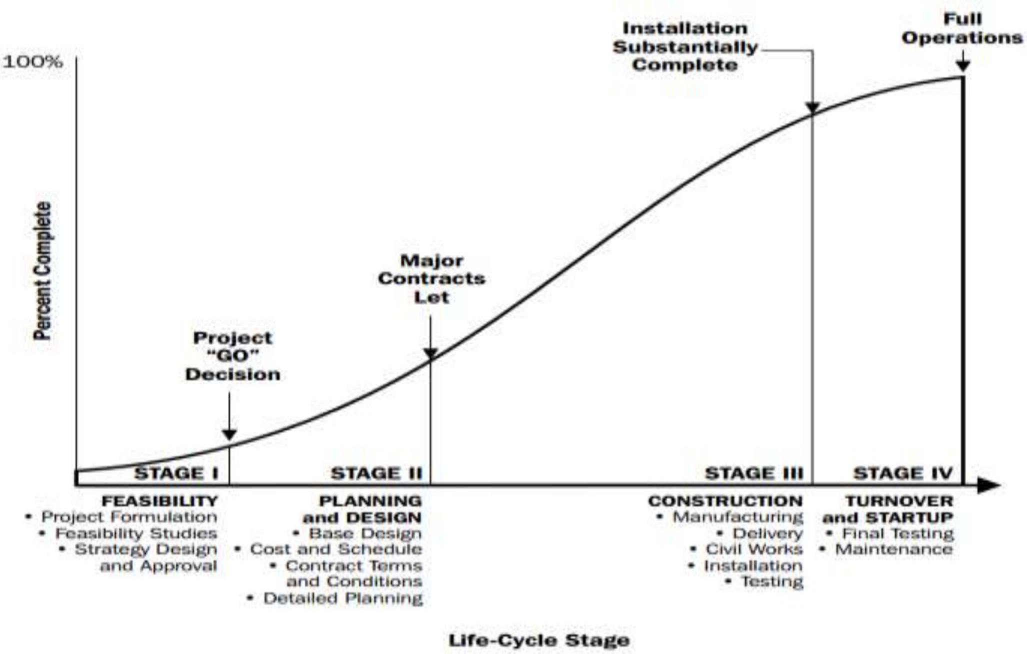


Figure 2.1: Representative construction project life cycle as per Morris (PMI, 2000: 15).

2.5 Risk Management

2.5.1 Historical Development of Risk Management

In the late 1950s, to manage project schedule uncertainty, scheduling and risk management tools were acquired. According to Moder and Philips, 1970 (Cited in Chapman and Ward, 2003:62), PERT (Program Evaluation and Review Technique) as originally developed in the late 1950s for the Polaris Missile Project. Chapman and Ward (2003:62-63), states that PERT is usefully thought as the first formal project-planning technique to address project risk and uncertainty in an activity-based planning framework. Using this model in its original 1950s' form, the expected duration of the project is defined by an expected critical path identified using a standard CPA (Critical Path Analysis) algorithm with expected durations for each activity. By the late 1960s, some authors were arguing for probabilistic models involving decision trees embedded in Markov processes. GERT (Graphical Evaluation and Review Technique) is one label used to describe this type of model. Chapman and Ward, Project, (2003:63) states that GERT allows activities to be addressed in time period by period, greatly enhancing our ability to understand both simple and complex repetitive processes, to accommodate contingency responses that do not wait until an activity has been completed, and to deal with time dependencies.

The concept of risk management became evident in the 1980s and was extended into the management of projects (Saipol, 2014:68-112). Moreover, According to Renuka, Umarani and Kamal (2014: 32), During 1990s, risk factor identification and assessment technique became a hot research topic. Till 2000, only few attempts have been made on the identification and assessment of risk factors of the construction projects. As a result, there was a lack of systematic approaches to identify and manage the risks in construction projects. In the post-2000's, many researchers tried to propose the limitations and complexity of risk assessment tools. There is a sharp increase in the number of risk identification and assessment papers published after 2010. More sophisticated models have been developed by various researchers for integrating risk assessment in comprehensive decision-making framework.

2.5.2 Risk Management Process

Risk management (RM) is essential part of project management. Managing risks in construction projects has been recognized as a very important management process to achieve the project objectives in terms of time, cost, quality, safety and environmental sustainability (Zou, Zhang and Wang, 2005:1). Without risk, there is no reward or progress, but unless risk is managed effectively within an organization the opportunities will not be maximized and the threats minimized. Risk is all about uncertainty or more importantly the effect of uncertainty on the achievement of objectives (Kevin, 2010:9).

Risk management is the systematic process of identifying, analyzing, and responding to project risk. It includes maximizing the probability and consequences of adverse events to project objectives (PMBOK, 2000:128). Project RM aims at identifying the potential risks associated with a project and responding to those risks and provides approaches by which uncertainty can be understood, assessed, and managed within projects. It includes activities which aim to maximize the consequences associated with positive events and to minimize the impact of negative events. It is believed generally that risk in an environment is a choice rather than fate, and the inherent uncertainty in the plans can affect the desired outcome of achieving project and business goals. Risk is present in all activities in a project; it is only the amount which varies from one activity to another (Nadeem et' al, 2010:16; Dan et' al, 2011:142).

Many companies often establish a risk management procedure in their projects for improving the performance and increase the profits. Projects undertaken in the construction sector are widely complex and have often significant budgets, and thus reducing risks associated should be a priority for each. Each Industry develop their own RM standards, but the general ideas of the concept usually remain the same regardless of the sector (Ewelina and Mikaela, 2011: VI and 11). Risk management plans and activities should be an integral part of an organization's management processes. In addition, Risk should be considered at the earliest stages of project planning, and risk management activities should be continued throughout a project (Dale et' al, 2005:2). For meaningful results, it is imperative that risk management to be applicable throughout a project's life cycle. The earlier in the project life cycle that the risks are recognized, the more realistic the project plans and expectations of results will be (Dan et' al, 2011:146-147).

Project risk management process includes conducting of risk identifications, analysis of impact (evaluation or quantification), responses (mitigation process), and monitoring and control of risks. (Dan et' al, 2011:143). In addition, Nadeem et' al (2010:18), puts the four-common project risk management processes as risk identification, risk quantification, risk response development, and risk response controlling.

a) Risk Identification:

Risk identification can be defined as determination of most likely risks affecting the project and documentation of characteristics of each risk. There are two methods to determine risks in a project, namely the qualitative and quantitative approach. The quantitative analysis relies on statistics to calculate the probability of occurrence of risk and the impact of the risk on the project. The qualitative approach relies on judgments and it uses criteria to determine outcome. (Nadeem et' al, 2010:18). Risk identification includes the following components (PMBOK, 2000: 131):

- Risk management plan
- Project planning outputs: which includes project charter, WBS, product description, schedule and cost estimates, resource plan, procurement plan, assumption and constraint lists)
- Risk categories
- Historical information from project file, and published information's.

There are different means of collecting information for risk identification. The following are some of risk identification mechanisms (Kevin, 2010:25):

- ✓ Audits or physical inspections;
- ✓ Brainstorming;
- ✓ Decision trees;
- ✓ Examination of local or overseas experience;
- ✓ Expert judgment;
- ✓ Flow charting, system design review, systems analysis, systems engineering techniques;
- ✓ Interview/focus group discussion;
- ✓ Operational modelling;
- ✓ Personal experience or past organizational experience;
- ✓ Scenario analysis;
- ✓ Strengths, weaknesses, opportunities and threats (SWOT) analysis;
- ✓ Survey, questionnaire; and
- ✓ Work breakdown structure analysis.

b) Risk quantification or assessment:

Risk quantification is an assessment of risks and the possible interactions of risks with project activities to evaluate the possible outcomes of the project (Nadeem et' al, 2010:18). In some cases, risk analysis is merged with risk identification process (PMI, 2000: 128).

There are two major categories of risk quantifications; qualitative and quantitative. There is no single analysis/modeling technique that is best for construction projects. The best selection will depend on the project parameters and possible historical data available at the time of analysis (Abdou, Lewis and Alzarooni, 2004: 150). Qualitative risk analysis should be revised during the project's life cycle to stay current with changes in the project risks. This process can lead to further analysis in quantitative risk analysis or directly to risk response planning. Tools and techniques for qualitative risk analysis includes (PMI, 2000: 133-134):

- Risk probability and impact;
- Probability/impact risk rating matrix;
- Project assumptions testing; and
- Data precision ranking.

Quantitative risk analysis process aims to analyze numerically the probability of each risk and its consequences on project objectives, as well as the extent of overall project risk. The tools and techniques for quantitative risk analysis includes (PMBOK, 2000:138-139):

- Interviewing;
- Sensitivity analysis;
- Decision tree analysis; and
- Simulation.

c) Risk response development:

The next step after qualitative and quantitative risk analysis in PMI (2000:140) is risk response planning. Risk response planning is the process of developing options and determining actions to enhance opportunities and reduce threats to the project's objectives. It includes the identification and assignment of individuals or parties to take responsibilities for each agreed risk response. Risk response planning must be appropriate to the severity of the risk, cost effective in meeting the challenge, timely to be successful, realistic within the project context, agreed upon by all parties involved, and owned by a responsible person. According to Nadeem et' al (2010:18), there are five categories of classic risk response strategies:

- Accepting the risk
- Avoiding the risk
- Monitor the risk and prepare contingency plans
- Transfer the risk
- Mitigate the risk

Based on my opinion mitigation is not a risk response strategy since it is the response to the risk after it affect the project. In this scenario, we are not expecting the risk to occur and since we are not anticipating the risk to occur, we cannot develop a risk response strategy to it. When we develop response we can use As low as reasonably practical (ALARP) concept, in which a level of risk is negligible and can be accepted without specific treatment other than monitoring and a level where risk is intolerable and the activity must cease, unless risk can be reduced. Between these levels is a region where costs and benefits are taken into account. When risk is close to the intolerable level the expectation is that risk will be reduced unless the cost of reducing the risk is grossly disproportionate to the benefits gained. Where risks are close to the negligible level then action may only be taken to reduce risk where benefits exceed the costs of reduction (Kevin, 2010:38).

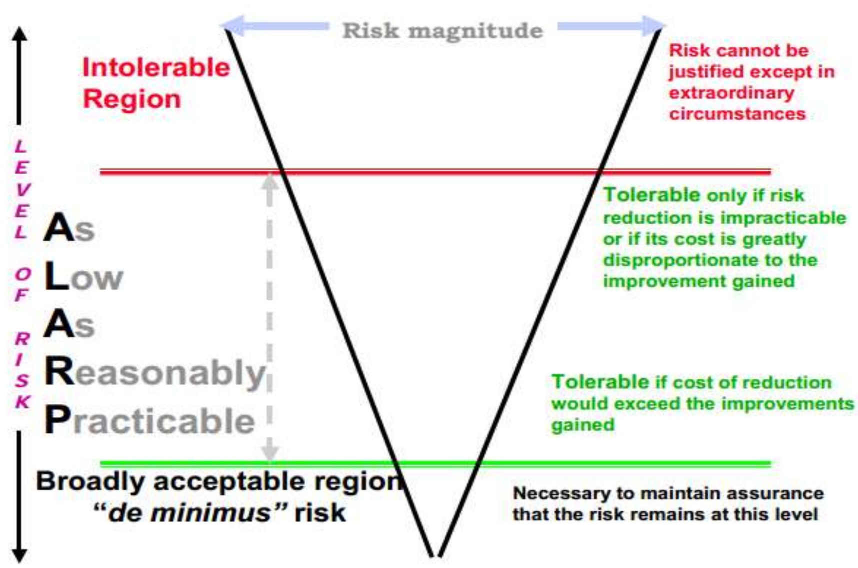


Figure 2.2: ALARP Process (Kevin, 2010:38).

d) Risk response control

The final risk management process in PMBOK (2000, 144-145), is risk monitoring and control which 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 effectiveness in reducing risk. Risk monitoring and control records risk metrics that are associated with implementing contingency plans. Good risk monitoring and control process provide information that assists with making effective decisions in advance of risk's occurring. Communication to all project stakeholders is needed to assess periodically the acceptability of the level of risk on the project. The tools and techniques for risk monitoring and control includes:

- Project risk response audits;
- Periodic project risk reviews;
- Earned value analysis;
- Technical performance measurement; and
- Additional risk response planning.

2.6 Types and Sources of risks in Construction

Even if they have common ground, different scholars and researchers categorize risk in several ways. According Nadeem et' al (2010:18), risk can be associated to technical, operational or business aspects of a project. Based on our strategy, risk can be either acceptable or unacceptable. In addition based on their impact duration, risks can either have short term or long-term impact. Risks can also be viewed as manageable and unmanageable. A manageable risk can be accommodated, example being a minor change in project requirements. An unmanageable risk, on the other hand, cannot be accommodated, such as turnover of critical team members. Based on their source, risks can also be characterized as internal or external. An internal risk is unique to a project and is caused by sources inherent in the project; example can be the inability of a product to function properly. Whereas, an external risk has origin in sources external to the project scope, such as cost cuts by senior management. Moreover, risk factors associated with the construction industry can broadly categorized into:

- Technical risks;
- Logistical risks;
- Management related risks;

- Environmental risks;
- Financial risks; and
- Socio-political risks.

Renuka, Umarani and Kamal (2014:33), attempt to generalize the critical risk factors listed by many researchers in different projects like residential, industrial, commercial, and infrastructure in a unique way which include:

- Country risk (Inflation, country economic condition);
- Environmental and geological risk (weather and climatic conditions);
- Statutory Compliance Risk (Statutory clearance before planning a project);
- Design risk (scope and design changes);
- Project Execution risk (modern technology implementation, poor safety procedures, construction delays, inadequate managerial skills, improper coordination between teams); and
- Resource Risk (lack of availability of resources).

2.7 Approach to Risk Management

2.7.1 General

We can tackle organization and project risks with different means. In general, Smith, Merna and Jobling 1999 (cited in Mahadi, Mastura and Ehsan, 2012:62) classify this risk management approaches in to two:

- A formal approach; and
- An informal approach

2.7.2 Formal approach

Formality is not about the pursuit of a closely defined, inflexible procedure; it is about providing a framework that guides and encourages the development of best practice. Formality in Risk Management Process is partly about making sure the right questions get asked and answered (Chapman and Ward, 2003:55). The procedures are structured and give guidelines to be followed, so that they can be used by any member of the organization. This structure ensures the uniformity of the approach to various problems. Formalized procedures for risk management in projects are designed to suit the needs of particular organization; thus, there is no single methodology. However, there are frameworks for formalized risk management. Procedures do not detail the methods that should be used but allow the user to choose appropriate techniques. The quality of a formal process of risk management generally depends on management awareness, motivation of project personnel, a methodical approach, the information available (often linked to the project phase), the assumptions and limitations upon which the risk analysis is based, the qualifications and knowledge within the project, and the experience and personality of the risk analyst leading the process. (Mahadi, Mastura and Ehsan, 2012:62).

2.7.3 Informal approach

The informal approach to the management of risk is one that views the risks in a subjective manner and due to the nature of this approach, many organizations implement these methods but do not realize that they are operating any kind of risk management procedure (Smith, Merna and Jobling, 2007:37-38). One of the most widely used techniques in the informal approach to risk management is the provision of contingency funds and the second, talking to experts or people with experience in similar projects and gaining their views as to the possible risks in a project. There are two main types of contingency funds: lump sum contingencies and percentage contingencies (Mahadi, Mastura and Ehsan, 2012:62-63). Contingency funds can be used as a risk management technique because the amount of money allocated to a contingency fund should be representative of the cost of mitigation of the risks that are thought likely to occur in a project. Hence, a contingency fund should represent the cost of the risks that are thought likely to be realized in a project rather than, as is often the case, being adequate to cover all eventualities (Smith, Merna and Jobling, 2007:38).

2.8 Risk Allocation

Risk management is not limited to a few processes, but includes much more in order to have a complete view of the suggested risk management process. One of the most crucial decisions in a project relates to the allocation of risks: who carries which risks (Artto et al, 2005) (Cited in Wakjira, 2011: 46). This is directly linked to the proper risk management strategy; as it will examine how risks are mitigated and handled in construction projects and which actors take responsibility for risk management. Before the decisions of risk allocations are ready to be made, the attitude that project actors have towards the risk has to be determined. Before a project starts, every actor’s strategy, as well as the ability to bear and manage risks, has to be known before risks are assigned to them. It is clear that a major part of risk management/mitigation is allocation of risks to various parties. Allocation of risks is usually implemented through a construction contract (Fisk, 1997) (Cited in Wakjira, 2011: 46).

Risk allocation is a key concept in managing project risks. Several literatures related to risk allocation inevitably describe the common principle that the risks in a project should be apportioned to those project parties who can best manage them. The broad doctrines of risk allocation according to the relevant literature are as follows (Macdonald, 2001: 345).

- Allocate risk to the party in the best position to control it;
- Consider the consequences to the receiving party;
- Consider whether the cost incurred or charged by the receiving party is acceptable; and
- Evaluate the potential for new risks being transferred back to the project owner.

2.9 Risk and Contract Types

A contract is the widely used risk allocation mechanism. In order to optimize the strategy to deal with project risks, different types of construction contracts can be used. According to Loots, 2007 (Cited in Mohebbi and Bislim, 2012: 5), contracts can be differentiated based on payment methods and duties and responsibilities of the various disciplines of the project. In addition, there level of risk varies. Table 2.2 shows risk comparisons in different contracts based on Mohebbi and Bislim, (2012: 6) from Delmon (2008), Huse (2002), Burke (1999).

Recent changes in the nature of government procurement strategies in many countries have provided a new incentive for sound risk management. That leads to various delivery systems. The emergence and increasing use of arrangements such as design-build (DB) build-own-operate (BOO), build-own-operate-transfer (BOOT), public–private partnerships (PPP) and private finance initiatives (PFI) for asset and capability acquisition have changed the traditional procurement environment. These new structures require different kinds of contractual arrangements and new forms of control and accountability, all of which introduce new kinds of risks (Dale et' al', 2005: 3-8).

Table 2.2: Risk comparison of different contracts.

Contract Type	Applications	Rate of Contractor's risk	Rate of Client's risk
Cost plus	This method is used when the client and contractor have strong relationship and trust level.	Low	High
Partnership	Bulky projects, Being specific in different items, and the political necessity of the project.	Equal	Equal
Fixed Price	This kind of contract is selected when all aspects of the project are specified. However, most of the time the client selects this method in order to transfer project risk to the contractor.	High	Low
Unit Rates	This method is used when project design is not completed before the contract assignment time or is used when it is required to determine a limit for the prices in the bidding.	High	Low
Turnkey	The client does not have sufficient staffing to supervise and manage the project, or when the project involves a specific technology which is not available to everyone.	High	Low
B.O.T (Build, Operate and Transfer)	The client is unable to finance the project and/or when the project applies a specific technology.	High	Low

Source: Mohebbi and Bislim, (2012: 6) from Delmon (2008), Huse (2002), Burke (1999).

As shown in Table 2.2 rate of contractor's risk increase in fixed price, unit rates, turnkey, and B.O.T contracts. As discussed in the table mostly fixed price is considered by the client when the client has less information about the project and when he needs to transfer the risk to the contractor. Unit rate contract is used when the client needs to quantify the cost of each item of work through bidding process. The client may select the lowest bidder after evaluating there technical qualification. Therefore mostly contractors may lower there price to win the bidding. This scenario may lead to high rate of risk for the contractor. In turnkey contract the expectation of the client is much high since clients need to accept the project in fully operational form. Therefore, contractor's responsibility will be much higher. In cost plus contract types mostly the rate of client's risk is much higher since the client pays to the contractor after he covers his cost.

2.10 Role of Insurance in Construction Risk Management

The Insurance industry plays a predominant role in managing construction risks through different arrangements. Babu, and Kanchana (2014: 209) discussed the following arrangements;

- **Contractor's All Risk Policy (CAR):** This policy is specially designed to give financial protection to the Civil Engineering Contractors in the event of an accident to the civil engineering works under construction.
- **Professional Indemnity Policy:** This policy is meant for professionals to cover liability falling on them as a result of errors and omissions committed by them whilst rendering professional service. The policy offers a benefit of Retroactive period on continuous renewal of policy whereby claims reported in subsequent renewal but pertaining to earlier period after first inception of the policy, also become payable. Group policies can also be issued covering members of one profession. Group discount in premium is available depending upon the number of members covered.
- **Contractor Plant and Machinery Policy:** The sum insured of each item of machinery should represent the current purchase cost of a similar new machine including all incidental expenses like freight, duty, taxes, cost of erection etc.
- **Public and Product Liability:** It is also known as combined liability or general liability. Public liability is a legal ability to pay compensation to third parties arising in connection with the business activities of the insured. Product liability is the legal ability to pay compensation to third parties arising in connection with the insured's products.
- **Worker's Compensation policy:** This insurance effectively covers all liabilities whether arising under statute or at common law, in relation to death or injury of employees or persons demand to be employees.
- **Compulsory third-party motor vehicle insurance policy:** Principals often require the inclusion as required by the statute in the relevant jurisdiction for vehicles used in connection with work under the contractor.

According to Yilma (2014: 94) The following Insurance policies are widely used in Ethiopian Road Construction Industry by Clients, Consultants, and Contractors:

- Bid Bonds;
- Performance bonds and guarantee;
- Contractor's all risk;
- Plant and equipment insurance;
- Motor insurance to cover Vehicles;
- Good in transit/ Transport floater;
- Third party insurance;
- Fire perils insurance on premises and contents;
- Workers compensation insurance;
- Employers' liability insurance.

2.11 Risk management frameworks

2.11.1 General

Formalized procedures for risk management in projects are designed to suit the needs of particular organization; thus, there is no single methodology. However, there are frameworks for formalized risk management (Mahadi, Mastura and Ehsan, 2012:62). Also, it needs to be supported by a structure that is appropriate to the organization and its external environment or context. A successful risk management initiative should be proportional to the level of risk in the organization (as related to the size, nature and complexity of the organization), aligned with other corporate activities, comprehensive in its scope, embedded into routine activities and dynamic by being responsive to changing circumstances (ISO 31000, 2010:3). Tangible and intangible benefits can be derived from the application of the risk management framework. Tangible advantages are associated with decision-making and include an improved understanding of projects, giving as a consequence a better control over resources, the provision of a structured support to develop and implement monitoring strategies, and a better use of means to identify and assess risk with an inherent positive impact on the evaluation of contingencies (Sabrina, Carlo, and Anna, 2012:92). Some of the common risk management frame works are presented below:

Table 2.3: Risk Management Frameworks

Designation	**Author**	**Context**	**Description**
Department of Defense (DoD)	U.S. Department of Defense (DoD) 2000	Public Application	This RMP is a product of a joint effort by the under Secretary of Defense (DoD U.S. 2000)
Risk Filtering, Ranking and Management (RFRM)	Haimes et al. 2002	Public Application	The RMFW identify, Prioritize, asses and manage risks to complex, large-scale systems. It encapsulates the six questions of risk assessment and management. Thereby, adhering to a comprehensive risk analysis process.
Australian/ New Zealand Standard (AS/NZS 4360)	Dale 2004	Public Application	This standard was developed to accommodate public sectors and private organizations on RM. Its RM approach is very generic and can be used in any projects.
Continuous Risk Management (CRM)	Rosenberg et al. 1999	Software Engineering	This methodology was developed in conjunction with the Software Engineering Institute (SEI) as Carnegie Mellon University and tailored to the NASA systems community.
Risk Kit (RISKIT)	Kontio 2001	Software Engineering	Based on a graphical modeling formalism, it supports multiple stakeholder views to risks by considering their potential utility losses. Konito developed the concept of Risk scenario with in the RISKIT (Kontio 2001).
Construction Risk Management System (CRMS)	Al-Bahar and Crandall 1990	Construction Engineering	The RMP provides an effective and systematic framework for quantitatively identifying, evaluating, and responding to risks in construction projects.
Risk Analysis and Management for Projects (RAMP)	Institution of Civil Engineers et al. 1998	Construction Engineering	The RAMP is a logical process, designed to provide a useful and practical framework for the identification, analysis, mitigation, and control of risk inherent in a complex activity. It specifically conceived for a capital investment projects.
Project Uncertainty Management (PUMA)	Del Cano and De la Cruz 2002	Construction Engineering	The PUMA is a generic methodology that is proposed based on professional experience of the authors, an analysis of

			the previously published project RMP and interviews with professionals.
Risk Man (RISKMAN)	Carter et al. 1996	Project Management	It has a practical approach the management of risk. The purpose of RISKMAN methodology is to provide a general framework for professional project RM, and guidance for its implementation.
Shape Harness and Manage Project Uncertainty (SHAMPU)	Chapman and Ward 2003	Project Management	The SHAMPU is a generic RMP consisting of nine steps, is explicitly is defined to be iterative with the level of detail (saari, 2004), and is established based on risk efficiency concept (Chapman and Ward, 2003).
Project Risk Analysis and Management (PRAM)	Association for Project Management (APM) 2004	Project Management	The PRAM is designed to the largest projects and the authors provide simplification for specific cases. PRAM has a special importance because it was the first highly comprehensive process developed by a large number of persons, Including a mix of practitioners, and academics, with results of very high quality.
Project Management Body of Knowledge (PMBoK)	Project Management Institute (PMI) 2004	Project Management	It is a prime instance of literature that describes RM practice. The importance of PMBoK lies in the relevance of the PMBoK as ANSI (American National Standard Institute) and IEEE (USA Institute of Electrical and Electronics Engineers) standards.

Source: Seyed, Siamak, and Mohammad, 2008:219-220.

2.11.2 Project Management Institute's Risk Management Framework

To cure the disconnect between multiple project management models vying for an organization's attention since 1981 the Project Management Institute (PMI) commissioned a standard by which organizations could standardize on how to manage their projects, by incorporating different project management knowledge area. One of the knowledge area is risk management (John, 2013:13). Project Management Body of Knowledge 2000 edition risk management framework considers six risk management process: planning, identification, qualitative analysis, quantitative analysis, response planning, and monitoring and control. While this framework provides a comprehensive approach to problem solving, its effectiveness relies on the ability of these processes to cope with the multidimensional uncertainty of risks: identification, likelihood, impact, and occurrence. The traditional tools and techniques used in these processes were not designed to address the increasingly systematic nature of risk uncertainty in modern projects (Alexandre, 2001:1). The six major risk management processes as shown in the figure below (PMI, 2000, 128):

PROJECT RISK MANAGEMENT

Risk Management Planning

1. **Inputs**
   1.1 Project charter
   1.2 Organization's risk Management policies
   1.3 Defined roles and responsibilities
   1.4 Stakeholder risk tolerances
   1.5 Template for the organization's risk management plan
   1.6 Work breakdown structure (WBS)
2. **Tools and Techniques**
   2.1 planning meetings
3. **Outputs**
   3.1 Risk management plan

Risk Identification

1. **Inputs**
   1.1 Risk management plan
   1.2 Project planning outputs
   1.3 Risk categories
   1.4 Historical information
2. **Tools and Techniques**
   2.1 Documentation review
   2.2 Information-gathering techniques
   2.3 Checklists
   2.4 Assumptions analysis
   2.5 Diagraming techniques
3. **Outputs**
   3.1 Risks
   3.2 Triggers
   3.3 Inputs to other processes

Quantitative Risk Analysis

1. **Inputs**
   1.1 Risk management plan
   1.2 Identified risks
   1.3 List of prioritized risks
   1.4 List of risks for additional analysis and management
   1.5 Historical information
   1.6 Expert judgment
   1.7 Other planning outputs
2. **Tools and Techniques**
   2.1 Risk probability and impact
   2.2 probability/impact risk rating matrix
   2.3 project assumptions testing
   2.4 data precision ranking
3. **Outputs**
   3.1 Overall risk ranking for the project
   3.2 List of prioritized risks
   3.3 List of risks for additional analysis and management
   3.4 Trends in quantitative risk analysis results

Quantitative Risk Analysis

1. **Inputs**
   1.1 Risk management plan
   1.2 Identified risks
   1.3 List of prioritized risks
   1.4 List of risks for additional analysis and management
   1.5 Historical information
   1.6 Expert judgment
   1.7 Other planning outputs
2. **Tools and Techniques**
   2.1 Risk probability and impact
   2.2 probability/impact risk rating matrix
   2.3 project assumptions testing
   2.4 data precision ranking
3. **Outputs**
   3.1 Overall risk ranking for the project
   3.2 List of prioritized risks
   3.3 List of risks for additional analysis and management
   3.4 Trends in quantitative risk analysis results

Risk Response Planning

1. **Inputs**
   1.1 Risk management plan
   1.2 List of prioritized risks
   1.3 Risk ranking of the project
   1.4 Prioritized list of quantified risks
   1.5 Probabilistic analysis of the project
   1.6 Probability of achieving the cost and time
   1.7 List of potential responses
   1.8 Risk thresholds
   1.9 Risk owners
   1.10 Common risk causes
   1.11 Trends in qualitative and quantitative risk
2. **Tools and Techniques**
   2.1 Avoidance
   2.2 Transference
   2.3 Mitigation
   2.4 Acceptance
3. **Outputs**
   3.1 Risk response plan
   3.2 Residual risks
   3.3 Secondary risks
   3.4 Contractual agreements
   3.5 Contingency reserve amounts needed
   3.6 Inputs and other process
   3.7 Inputs to a revised project plan

Risk Monitoring and Control

1. **Inputs**
   1.1 Risk management plan
   1.2 Risk response plan
   1.3 Project communication
   1.4 Additional risk identification and analysis
   1.5 Scope changes
2. **Tools and Techniques**
   2.1 Project risk response audit
   2.2 Periodic project risk reviews
   2.3 Earned value analysis
   2.4 Technical performance measurement
   2.5 Additional risk response planning
3. **Outputs**
   3.1 Workaround plans
   3.2 Corrective action
   3.3 Project change requests
   3.4 Update to the risk response plan
   3.5 Risk database
   3.6 Update to risk identification checklist

Figure 2.3: PMBoK's risk management framework.

2.11.3 ISO 31000: 2009 Risk Management Framework

ISO 31000:2009 sets out principles, a framework and a process for the management of risk that are applicable to any type of organization. It does not mandate a one size fits all approach but rather emphasizes the fact that the management of risk must be tailored to the specific needs and structure of the particular organization (Kevin, 2010:9).

In order to successfully implement, support and sustain the risk management process, a structure is required. ISO 31000 refers to this structure as the risk management context. ISO 31000 states that risk management must be integrated into the culture of the organization and this will include mandate, leadership and commitment from the Board. It must translate risk strategy into tactical and operational objectives, and assign risk management responsibilities throughout the organization There are three core points on internal arrangements for communicating risk issues; namely risk architecture, risk strategy and risk protocol. ISO 31000 describes the components of a risk management implementation framework. ISO 31000 describes a framework for implementing risk management, rather than a framework for supporting the risk management process. Information on designing the framework that supports the risk management process is not set out in detail in ISO 31000. An organization will describe its framework for supporting risk management by way of the risk architecture, strategy and protocols for the organization. The figure below shows ISO 31000 framework for managing risk (ISO 31000, 2010:7).

Figure 2.4: ISO's Framework for development of risk management.

Although this International Standard provides generic guidelines, it is not intended to promote uniformity of risk management across organizations. The design and implementation of risk management plans and frameworks will need to take into account the varying needs of a specific organization, its particular objectives, context, structure, operations, processes, functions, projects, products, services, or assets and specific practices employed (ISO 31000, 2015:10). ISO 31000 recognizes the importance of feedback by way of two mechanisms. These are monitoring and review of performance and communication and consultation. Monitoring and review ensures that the organization monitors risk performance and learns from experience. Furthermore, the risk management process of ISO 31000 is illustrated in the figure below (AIRMIC, Alarm and IRM, 2010:6-7).

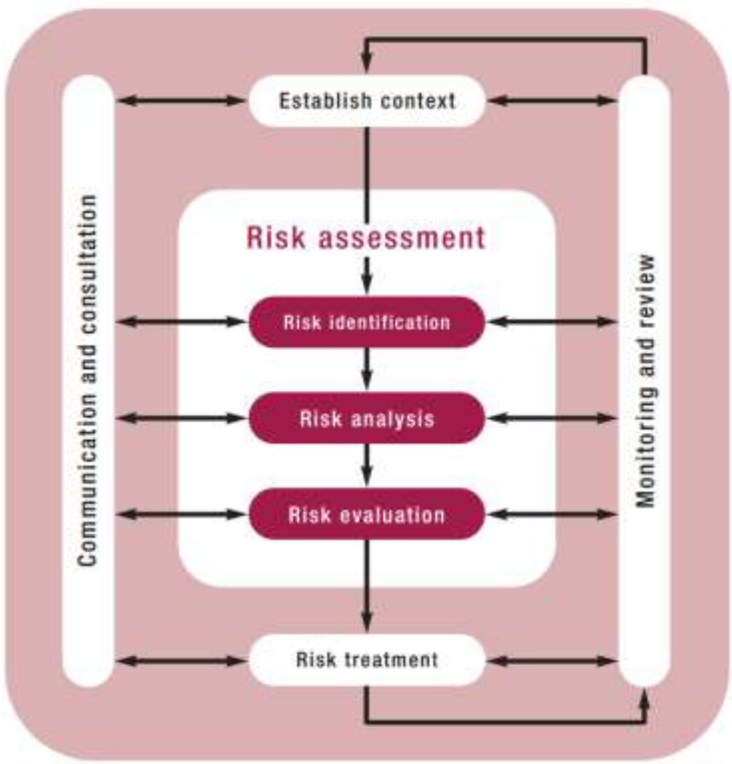


Figure 2.5: ISO's risk management framework.

2.11.4 Chapman and Wards' Risk Management Framework

Chapman and Ward has developed SHAMPU (Shape, Harness, and Manage Project Uncertainty) risk management framework. The SHAMPU label is new, but the SHAMPU process has emerged from the synthesis of earlier project RMPs and models. These processes and models have themselves evolved over a considerable period, as the range of issues addressed was extended. The nature of these developments may be of interest in their own right, but they are outlined to provide a rationale for the SHAMPU structure and to indicate the content and importance of each phase. If an organization or an individual is starting from scratch, the SHAMPU (Shape, Harness, and Manage Project Uncertainty) process is a good place to start. However, for organizations or individuals with some experience of risk management, it may be important to accommodate preferences and pressures for alternative processes (Chapman and Ward, 2003:55-62). Alignment of simplified (macro phase) of SHAMPU process is presented below;

Table 2.4: Portrayals of the SHAMPU process

The basic nine phase SHAMPU process	Middle level (five phase) portrayal	Simplest (three phase) portrayal
Define the project **Focus** the process	Clarify the **basis of analysis**	
Identify the issues **Structure** the issues Clarify **ownership**	Execute the **qualitative analysis**	**Shape** the project strategy
Estimate variability **Evaluate** implications	Execute the **quantitative analysis**	
Harness the plans	**Harness** the plans	**Harness** the plans
Manage Implementation	**Manage** Implementation	**Manage** Implementation

Source: Chapman and Ward, 2003:55-62

Starting in 1975, Chapman and BP International developed probabilistic models for planning and costing offshore North Sea projects, which embedded the fault tree and event tree concepts used for safety analysis in GERT models. SCERT (Synergistic Contingency Planning and Review Technique) is one label used to describe this model in the PERT and GERT tradition. The SCERT process had four phases: scope, structure, parameter, and manipulation. Each contributed directly to the shape of the SHAMPU process. The SCERT scope phase corresponds to the activity-based planning aspects of the SHAMPU define and identify phases. In the context of a SCERT focus on sources of uncertainty associated with activity-based planning, the SCERT structure, parameter, and manipulation phases correspond closely to the SHAMPU structure, estimate, and evaluate phases, respectively (Chapman and Ward, Project, 2003:63-64).

2.11.5 COSO RISK MANAGEMENT FRAMEWORK

COSO is a famous risk management framework and its mission is to provide thought leadership through the development of comprehensive frameworks and guidance on enterprise risk management, internal control and fraud deterrence designed to improve organizational performance and governance and to reduce the extent of fraud in organizations (Robert and Frank, 2016:1). Enterprise risk management is a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives. This definition reflects certain fundamental concepts. Enterprise risk management is (COSO, 2004:16-17):

- A process, ongoing and flowing through an entity
- Effected by people at every level of an organization
- Applied in strategy setting
- Applied across the enterprise, at every level and unit, and includes taking an entity level portfolio view of risk
- Designed to identify potential events affecting the entity and manage risk within its risk appetite
- Able to provide reasonable assurance to an entity's management and board
- Geared to the achievement of objectives in one or more separate but overlapping categories – it is a means to an end, not an end in itself

COSO Framework, originally published in 2004, is a widely accepted framework used by management to enhance an organization's ability to manage uncertainty and to consider how much risk to accept as it strives to increase stakeholder value (Robert and Frank, 2016:4). The ERM considers activities at all levels of the organization (Tony, 2014:10):

- Enterprise-level
- Division or subsidiary
- Business unit processes

Enterprise risk management is not strictly a serial process, where one component affects only the next. It is a multidirectional, iterative process in which almost any component can and does influence another.

There is a direct relationship between objectives, which are what an entity strives to achieve, and enterprise risk management components, which represent what is needed to achieve them. The relationship is depicted in a three-dimensional matrix, in the form of a cube (COSO, 2004:3).

Figure 2.6: COSO's risk management framework

2.11.6 APM's PRAM risk management framework

Project Risk Analysis and Management (PRAM) is a distillation of the experience of a large number of the United Kingdom (UK) organizations that had used RMPs successfully for many years. The draft PRAM process was based on a synthesis of designed and evolved processes using a nine-phase structure. (Chapman and Ward, Project, 2003:65). The risk management process requires an initiation step to define scope and objectives, after which risks can be identified. The relative significance of identified risks is assessed using qualitative techniques to enable them to be prioritized for further attention. Qualitative risk analysis may also be used to determine the combined effect of risks on overall project outcome. A range of techniques are available, such as Monte Carlo simulation, decision trees and influence diagrams. The process continues with risk response planning, aiming to avoid, reduce, transfer or accept threats as well as to exploit, enhance, share or accept opportunities, with contingency for risks which can be handled proactively. The next step is implementation of agreed responses, followed by iterative identification, review and update throughout the project life cycle to maintain awareness of current risk exposure (APM, 2006: 26).

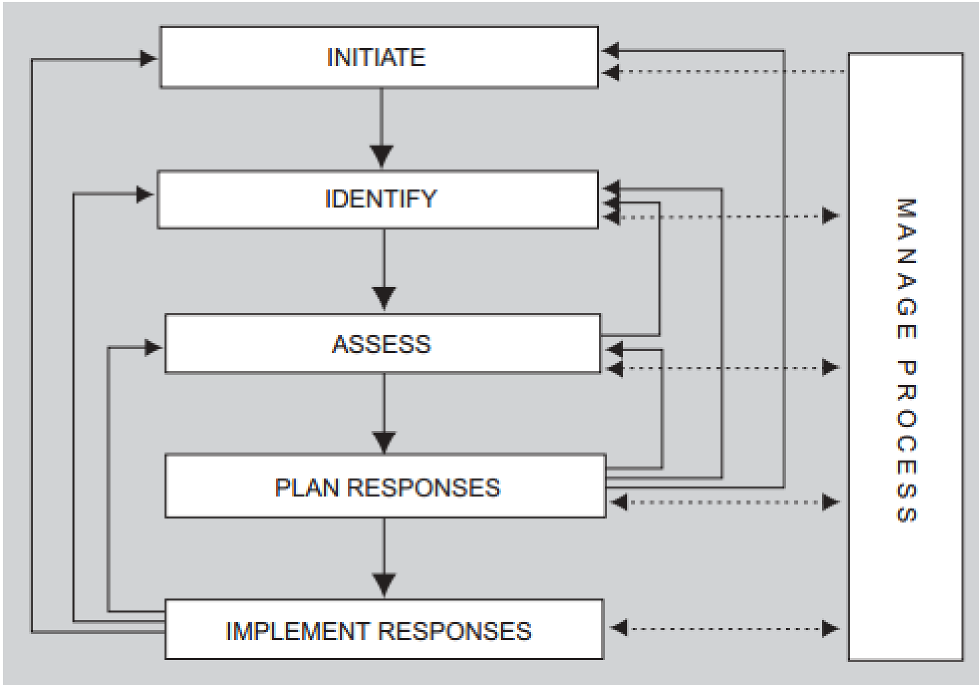


Figure 2.7: PRAM risk management process (APM: 2004) cited in APM: 2006: 27

2.11.7 Australian and New Zealand's Risk Management Standard (AS/NZS4360: ISO 31000:2009)

The risk management standard developed using ISO risk management standard. The main variations to AS/NZS ISO 31000:2009 is that ISO 31000 has been developed on the basis of an existing standard on risk management, whereas AS/NZS 4360:2004/9. The initial Standards Australia approach provided a process by which risk management could be undertaken, ISO 31000:2009 addresses the entire management system that supports the design, implementation, maintenance and improvement of risk management processes. This Standard is intended to meet the needs of a wide range of stakeholders including;

- Those accountable for achieving objectives and therefore ensuring that risk is effectively managed within the organization as a whole or within a specific area, project or activity;
- Those responsible for developing risk management policy within their organization;
- Those who need to evaluate an organization effectiveness in managing risk; and
- Developers of standards, guides, procedures, and codes of practice that in whole or in part set out how risk is to be managed within the specific context of these documents.

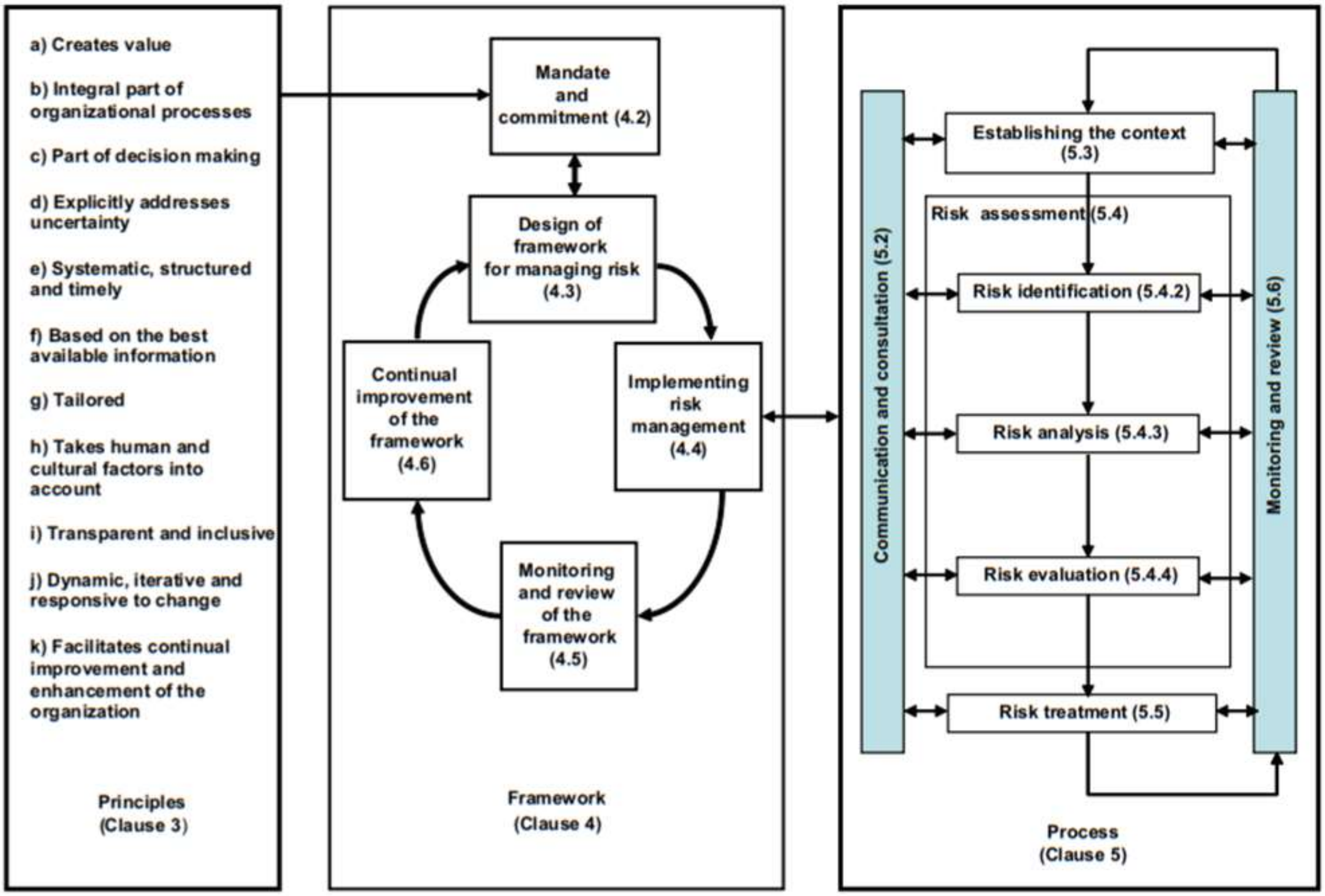


Figure 2.8: AS/NZS ISO 31000: 2009, Principles, Framework, and Process

2.11.8 U.S. Department of Transportation Risk Management Guideline

Federal Highway Administration of United States has published Risk assessment and allocation guideline for highway construction management. The six primary steps in FHWA project risk management includes; Identification, Mitigation, Assessment, Allocation, Analysis, and Tracking and updating. The overall risk management process is shown in the figure below;

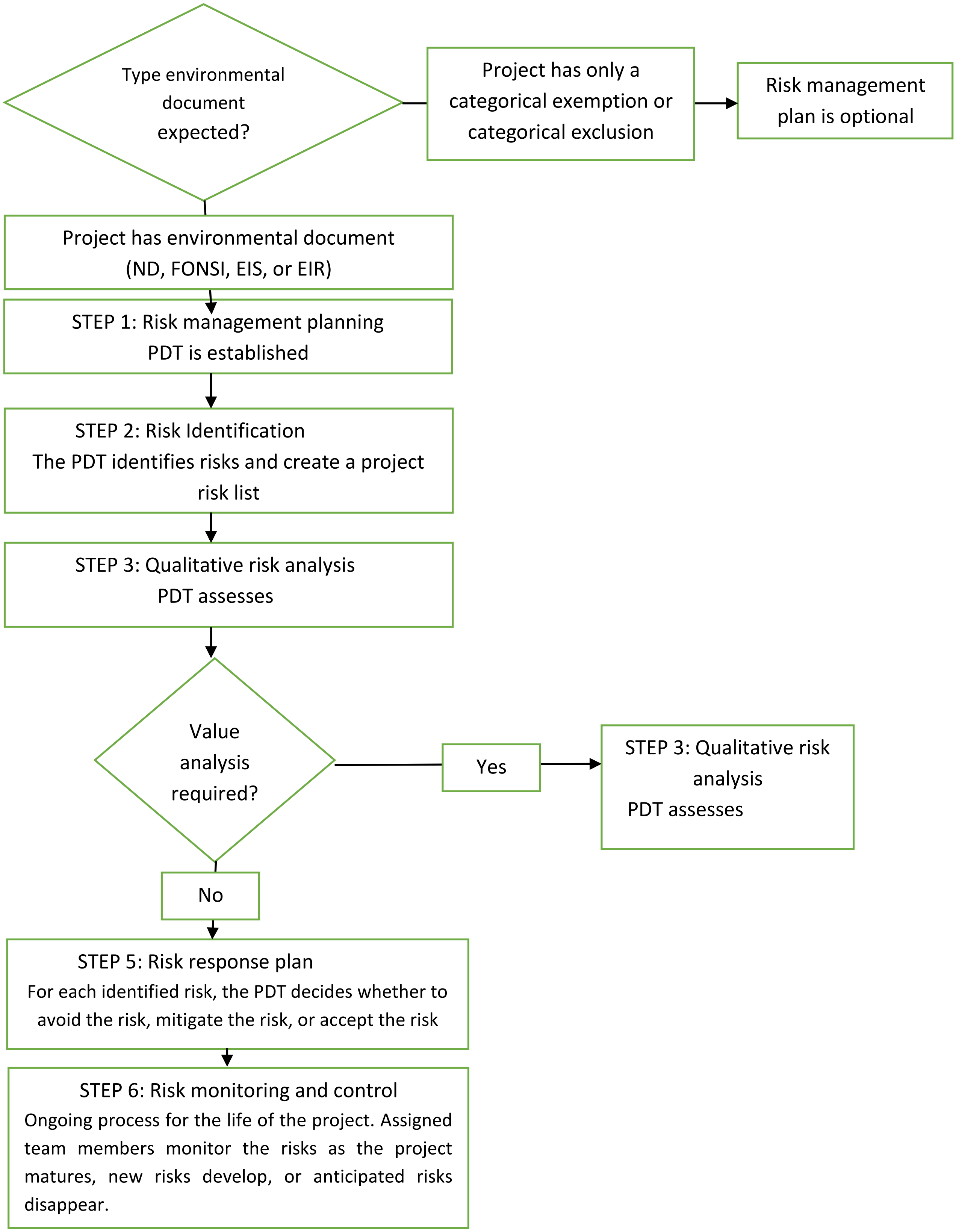


Figure 2.9: U.S. FHWA risk management process

The risk identification process begins with the team compiling the project's risk events. The identification process will vary, depending on the nature of the project and the risk management skills of the team members, but most identification processes begin with an examination of issues and concerns created by the project development team. These issues and concerns can be derived from an examination of the project description, work breakdown structure, cost estimate, design and construction schedule, procurement plan, or general risk checklists. Risks matrix is used for assessment of project risks.

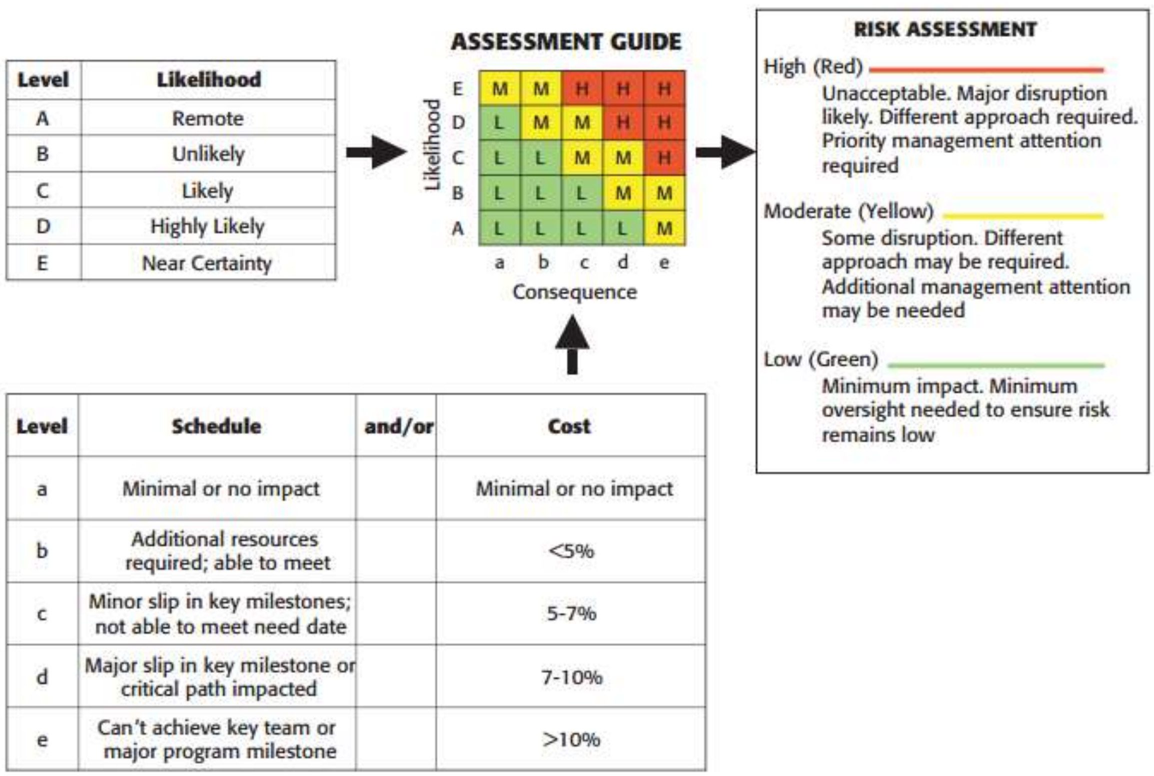


Figure 2.10: U.S. FHWA risk matrix assessment technique

Typically, a project's qualitative risk assessment intends to recognize some risks whose occurrence is so likely or whose consequences are so serious that further quantitative analysis is warranted. A key purpose of quantitative risk analysis is to combine the effects of the various identified and assessed risk events into an overall project risk estimate. This overall assessment of risks can be used by the transportation agency to make go/no-go decisions about a project. It can help agencies view projects from the contractor's perspective through a better understanding of the contractor's risks. More commonly, the overall risk assessment is used to determine cost and schedule contingency values and to quantify individual impacts of high-risk events. The objectives of risk mitigation and planning are to explore risk response strategies for the high- risk items identified in the qualitative and quantitative risk analysis. The process identifies and assigns parties to take responsibility for each risk response. The contract is the vehicle for risk allocation. Whether the contract is for construction, construction engineering and inspection, design, design-build, or some other aspect of highway construction management, it defines the roles and responsibilities for risks. Risk allocation in any contract affects cost, time, quality, and the potential for disputes, delays, and claims. The next step is risk monitoring and updating, and its aim is to; systematically track the identified risks, identify any new risks, effectively manage the contingency reserve, and capture lessons learned for future risk assessment and allocation efforts.

2.11.9 PRINCE2 Risk management framework

As defined by Cabinet Office (2012) (cited in Mohebbi, and Bislimi, 2012: 15), PRINCE2 stands for projects in Controlled Environments, which is a de facto standard adopted and utilized widely by the UK government and is extensively accepted and employed in the private sector globally. It is a non-proprietorial process-based method for project management and is recognized as the best practice in project management application in the public domain. At 1989 this methodology was primarily established by The Central Computer and Telecommunications Agency. It was initially intended to be applied as a UK Government standard for managing information technology projects however, after the release in 1996 as a generic project management model, it became globally recognized and accepted.

As it is stated in PRINCE2 (2002) (cited in Mohebbi, and Bislimi, 2012: 15), that the standard describes how to divide a project into smaller manageable parts in order to control the resources and work progress effectively. In this model risk management is defined in two parts and six steps as below:

- ***Risk analysis:*** risk identification, risk evaluation, risk response selection
- ***Risk management:*** planning and resource assignment, tracking and reporting

2.11.10 Dale F. Cooper et' al risk management framework

According to Dale et' al (2005:2-3), The scope of risk management for projects includes risks associated with the overall business approach and concept, the design and delivery of the project, transition into service, and the detailed operations and processing activities of the delivered asset or capability. In addition, he has developed a risk management framework. The framework has the following contents; establishing the context, identifying the risks, analyzing the risks, evaluating the risks and treating the risks along with communication and monitoring and reviewing.

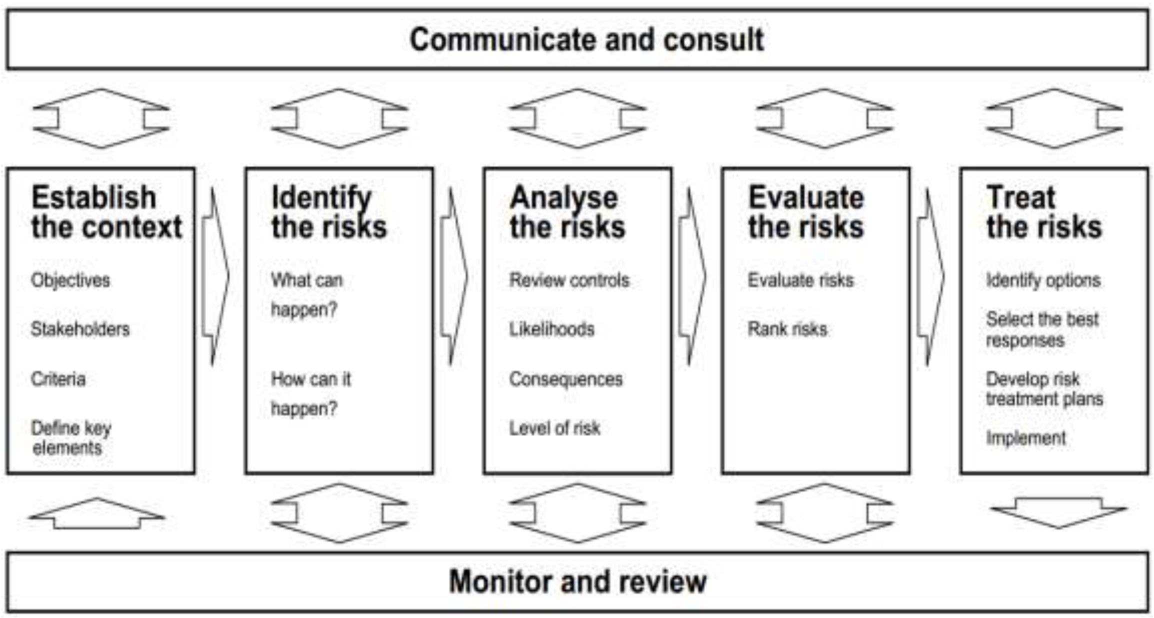


Figure 2.11: Dale et' al project risk management process (Dale et' al, 2005:2).

2.12 Selection and Development of Risk Management Framework

The management of risk is currently one of the main topics of interest for researchers and practitioners working in the field of project management. Different perceptions, attitudes, values regarding risk, needs, project sectors, specifications, geographical, social, economic, and political environments have led to a variety of definitions, concepts, terms, and approaches, all highlighting the need for systematically addressing uncertainty (Sabrina, Carlo, and Anna, 2012:67). According to Jackson and Flanagan (2002) (cited in Abdou, Lewis and Alzarooni, 2004: 143), Selecting an appropriate framework is the first step to planning for implementation of risk management processes.

An effective risk management regime is a combination of the culture, processes and structures that are directed towards realizing potential opportunities whilst managing adverse effects (Kevin, 2010:8). Based on a careful analysis of the characteristics of the techniques supporting risk management proposed in literature and applied in business practice, among the different criteria

- The phase of the risk management process;
- The phase of the life cycle of a project; and
- The corporate maturity towards risk.

are the three dimensions that encompass the most relevant aspects for understanding and choosing among project risk management techniques.

The management system adopted must ensure that all risks have owners who have accountability for their management and who also have the authority and resources to make decisions with respect to the treatment of the risk. Systems to monitor and review risks and the risk management process require careful selection, targeting and planning as they absorb scarce resources. Priority should be given to (Kevin, 2010:7-8):

- High exposure risks, that is, where the consequence of the event could be high;
- High current residual risks, where there is evidence of low control effectiveness;
- Activities where change could give rise to significant risk;
- Parts of the organization that are consciously exposed to high levels of risk;
- Technological advances that may offer more effective or lower cost alternatives to current risk treatment.

2.13 Summary and gap identification

It is learnt from the literature review that risks are inherent in the construction industry. It is due to adverse effect of change, numerous project stakeholders, influences of internal and external factors, complexity, and strategic nature in the industry. Nevertheless, the construction industry has had a very poor reputation for coping with these, with many projects failing to meet deadlines, and cost and quality targets. The research work will assess significance of various risk factors in Ethiopian road construction projects. Based on the literature review significance of risk factor is the product of its hazard and exposure. In order to decrease the impact of different risk factors on projects objectives we have to implement risk management and it is the systematic process of identifying, analyzing, and responding to project risks. The research work aims at studying the risk management practice of AACRA's and ERA's road construction projects. Project risks can be associated to designers/consultants, contractors, subcontractors, government bodies, and external bodies.

From the literature review it was found out that risks in the construction industry can be related to technical risks, logistical risks, management related risks, environmental risks, country risks, socio-political risks, and physical risks. These risks can be managed using formally and informal approaches. Informal approach is the most widely used mechanism. However they are less efficient than formal approaches. Formality help us to ask the right questions and answer them. There are risk management frameworks for managing various risks. Some of the risk management standards and frameworks for managing risks in the construction industry includes: PMI's, ISO's, Chapman and Ward's, COSO's, APM's, Australian and New Zealand's, U.S. Department of Transportation's, U.K.'s, and Dale F. Cooper et' al 's risk management standards and frameworks. The research work aims at developing a formal risk management framework for AACRA. In addition it will provide practical recommendations pointing toward upgrading the risk management practice in AACRA and ERA after identifying the gaps.

CHAPTER THREE

MATERIALS AND RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter discussed risk and uncertainties, risks in construction projects, type and source of risk, risk management process, risk and contract, role of insurances in managing risk, approach to risk management, and risk management frameworks.

This Chapter deals with materials and methodology of the research. In designing the research method; types of research, research strategy, research approach, data collection and analysis methods were considered. The research method and materials used will be discussed in this chapter.

3.2 Research Strategy

Research is a journey of discovery, whether anything is discovered or not (Fellows and Liu, 2008: 4). The Concise Oxford Dictionary 1995 (cited in Fellows and Liu, 2008: 4), provides a more extensive definition of research as “the systematic investigation into and study of materials, sources etc. to establish facts and reach new conclusions”. According to Naoum (2007: 37), research strategy is “the way in which the research objectives can be questioned”.

Based on the purpose of the study, type and availability of data the research is executed using quantitative and qualitative research strategies. Some of the data were collected in descriptive form while some were collected in numeric form to get necessary data. This research is qualitative research since, it explores the approach and culture of risk management in AACRA’s and Federal road projects, collect information and data such that theories will emerge to develop qualitative risk management framework, where quantitative approaches is used to provide ‘snapshots’ and address questions such as what, how much, how many? For Identifying the likelihood of key risk factors in AACRA projects that could stand in front of construction processes; investigating their impacts on project goals (i.e. cost, quality, and time); analyzing the significance identified risk factors; studying the allocation of each identified risk factors based on stakeholder’s perception; identifying key risk factors in Federal road projects. Accordingly, the research study will follow the sequences depicted in Figure 3.1 below:

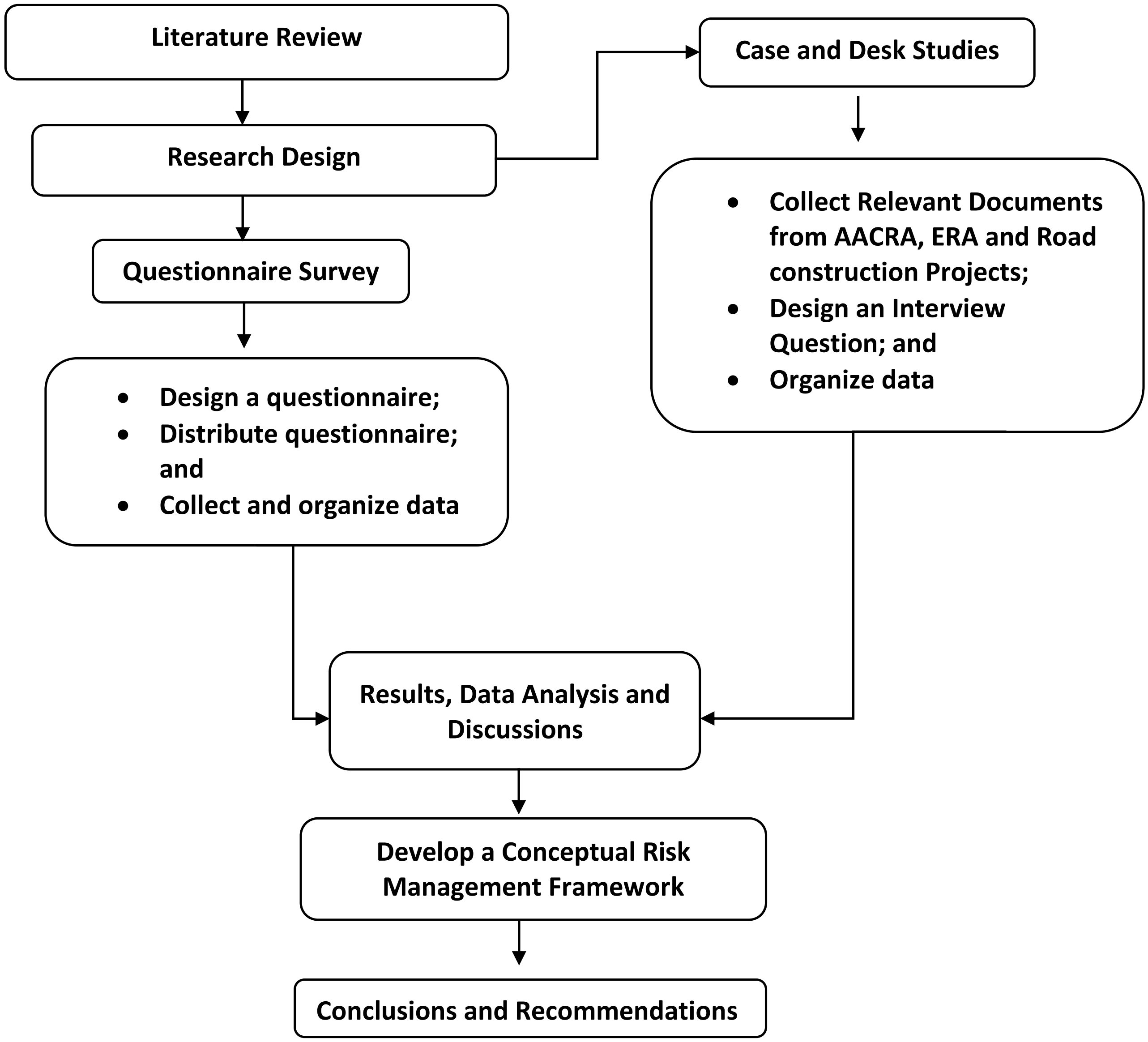


Figure 3.1: Research flow chart

3.3 Data Collection and Sampling

To achieve the research objectives, relevant data were collected. The data were collected from primary data source which was acquired through case studies and questionnaires; and secondary data sources; which includes desk studies, books, previous researches, publications, and journals. The desk study focused on Addis Ababa Roads Authority and Ethiopian Roads Authority in respect of the risk management culture and construction project's phases of these two public organizations. Ethiopian Roads Authority was studied because it is needed to see if there is a risk management practice that can be adopted to Addis Ababa City Roads Authority. Semi-structured interviews were conducted with various officials to support the desk study. The case study included ongoing, provisionally accepted, and terminated AACRA and Federal road projects. It assessed the risk management practice through their project life cycle. The case study reveals different risk factors that are currently challenging the road construction sector. It also studied allocations and mitigation measures used. Two ongoing AACRA's projects were selected as a case and studied. For ERA a design build (DB) and design bid build (DBB) project were selected and studied. In addition, a project at the feasibility study was considered. The case study gave insights of significant risks, their impacts and its management practice in the projects.

A questionnaire survey was conducted on AACRA's projects, involving the client, consultant, and contractor. The population of the study for the questionnaire survey were AACRA's currently ongoing, provisionally accepted, and terminated which were thirty-two (32) road construction projects (as of Feb 30, 2017). The projects commencement period ranges from 2012 to 2017.

Sampling was necessary because it is rarely possible to examine the entire population. One of the main issue in sampling is determination of the size of the sample. The sample should predict the behavior of the population as accurately as possible and they should be; consistent, unbiased, efficient and sufficient (Fellows and Liu, 2008: 163). First the projects were clustered as Indigenous and International projects. In this scenario, local companies are fully engaged with Indigenous projects while in the case of International projects, both local and foreign companies have taken part. Out of the total thirty-two projects, seven (7) were international projects and the remaining twenty-five (25) were indigenous projects. All the local contractors and consultants that took part in the projects were grade ones. The required sample size for the research was statistically determined using the following expression (Kish, 1995 cited in Ayalew, 2009: 55):

$n = n0 / [1+ (n0 / N)]$ …………………………………………….. *[Equation 3.1]; and*

$n_0 = (p*q)/ V^2$ ……………………………………………........... *[Equation 3.2]*

Where:

n_0: First estimate of sample size;

p: The proportion of the characteristic being measured in the target population;

q: Complement of p or 1-p;

V: The maximum standard error allowed;

N: The population size; and

n: The sample size

p was set at 0.5. The population size was 32 ongoing, provisionally accepted, and terminated projects in AACRA. The maximum standard error V was set at 10% or 0.1. Then, the sample size for the survey became 15. Accordingly, 15 questionnaires were distributed to consultants and contractors proportional to their project cluster. In addition, all the eleven staff of AACRA's contract administration team are also surveyed.

3.4 Data Analysis Methodology

Data Analysis is directly related to the type of data available. In this research both descriptive and inferential statistics were used for analysis of the data. Excel software was used for the data analysis. Before executing the data analysis, the data's obtained were checked for reliability using Cronbach's Alpha coefficient. Reliability is concerned with the ability of an instrument to measure consistently whether the test designer was correct in expecting a certain collection of items to yield interpretable statements about individual differences. Whereas, internal consistency is the extent to which all questions contribute positively towards measuring the same concept or construct and hence it is connected to the inter-relatedness of the items within the test. Internal consistency is the proportion of the test variance that can be attributed to a group of items, which measures the reliability coefficient alpha. (Cronbach, 1951: 297). Cronbach's alpha reliability coefficient normally ranges between 0 and 1. However, there is actually no lower limit to the coefficient. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale (Gliem, 2003: 84). It is calculated as follows;

$$\alpha = \frac{I}{I-1}\left(1 - \frac{\sum_{i=1}^{I}\sigma_i^2}{\sigma_X^2}\right) \quad \text{……………………………………………………..} \; \textit{[Equation 3.3]}$$

where

n = 1, 2 . . . I; are the number of items in the scale,

σ_i^2: variance of item I; and

σ_x^2: variance of the observed total test scores.

Mean score (MS), Cumulative mean score (CMS), Ranking, and Pearson's correlation were used for analysis of data's. The mean score (MS) of each potential risk factors were computed for analyzing their exposure and impacts using the following expression.

$$MS = \frac{\sum(f x S)}{N} \quad \text{……………………………………………………………} \textit{[Equation 3.4]}$$

Where:

MS = Mean score

f = frequency of response for each score

S= score given to each factor (0 to 5)

N= Total number of responses for each factor

After the analysis of mean score (MS), the most significance risk factors in the projects were identified by computing their cumulative mean scores. Which implies as follows:

Risk = Likelihood x Impact …………………………………………… *[Equation 3.5]*

Amongst the measures of relationship, Karl Pearson's coefficient of correlation is the frequently used measure in case of statistics of variables (Kothari, 2004: 131). Pearson's correlation coefficient is used for a statistical measure of the strength of a linear relationship between paired data as depicted below:

$$r = \frac{\Sigma(X_i - \overline{X})(Y_i - \overline{Y})}{n \cdot \sigma_X \cdot \sigma_Y} \quad \text{………………………………………..................} \textit{[Equation 3.6]}$$

where

X_i = ith value of X variable;

X = mean of X;

Y_i = ith value of Y variable;

Y = Mean of Y;

n = number of pairs of observations of X and Y;

σ_X = Standard deviation of X; and

σ_Y = Standard deviation of Y.

The results can be interpreted as follows;

- Positive values denote positive linear correlation;
- Negative values denote negative linear correlation;
- A value of 0 denotes no linear correlation; and
- The closer the value is to 1 or –1, the stronger the linear correlation.

After the acquired data were analyzed, based on the findings, conclusions were formulated, and practical recommendations were forwarded.

CHAPTER FOUR

DESK AND CASE STUDIES

4.1 Introduction

Desk and case studies were conducted to assess the culture of risk management in the road construction sector. In addition, along the studies, major risks are identified and their allocation and response mechanisms by the parties were studied and severity of cost overruns and delays in the work and service contracts were also identified. Semi structured interviews were conducted with the AACRA and ERA officials to support the desk studies. The case study includes projects at feasibility study and construction phases to assess the risk management practice at the two cycles. Since AACRA is not conducting feasibility studies, the selected case studies were at their construction phase. One design build (DB) and One design bid build (DBB) projects in ERA were studied. In addition, One ERA project in respect of feasibility study was investigated. Various reports, contract documents, feasibility studies, claims, letters, and other relevant documents were assessed during the study.

4.2 Desk Study in AACRA

4.2.1 General

The Addis Ababa City Roads Authority was organized to construct, maintain and administer the road works within the Addis Ababa City Administration. AACRA's mandate includes: the task of constructing asphalt roads, gravel access roads, cobble stone pavement roads, drainages, bridges and concrete roads for enhancing regular activities. The Authority has a vision to construct reliable, standardized and quality roads in Addis Ababa City. Besides to expand the road transport coverage of the city, it strives to attain by 2020 the road network to get interchangeable traffic flow of 25% for the communities of the City. Even if, with the help of established regulation and exclusive powers vested upon it, the Authority has been constructing roads, as per the master plan for the past nine years of its establishment but the projects have encountered several challenges like: quality problems, delays, and cost overruns. Organizational and project management principles are the best way to solve such cases.

Recently, new strategies and techniques were developed to tackle various challenges and achieve the Authorities' objectives. However, Risk Management principles are not included in the new organizational change and development. Among the new advances, the modified organizational structure is believed to solve some of the challenges in the City's public road sector. The new organizational structure of AACRA has some very similar features with ERA’s current organizational structure. The major difference is that there is an operational department in AACRA’s organizational structure. As per the authority's establishment regulation, it has: Executive Board, General Manager and necessary officials and workers. As shown in Figure 4.1 below, there is no separate risk management department in the Authority. However, they are trying to solve various challenges and risks in their projects and organizations through traditional and informal ways.

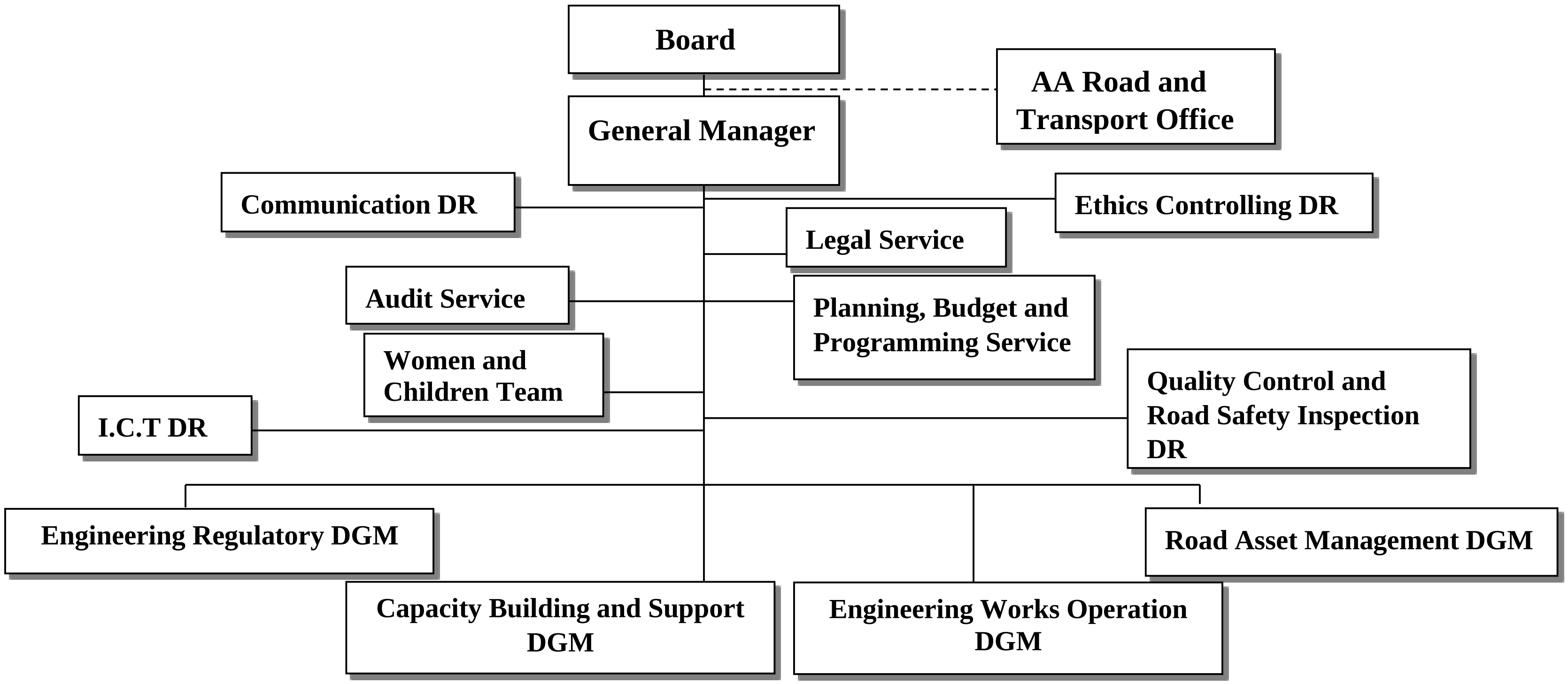


Figure 4.1: Addis Ababa City Roads Authority's organizational structure

Interviews were conducted with five officials at different departments of AACRA which includes; Procurement Department; Road Construction Maintenance, Designs, Implementation and Revisions Department; and Contract Administration department. The first enquiry of the interview was if they had an awareness about risk management and accordingly the representatives of these departments said that they have good awareness of risk management techniques. As discussed in the literature review, a formal risk management should be applied at organizational and project level for tackling different risks and achieve organizational missions and project objectives. However, from the interviews undertaken it was revealed that AACRA is not implementing a Formal Risk Management Framework or else guideline neither at department nor at organizational and project level, where risk will be identified, quantified, evaluated, and monitored. The interviewees confirmed they use qualitative techniques of project history, personal experience, meetings, physical inspections and expert's opinion for informally identifying different risk of the road projects.

Based on the discussion with Road Construction Maintenance, Designs, Implementations, and Revision Directorate, at the initial stage, AACRA identifies projects considering socio-political influence, traffic flow, master plan and public demands. However, the identified projects do not pass through feasibility study. Feasibility studies are done only when it was mandatory by financers. The reason behind this is that, all road construction projects in Addis Ababa are considered to be feasible. These shows that there is a gap in project life cycle of the road projects and, there is uncertainty in project's viabilities. The practice involves partially political decisions. In feasibility study of a project economic cycle risks can be considered and given solution. In the current practice the first step is demand and master plan analysis. This step involves identifying demand of road infrastructure of the population. Along demand analysis the master plan of Addis Ababa will be reviewed by AACRA. Then the next step involves project identification considering demand and master plan analysis and other factors like traffic flow and socio-political influence. Then the identified projects will be prepared in to a development plan. The development plan may have different phases and it may range from one year to five years plan. Consequently, process for designing, construction, and turnover and maintenance will follow. The overall road construction project phases can be summarized as follows:

- Demand and Master Plan Analysis;
- Project Identification;
- Development Plan;

- Design Service Procurement;
- Project Appraisal;
- Project Design;
- Construction Supervision Service Procurement;
- Works Procurement;
- Road Project Implementation Startup;
- Road Project Mobilization;
- Road Project Execution;
- Provisional acceptance;
- Final acceptance; and
- Asset Management.

The practice related to environmental impact assessment and resettlement action plan is very weak in feasibility, and planning phase. This shows risks of the project that can be identified and can be given solution at these stages are ignored. This risks may include right of way obstacles and damage to the surrounding environment. However, it is said that there is a plan to enforce feasibility study, resettlement action plan, and environmental impact analysis for all future projects by inviting consultants and preparing term of references.

Starting from the design and planning stage, all the departments comment on the risks that are sensitive for them and they will try to incorporate in the process informally. As we observed in the city roads, lack of coordination among road, railway, power, telephone, water developing and operating institutions have been responsible for most of the inefficiency & wastage of resources and public dissatisfaction. However, AACRA has not yet developed an action plan to identify and solve those risks during planning. Regarding design, except AACRA's own force construction projects, consultants are responsible for scheduling and designing of the projects. Based on projects history, a new reviewing check list has been recently prepared by AACRA to identify and monitor factors that may incur design changes by consultants.

Risks are allocated to parties based on the conditions in the contract document as it has been stated that parties should carry the remedial responsibilities which they are entitled to. AACRA has no additional policy or guideline how to allocate risks to the parties. For example, designs are done by consultants but evaluated and given approval by the Authority; however, the risk related to the design is allocated to the concerned consultant, even if the AACRA have approved it. This is mainly because of lack of experience by AACRA's staff members. Contractors are also responsible for construction errors that are caused due to poor design. The contractors are supposed to evaluate and comment on the workability and design prior to construction.

Risk avoidance mechanisms are merely applicable by the authority. This mechanism is only applicable, when they avoid executing construction by own force because of complexity and volume of work. The risk response strategy used in AACRA is regularly risk transfer. Design-related risks are transferred to the consultants and construction-related risks are transferred to the contractor and has been confirmed by the questionnaire respondents. Some of the risk factors like right-of-way problems, and scope changes impacts are accepted by the client.

MoWUD, 1994 condition of contract is used for developing contract documents. But currently, AACRA is planning to use the FIDIC condition of contract for all the projects to be undertaken. The signed work contracts enclose a clause for managing risks in the general condition of the contract documents. As per MoWUD (1994: 11), Clause 20 (1), from commencement of the Works until the date stated in the certificate of completion for the whole of the works, the contractor shall take full responsibilities of the work. Further, it is provided that the contractor should take full responsibility for the care of any outstanding work, which he shall have undertaken to finish during the period of maintenance until such outstanding work is completed. MoWUD (1994: 11) states that except "excepted risks", the contractor shall be responsible for the care thereof the work. The "excepted risks" includes: war, hostilities (whether war be declared or not), invasion, act of foreign enemies, rebellion, revolution, insurrection or military or usurped power, and civil war.

During the tendering process, the consultants fix the schedule of the project and based on that the contractor submit preliminary schedule on the given time bound for each activity. After the selection of the contractor, the contractor will be asked to prepare detail schedule and based on that, the consultant follows his progress and if there is delay the consultant would comment following the activity durations. The contract type for all the works is measurement. The practice related to quantity surveying is that the consultant and contractor representatives will go out to the site and take measurement jointly and payment will be made accordingly.

The type of delivery systems used in AACRA is mostly traditional or design bid build DBB, and Own force contracting delivery system. Design build (DB) delivery system was used in the past due to urgency and complexity of one specific project. AACRA will decide to execute road projects with own force when the project is expected to take substantial period of time because of complicated right of way problem, when the volume of the work is small (scope of the project), and if the contractor is terminated and the scope work left is not suitable to give to another contractor. According to the Procurement Directorate, the decision for choosing between national and international competitive bidding of projects is based on the scope of the work, and budget of the projects, financer, complexity, and local capacity of contractors.

At the construction stage, a formal site supervision of the project whether it complies with right quality, with the given budget and expected time is supervised by the consultant as well the counterpart engineer from the authority. However, the consultant’s representatives are reluctant or ignorant to dedicate their full time and follow the project. During commissioning, the representatives from the design, contract administration and the road asset directorates of AACRA and representatives from consultants and contractors will be assigned by the parties and they take snag list and minutes of what is left will be taken and jointly signed by them. Then the contractor is expected to furnish and rectify the identified defects during the defect liability period. Finally, all the interviewees said that almost all road construction projects failed to meet their project objectives and encountered delays, cost overruns and quality failures and the main reasons behind these include unexpected city development, failure of forecasting traffic flow, scope and design changes, variations and right of way problems which is generally lack of proper planning and feasibility study.

4.2.2 Current Road Construction Projects

AACRA is undertaking road projects across the city by both own force construction and out sourcing to contractors and consultants. However, as discussed in the methodology, the desk study focused on out sourced projects since these projects incur considerable cost and risk because mostly they have bigger budget. Various documents were reviewed, and the projects status are summarized in Table 4.1 below. The Table presents cost overrun of contract works and consultancy service contracts; and delays in physical progress of the projects. The project costs were factored with similar ratios for confidentiality purpose.

Table 4.1 Current AACRA's projects work status

Project Name	Works Contract			
	Original Contract Amount (Birr)	Revised Contract Amount (Birr)	Cost Overrun (%)	Variation of time after EoT (%)
Project A	37,463,815	-	0.0%	500.0%
Project B	74,991,466	49,290,599	-34.3%	129.2%
Project C	26,869,724	34,808,250	29.5%	237.5%
Project D	19,899,093	19,899,093	0.0%	66.7%
Project E	19,247,055	24,019,269	24.8%	127.8%
Project F	35,871,817	39,564,780	10.3%	133.3%
Project G	9,917,453	30,683,616	209.4%	461.1%
Project H	21,255,353	24,125,036	13.5%	416.7%
Project I	264,754,976	258,231,149	-2.5%	466.7%
Project J	16,681,386	16,681,386	0.0%	500.0%
Project K	34,243,556	34,243,556	0.0%	36.4%
Project L	77,784,586	110,008,436	41.4%	16.7%
Project M	37,297,602	46,213,556	23.9%	191.7%
Project N	8,743,633	9,188,677	5.1%	391.7%
Project O	23,055,122	23,055,122	0.0%	100.0%
Project P	26,311,638	26,529,430	0.8%	257.1%
Project Q	66,068,675	66,068,675	0.0%	184.6%
Project R	26,436,142	24,654,805	-6.7%	357.1%
Project S	37,405,873	41,547,761	11.1%	0.0%
Project T	14,986,058	15,599,622	4.1%	100.0%
Project U	37,843,354	38,515,032	1.8%	475.0%
Project V	103,032,797	103,032,797	0.0%	21.1%
Project W	34,143,602	35,306,725	3.4%	75.0%
Project X	288,000,000	288,000,000	0.0%	200.0%
Project Y	48,000,000	56,000,000	16.7%	0.0%
Project Z	28,797,357	28,797,357	0.0%	0.0%
Project AA	15,507,447	19,069,025	23.0%	0.0%
Project BB	19,069,025	19,069,025	0.0%	42.1%
Project CC	52,146,512	52,146,512	0.0%	0.0%
Project DD	20,113,430	20,113,430	0.0%	100.0%
Project EE	39,384,953	39,384,953	0.0%	33.3%
Project FF	25,993,301	25,993,301	0.0%	0.0%
Average	**49,728,650**	**52,252,934.68**	**5.1%**	**175.6%**

Source: Adopted from AACRA's Contract Administration Directorate February 2017 GC Report.

As shown in the table above, out of the thirty-two (32) projects, eighteen (18) of the work contracts have shown variation of cost and out of these fifteen (15) of them were cost overrun and the rest shows a negative variation because of omission of works. From the table we can see that some of the projects have not experienced cost overrun even if they incur considerable variation of time. This doesn't imply that time have no value in the cost of the project instead the projects may have high cost overruns but it shows that the contract amounts are not revised due to substantial procedures. In addition to the cost overruns, there is a loss of value because of the extension of their service. Except six (6) undergoing projects, all the undergoing and provisionally accepted projects show variations from the original contract in project's duration. Based on referred documents, the most significant delays occurred in a small volume works and projects who have a very tight schedule. The average delay after extension of time was 175.6% and the highest delay was recorded as 500%. This implies that the projects are not meeting their objectives in terms of cost and time. As discussed in the literature review, the reason behind this can be technical, logistical, management, environment, financial, socio-political, contractual, and physical or other risks. Therefore, it can be concluded that the risk factors are not well managed by the client and are not satisfying public interest. Some huge figures were recorded in the cost overrun of the consultancy service contracts in the road construction projects. The highest cost overrun was varied from the original contract with 285 %. The main reason behind cost overrun of the consultancy service contracts was physical delays of the projects. Cost overrun of the service contract projects is presented in Figure 4.2 below.

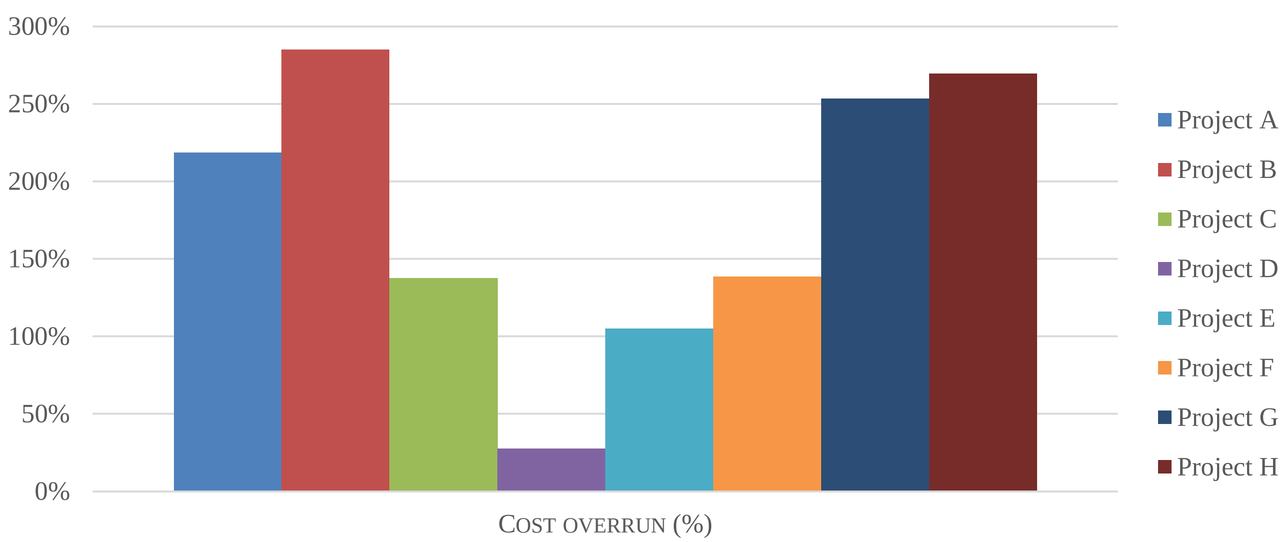


Figure 4.2 Current AACRA's service contracts cost overruns

4.3 Case Studies in AACRA

4.3.1 Project I

The first selected case study was ongoing road project at its construction phase. The project scope includes: construction of asphalt concrete dual carriage way, sidewalks, medians, drainage structures, major structures, interchanges and intersections, bus bay stops, road markings and road signs, street lighting facilities, and plantation. The project is financed 50% by the Ethiopian Government and the rest through foreign loan. The estimated completion date for the project is 1,029 calendar days (after commencement date). The delivery system of the project is Design Bid Build (DBB). Based on the desk survey, AACRA has only allocated budgets to consultants and contractors only for engineering design, preparation of tender document, construction, and contract administration and supervision activities. This shows that the feasibility study is not considered in the budget.

The consultant made the design. Initially, the contractor had submitted the master work program and methodology. Accordingly, the engineer reviews and checks the master work program and method at this period, there were corrections and amendments that should be made before final approval. In the work schedule, the contractor has been instructed to incorporate the engineer’s comments like the need of protective measures for every construction works, a need to be fulfilled with respect to safety of humans, and any adjacent infrastructures. The contractor was also instructed to include the construction safety laws and regulations of Ethiopia in his safety section. Moreover, the consultant has instructed the contractor that the physical and/or financial work schedule that has been given shall show the critical path of the project clearly in order to monitor the project. In order to follow up the economic cycle, the contractor is instructed to submit separate cash flow program. At this stage, the executed major works of the contractor include:

- Establishment of the contractor’s and consultant’s office;
- Joint surveying works;
- Working drawing submission;
- Earth works;
- Structural works (box culverts constructions, retaining walls construction, side drainage installations, manhole constructions);
- Construction material sampling and quality tests; and
- Identification of quarries.

The main challenge of the project was right of way obstacles. Physical obstructions, houses, fences and urban utilities (electric poles and water lines), trees and others, along the road and within the construction limit of the road, which have been approved by the master plan office, have been reported by the consultant to AACRA. In addition, geo-technical investigations have continued at this stage.

During the time, the contractor has already forecasted the major risk factors that can be solved by the consultant and AACRA informed them successively. Right of way obstacles were identified and several site and office discussions have been made with representatives of utility offices, such as Addis Ababa Water and Sewerage Authority (AAWSA), Ethio-telecom, Ethiopian Electric Power Corporation (EEPCo) and sub-cities. In addition, a technical committee was formed to have continuous site/office discussion during project progresses.

AACRA and the contractor reviewed the designs to mitigate risk that may rise from design errors. Similarly, Construction materials were sampled, and quality tests were done, and quarries/material sources/ were identified and reported to AACRA to solve risks that can happen from uncertainty over the quality and availability of materials. Even if the parties try to solve different challenges at the project traditionally, the project currently, has not achieved its objectives and incur delay. As shown in the table below, the accomplishment of the physical progress is only 49.92% of the work program and in terms of cost only 4.91% of the 10.17% of the financial plan was executed.

Table 4.2: Project I status

Description	**To date Status**
Planned Amount to date, ETB	187,638,881.53 ETB
Accomplished amount to date, ETB	90,609,232.91 ETB
Time elapsed to date (%)	12.79%
Work planned to date, Financially (%)	10.17%
Actual work executed to-date, Financially (%)	4.91%
Actual work planned to-date, Physically (%)	11.94%
Actual work executed to-date, physically (%)	5.96%
Accomplishment against work program, physically (%)	49.92%

Even though there are lots of right of way obstructions within the project, their clearances have not been commenced. Currently, the project needs clearance of pended obstructions which are mainly within the approved road sections. This cause delay of the project behind schedule. Accordingly, right-of-way obstruction has been identified as the major reason for delay of the project.

Insurances and Banks play a predominant role in the construction industry. As per the contract agreement, the contractor has submitted performance bond and advance payment guarantee. Accordingly, the guarantor undertook the payment to the beneficiary. As per the client's order moreover, the contractor has submitted amendments to performance guarantee from the bank saying that the guarantee is "Unconditional and Irrevocable" through his letter instead of "…hereby irrevocably undertakes to pay…" In unconditional performance guarantee will be given to any client so that the company pledged that something will be of specified quality, content, or that it will provide satisfaction or will perform or produce in a specified manner. Whereas, when only irrevocable is stated it means only the guarantee cannot be canceled or they are unalterable. Therefore both unconditional and irrevocable should be stated in the performance guarantee.

During this period, there were no claims and price escalations in the project. Construction materials like Bitumen Grade 85/100, spare parts, and furniture requested for importation by the contractor with letter. The purchase and importation process will take very long time due to risk factors of "lack of foreign currency" and "extensive procedures", and will delay the project if they are not imported on time. Therefore, the client has started process by coordinating and arranging necessary things to solve the "logistical risks".

The possessions of quarries for materials source and waste/spoil area have not been made. Even if the project is huge and needs bulk sources of construction materials, till now the contractor has not possessed the required materials for execution of project works. The contractor has only possessed about 20% of the road project which is free from any obstruction, due to lack of waste/spoil area. The contractor is unable to continue excavation works on small sections let alone the large number of free sections. Regarding design, even if the project has a total length of 10.5 km, till now final designs have completed for about 4.2 km. This implies that "delays in design" is one of the risk factor affecting the project.

4.3.2 Project II

The Addis Ababa City Roads Authority has outsourced a river bridge construction project with its approach road to replace the existing old bridge which is damaged seriously. Subsequently for the implementation of the project, AACRA has entered into an agreement with a consultant and a contractor. The consultancy service includes: detailed engineering design of the structures, geometrical design and modification wherever necessary, tender document preparation, construction supervision and contract administration services. Accordingly, condition survey and detailed ground topographic survey have been conducted to establish the crossing location with respect to foundation material, type of structures to be selected on basis of which detail design of the bridge has been prepared and approach roads designed. The climate condition of the specific area was studied by the consultant to forecast future climate of the site and schedule activities.

The work was selected to be executed with traditional delivery system and unit rate type of contract. The original completion time was 365 calendar days. However, the contractor gets additional 365 calendar days because he has claimed on right-of-way obstructions which includes EEPCo high power line and telephone cable along the existing bridge; and for delay and changes in the design. The contractor has also claimed for unexpected heavy rain fall, and flood at the construction area which cause subsequent effect on the site. In addition, there was a cost variation in the project due to change of scope, and change of design i.e. change of foundation type from spread footing to pile foundation. Therefore, supplementary agreements were made with contractor and consultant and the contract amount was revised.

In accordance with the general condition of the contract, the contractor has submitted performance bond, and advance payment guarantee. The bond and guarantee help AACRA to avoid risks related to poor performance of the contractor and to get guarantee of his paid advance payment to the contractor. To rectify some defects after provisional acceptance of the project, a retention was made and will be made from each payment.

Based on the agreement, the engineer (consultant) is required to monitor project risks. Accordingly, the consultant tries to ensure the work constructed in accordance with the general and particular conditions of contract, the technical specifications and engineering drawings and / or any amendments there to, optimize the use of available material resources to minimize costs to the employer or to maximize the quality of the works or expedite construction, and ensure that the works are completed within the contract price and stipulated time for completion as allowed under the contract. In addition, site visits were conducted by the intermittent staff or higher officials at director level and contract engineers of AACRA to monitor the project status and activities. To date, financial accomplishment of the project is 41.8%. This figure implies 41.8 % amounting work is executed compared with the planned amount of work by the contractor. Based on the contract 24.5% amounting work is executed to date. Similarly, only 53.9 % of the planned physical work was executed based on workload weighting of the consultant. The actual physical work based on their weight becomes 22.5 % of the overall work. The project financial and physical status is presented in Table 4.3 below.

Table 4.3: Project II status

Description	**To date Status [%]**
Planned Amount out of revised contract amount, Financially	58.7
Executed Amount out of revised contract amount, Financially	24.5
Accomplishment (Executed/Planned), Financially	41.8
Planned Physical Work	53.9
Actual Physical Work	22.5
Accomplishment (Actual/Planned), Physically	41.7

4.4 Desk Study on ERA

4.4.1 General

ERA was established to provide safe, comfortable and adequate federal road infrastructure to support the socio-economic development of the nation and satisfy road users. In addition, for improving transportation operating efficiency; reducing road transport costs; providing access to rural, neglected and food-deficit areas; and developing institutional capacity of the sector through; improving the condition of roads, expanding the road network, and preserving road assets. The organization is administered by board of directors from different sectors of government offices. At the organizational structure, under the General Manager, there are five supportive directorates and four deputy director generals namely planning and ICT, engineering operations, road asset management, human resources and finances. It is observed that there is no separate department or office responsible for managing risks at its organizational structure.

Interviews were made with different directorates in ERA to identify risk management practice and study project's life cycle. Planning and program management directorate, engineering procurement directorate, quality assurance, inspection and road safety directorate, design and build directorate, and regional contract management directorate did participate in the interview. All the interviewees in ERA said that they have awareness of risk management techniques. It was found out that currently, ERA is giving the task of risk assessment for the consultants. However, there is no formal guideline for them. In general ERA's projects has a conceptual phase, development phase, execution phase, and closing and maintenance phase. The following process are common in design-bid-build ERA projects.

Conceptual phase

- Demand Analysis;
- Project Identification;
- Value Management;

Development Phase

- Program Development;
- Formulate project Implementation Strategy;
- Annual Development Plan;
- Project Development Annual Operational Plan;
- General and Special Pre-qualification and Expression of Interest Assessments;
- Project Appraisal Scoping/Design Service Procurement;
- Project Appraisal;
- Revise Project Implementation Strategy;

Execution phase

- Scoping/Project Design;
- Construction Supervision Service Procurement;
- Works Procurement;
- Road Project Implementation Startup;
- Road Project Mobilization;
- Road Project Execution;

Closing and Maintenance phase

- Provisional acceptance;
- Final acceptance; and
- Asset Management.

During the interview, it was found out that clear criterions are used by the Planning and Programming Directorate for preliminary selection of projects. These criteria were socio-political factors, traffic level of the proposed road; network connectivity; road condition; and investment potential. Then at the project appraisal phase, the feasibility of the project is studied. In other words, economic life cycle risks will be considered and given solutions at this stage. It was during the feasibility stage that final project selection was made based on economic viability. All new construction and upgrading projects used a conventional producer surplus or HDM project level model approach to compare the total costs with the total benefits of the project discounted at 10% opportunity cost of capital. Total project costs included the construction and the maintenance cost of the road during the service period of the road. Benefits considered vehicle operating cost and travel time savings. Each project was assessed on its Economic Internal Rate of Return (EIRR) and Net Present Value (NPV). The Roads Economic Decision Model (RED), developed by the World Bank, was used to improve the decision-making process for the development and maintenance of low-volume regional roads. The model performs an economic evaluation of road investment options using the consumer surplus approach and was customized to the characteristics and needs of low-volume roads. Additionally, environmental impact assessment (EIA) will be considered at this stage. To incorporate environmental considerations properly and associated costs are considered for effective implementation of environmental and social mitigation measures.

Different delivery systems have been used by ERA over the years. The most common one is Design-Bid-Build (DBB) delivery system. Currently ERA is using Design-Build (DB), BoT (Build-Operate-Transfer), and Performance based delivery system for wide range of projects to avoid fragmentations and execute the projects within brief period; solve financial issues, transfer maintenance of the project to the contractor respectively. In the past, ERA have undertaken different projects by own force construction. But now the own force construction department is separated from ERA and it is established under Ethiopian Construction Corporations. This is a better strategy for defining firms mission and attain operational efficiency. As per the respondents, ERA is following Public Procurements Agency Guidelines for procuring services and work contracts.

Currently, the Federal Integrated Infrastructure Development Coordinating Agency is working in collaboration with ERA at the initiation of the projects to solve Right-of-way problems during execution of the projects. According to the new coordination arrangement, each institution incorporates right-of-way clearance plan of all the other institutions in its annual physical action plan and implement it within the planned period of the other concerned institution. Accordingly, EPCo, ethio-telecom, and railway corporation will incorporate ERA's right-of-way clearance plan, in their respective action plan and implement the same as planned by ERA. ERA also incorporate Row clearance plan of EPCo, ethio-telecom, and railway corporation in its annual plan and will implement the same as planned by the other respective institutions. The integration would address delay in right-of-way clearance due to lack of timely cooperation by EPCo, ethio-telecom, and water authorities in clearing right-of-way.

As per the contract document, risks related to right-of-way problem, change of scope, inflation of construction materials, unpredicted weather conditions, and force majeure are allocated to the Client. Risk related to incomplete design, and quality problem, logistical risks, management related risks, insufficiency of contractors, and unacceptable delays are allocated to contractors and consultants.

At the construction stage regional directorates, design build directorate, and express way directorate are responsible for managing and supervising the projects. In addition, consultants are delegated to closely follow the technical and contractual matters of the projects. During commissioning, representatives will be assigned by the parties and the project will be provisionally accepted after they take snag list and minutes. All the interviewees said that almost all road construction projects failed to meet their project objectives and encountered delays, cost overruns and quality failures and the main reasons behind these include right of way obstacles; design and changes; and variations.

4.4.2 Current Eastern Region Road Construction Projects in ERA

The Eastern Regional District was randomly selected among five districts and two special departments i.e. DB and express way departments of ERA. The projects are used analyze the performance of the projects in terms their time and cost. Nineteen projects incorporating: currently ongoing, substantially completed and provisionally accepted, completed but not provisionally accepted, and lastly terminated were reviewed. Table 4.4 below summarize the performance of the projects and show the cost overruns and delays. Eleven projects out of nineteen encountered cost overruns. The average cost overrun becomes 27.04%. Among the projects four of them show reduction in their contract amount this was because of omission in some work items quantity. Among the studied projects, thirteen had elapsed the contract time. The average extension of time from the projects was examined to be 70.48%.

Table 4.4: ERA's Eastern Region road construction projects status

Project Name	**Contract Amount (ETB)**		**Cost Overrun (%)**	**Time Variation from Contract after EoT (%)**
	Original	**Revised**		
Project A	470,318,862	809,260,778	72.07%	172.41%
Project B	352,282,430	939,368,144	166.65%	173.79%
Project C	436,743,984	576,006,003	31.89%	142.86%
Project D	496,999,194	555,781,895	11.83%	78.05%
Project E	796,497,965	1,036,323,243	30.11%	119.44%
Project F	856,551,105	745,195,626	-13.00%	125.00%
Project G	855,922,949	736,816,160	-13.92%	100.00%
Project H	198,744,278	246,744,278	24.15%	195.65%
Project I	409,056,931	670,205,291	63.84%	70.37%
Project J	540,005,276	661,806,676	22.56%	60.00%
Project K	304,996,552	278,859,974	-8.57%	33.33%
Project L	97,456,295	129,962,125	33.35%	30.77%
Project M	1,160,038,698	969,603,168	-16.42%	37.50%
Project N	2,382,360,661	2,393,505,111	0.47%	0.00%
Project O	1,928,499,999	1,941,204,053	0.66%	0.00%
Project P	1,518,154,029	-	0.00%	0.00%
Project Q	1,459,136,383	-	0.00%	0.00%
Project R	1,877,437,896	-	0.00%	0.00%
Project S	3,995,496,033	-	0.00%	0.00%

Source: Adopted from ERA's Eastern Region Directorate June 2016 Monthly Status Report.

4.5 Case Studies on ERA

4.5.1 Project A

The first project selected for case study was an ongoing road project which is at its detailed feasibility and design stage. Based on the GPS track data, the length of the project road was found out to be about 68.2 km. At this stage, the consultant has done: selection of design standards; identification of alternate routes; environmental, social and strategic assessments; preliminary engineering assessment; preliminary economic assessment and evaluation of the final route. The next step for the consultant was to execute detailed feasibility study and environmental impact assessment subsequently. It also includes, geological surveys, preliminary design, estimation of project costs, economic data and evaluation, identification of environmental impacts and develop mitigation and enhancement measures. During this process ERA will monitor consultants to avoid risks related to design.

The next phase for the consultant is to execute detailed engineering design and preparation of bidding documents. The works at this phase include: drainage design, geometric design, road safety, pavement design, geotechnical design, bridges design, materials and site investigation, topographical survey, and finally preparation of bidding documents.

The ERA enforces Resettlement Action Plan (RAP) for every project. Consultants Prepare a RAP according to the format provided in Volume 5 of the ERA Quality Manual. The purpose of the Resettlement Action Plan is to identify the land and assets needed for the project which clearly show the affected people and communities, and schedule the estimated costs and list the actions that will be taken to fairly resettle and compensate affected people and communities in accordance with the current legislation and policy statements. This will help to give mitigation actions for risks associated with the ROW obstructions. The RAP includes: desk study, surveys and identification, ROW obstruction identification and monitoring of RoW progress, compensatory entitlements and implementation schedule.

Availability of construction materials along the project route were assessed by consultant's team. During site visit, potential sources of water for compaction and concrete works, sand for concrete structures, stone for crushed aggregates and natural gravels for sub-base and borrow for embankment and improved subgrade materials were observed.

4.5.2 Project B

The second project selected for case study was a design build (DB) project which is currently at the construction stage. As seen in table 4.5, 20.27% of the total project period (222 calendar days) have elapsed. At this period, the project was not yet commenced. The first team of the contractor selected the final route, executed detailed topographic survey, submitted quality control manual, submitted technical specifications, and prepared environmental management plan. Along with these activities, the contractor executed construction works which included: clearing and grubbing, excavation, detour construction, crushing plant mobilization. To manage health and safety risk, ERA forced the contractor to prepare action plan regarding this issue. According to the contract document, the Contractor was required to prepare action plan within the mobilization period.

The contractor has conducted site investigation along with the route selection and proposed alternative routes based on socio-political and economic factors. Both the Employer and the Employer Representative had commented on the route selection report and then forwarded comments to the Contractor on the submitted route selection report. In the final submission, the contractor had consulted different industries along the proposed road and re-submitted the final route selection report to the Client after incorporating the consent of the industries.

As per the contract, some of the risks were transferred to insurances. The contractor has also offered some guarantees from the bank. In addition, the client has ordered the contractor to bring professional indemnity insurance, contractor's plant & machinery, and third-party workmen compensation insurances.

Due to delay of the finalized designs, access problem within the site, and unavailability of construction materials; the project was delayed. As shown in Table 4.5 below, the weighted percentage indicated that the progress of the project is 8.85% of the physical work. However, the planned work was 13.31%. This shows slippage of 11.42% from the contract period.

Table 4.5: Project B current status

Percentage planned up-to-date	13.31%
Up to date Progress	8.85 %
Total time elapsed	222 calendar days (20.27% of the total project period).
Slippage with respect to elapsed time	11.42%

4.5.3 Project C

The next case study will give insight on the practice of risk management by the consultants at the initiation of Design-Build projects. The proposed project intended to cover 76 km. Design Build (DB) scheme was selected because of urgency of the project. The consultant was given responsibility to develop feasibility study, assess environmental impact, prepare RAP, prepare detailed engineering design, and prepare a tender document. In line with this, a supplementary agreement was signed with the Ethiopian Roads Authority to carry out Risk Assessment for the first 76 km. The task included:

studying the nature of DB project, identifying risks associated with this specific delivery system, engineering estimate and estimating contingency as a percentage of the total cost estimate.

The risk identification and management process was done with the team compiling the project's risk events by examination of the project's description, checklists, work breakdown structure, cost estimate, design and construction schedule, procurement plan.

The primary method for risk identification was checklist. The project design team developed the checklist. Since the preparation of the checklist was done by one team it can be subjective. Therefore, it must include other project teams and stakeholders. In this regard the following are risk check lists (factors) anticipated by respective discipline:

- Change of route;
- Increase in the selected route due to;
  - Topographical survey data accuracy and geometric design,
  - Variations in quantities due to surveying data and method, and
  - Hydrological/Hydraulics Study
- Change in design; and
- Geotechnical investigation limitations.

Additionally, the consultant has executed desk study, and field assessment for risk identification. The studies conducted included:

- Construction materials identification, location and limited sampling and testing for assessing the risk of occurrence of "Unavailability of construction materials";
- Environmental impact assessment;
- Quantity estimate with the help of topographic maps, digital elevation model (with 30m resolution) and field observation;
- Engineering costs estimate based on existing current rates for avoiding "poor cost estimates";
- Project location from main supply centers (reinforcement steel, cement and others); and
- Climate.

As shown above, risk related to initiation stage were given more cover. All risks related to performance, scope, quality, technology issues, safety, and health concerns, socio-political, management, and logistic were not considered. This shows the limitation of the risk identification by the consultants. The next procedure was execution of risk assessment and allocation of risk factors. In commercial relationships, the basic principle is that individuals, equivalently Contractors and Employers in Construction Contracts, negotiate on the allocation of risks to the party that is better for managing the risk. Since the project delivery strategy is design-build, and the Contractor is a design builder. The risk of design transfers to the Contractor by this arrangement. Another term often used to characterize risk was to set contingency. Contingency is an amount of money or time needed above the estimate to reduce the risk of contractors offer to undertake the construction as per the requirements set in the employer's requirement. Cost contingencies were set by studying the project risks according to ERA's Bill series. This includes;

I. Series 1000: General
- Variation in assumption of project cost; and
- Variation in estimation of project duration

II. Series 2000: Site Clearance
- Variation from estimated bill of quantities because of additional trees, shrubs, and vegetation cover

III. Series 3000: Drainage
- Increase in the quantities of work;
- Change in culvert Design (number, size and type of culverts); and
- Change in ditch design: number, type,

IV. Series 4000: Earthworks
- Variation in topographic data accuracy;
- Limitation in Geotechnical Investigations; and
- Land slides.

V. Series 5000: Sub base and Road Bases
- Change in pavement design; and
- Change in material hauling distance.

VI. Series 6000: Bituminous Surfacing
- Change in material hauling distance from quarries

VII. Series 8000: Structures

- Change in the foundation condition of a structures;
- Change in span arrangement of a structure; and
- Change in material hauling distance from quarries.

VIII. Series 9000: Ancillary works

- Change in designed length and designed geometric elements; and
- Change in town section length.

The consultant has carried out the probability of bidders cost based on previous data for projects of similar nature through Bid Averaging Method (BAM) and set 20% cost contingency. Engineer's estimates and contractors cost of ongoing and recently completed projects from the ERA Procurement Directorate and from the Design and Build Directorate was collected. The selected projects were also filtered based on their terrain, volume of work, climatic area, and cost. Then, the costs were simulated using @risk software. Finally, the costs were converted to average cost per km and adjusted for inflation and/or devaluation. Figure 4.3 below presents the total project cost.

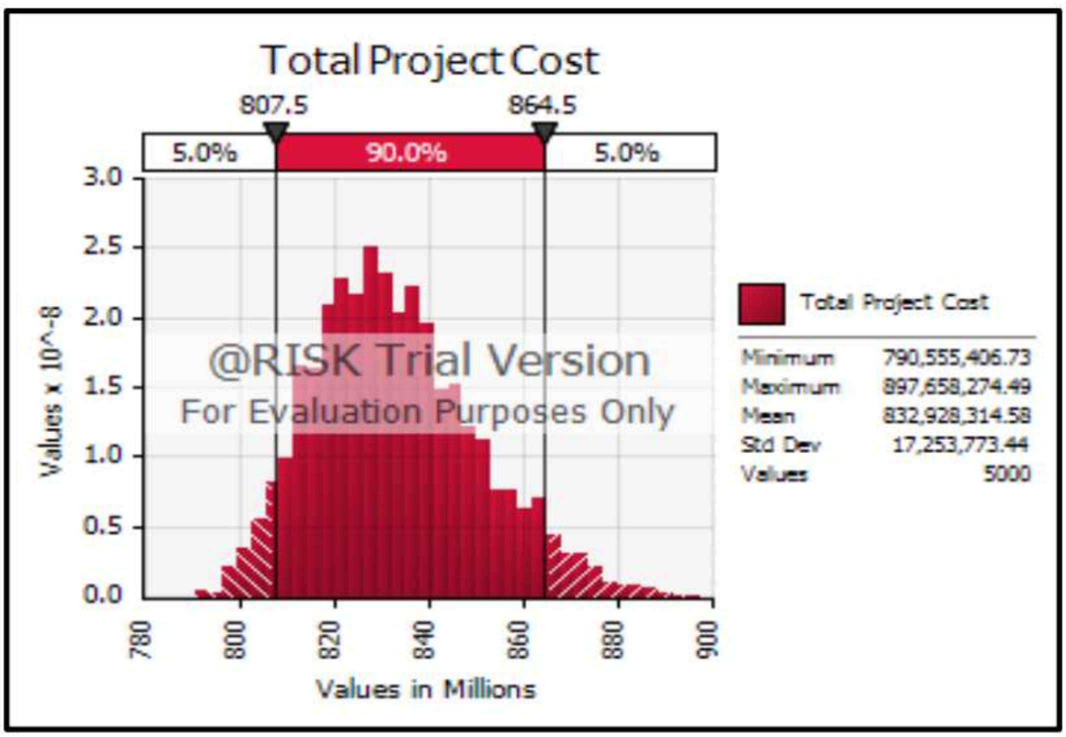


Figure 4.3: @Risk simulation output

The next step was risk mitigation planning. The aim of risk mitigation planning is to explore risk response strategies for the risk items identified. Accordingly, they identify and assign parties to take responsibility for each identified risk. The planned mitigation plan is attached in the Annex.

4.6 Summary

From the desk study it is found out that AACRA selects road projects for construction by considering their socio-political influence, traffic flow, master plan, and public demands. The projects may be executed by own force or by out sourcing based on their scope and complexity. If the project have high volume of work and/or complexity, AACRA has a strategy to transfer or outsource the work to consultants and contractors with design-bid-build arrangement. From the desk study it is also found out that road construction projects in AACRA does not pass through feasibility study. In addition the practice related to environmental impact assessment and resettlement action plan is very week. Current road construction projects service and work contracts in AACRA shows that they suffer from delay and cost overrun.

ERA executes its projects by design-bid-build, design-build, build-operate-transfer, and performance based delivery system. Among these delivery systems ERA only give the assignment of risk assessment for design-build projects. But from the case and desk study of ERA’s road construction projects it was found out that design-bid-build projects are also suffering from delay and cost overrun because of various risk factors.

CHAPTER FIVE

QUESTIONNAIRE DATA ANALYSIS AND DISCUSSIONS

5.1 Introduction

This chapter deals with analysis of data obtained through the questionnaire; and it includes discussions of the results. Other than desk and case studies, the other main input for this study was questionnaire. The questionnaire was organized to have four parts namely: general information, awareness of risk management, risks in a road construction sector, and risk management, and practice of risk management. The questionnaire was distributed to major stakeholders. i.e. client, contractors and consultants. The data analysis includes registering of responses, validity testing, mean square, cumulative mean square, ranking, and correlations. The data analysis was carried out using Excel software. The analysis includes study of risks likelihood; their impacts on cost, quality, and time; significance; allocations; and risk management process practice throughout the project's life cycle. The reliability of data is checked before beginning the analysis and an acceptable result of greater than 70% were found.

5.2 Results and Discussions

5.2.1 Population and Sample Characteristics

The questionnaire was distributed to major stakeholders that plays predominant roles in the road projects. This includes AACRA, Contractors, and Consultants. The population of the study is AACRA's currently ongoing, provisionally accepted, and terminated road construction projects (as of Feb 30, 2017). The population encompassed thirty-two (32) current AACRA projects. i.e. The projects commencement periods range from 2012 to 2017. The projects were clustered as indigenous and international projects. In this scenario, the indigenous projects are fully engaged by local companies while the international projects are engaged by both local and foreign companies. Among the projects seven (7) were international projects and the rest twenty-five (25) were indigenous projects. All the local contractors and consultants that have participated in the projects have grade one license. As mentioned in the methodology, among the thirty-two (32) projects, fifteen (15) were sampled which is about 49%. Then, the samples were selected based on proportion of their cluster group. Accordingly, fifteen (15) questionnaires were distributed to the contractors and consultants who are participating in the projects. On the client's side, all the eleven (11) counterpart engineers who are participating in the projects were given questionnaires too. Thus, the total questionnaires distributed were forty-one (41). Out of the over-all questionnaires distributed, thirty-six (36) were collected. However, two questionnaires were discarded because they were not valid for analysis. As shown in Table 5.1 below, the overall response rate was eighty-eight percent (88 %) and valid response of eighty-three percent (83 %), which is acceptable.

Table 5.1 Response Rate of the Questionnaire

Respondent Category	**Questionnaires**		**Returned in Percentage**	**Valid Responses**	**Valid Responses in Percentage**
	Distributed	**Returned**			
Client	11	9	82 %	8	73 %
Contractors	15	14	93 %	14	93 %
Consultants	15	13	87 %	12	80 %
Total	**41**	**36**	**88 %**	**34**	**83 %**

5.2.2 Respondents Profile

A wide range of professionals in their designation, management level and years of experience representing: client, contractors, and consultants participated in the survey. On the client side, only counterpart engineers participated in the survey. All the client professionals were in the middle level management. Their staffs are dominated by Bachelor degree holders and the rest thirty-eight (38%) percent were Master's degree holders. Half or fifty percent (50%) of the counterparts were junior engineers with less than five years' experience and the rest have experience of less than ten years. Sixty-three percent (63%) of the staff have been on their positions for less than two years which shows high rate of turnover. The surveying and the contractors' representatives were on top, middle and lower level managerial positions with proportions of thirty six percent (36%), fifty percent (50%), and fourteen percent (14%) respectively. Except seven percent (7%) of the master's holders, all the respondents in the contractor side were bachelor degree holders. All the respondents of the contractor were senior engineers having more than six years' experience and sixty-four percent (64%) of them have stayed in their current position for more than three years. Similarly, in the case of contractors, top, middle and lower level managers participated representing consultants. Unlike client and contractor representatives, the consulting firms have more professional with master's degree holders. Fifty percent (50%) of them were senior engineers with more than six years' experience. More than fifty- eight percent (58%) of the client's representatives have stayed in their current passions for more than five (5) years which shows low turnover compared to professional of AACRA and contractors. The data acquired through questionnaires were very dependable because most of the respondents, forty-one percent (41%) have worked in the construction industry for more than six years. Each firm's respondents profile is summarized below in Table 5.2.

Table 5.2: Characteristics of Respondents

Respondents characteristics	Client		Contractor		Consultant		Total	
	Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
Respondent's Position								
Top Level Managers	0	0	5	35.7	1	8.3	6	17.6
Middle Level Managers	8	100	7	50	4	33.3	19	55.9
Lower Level Managers	0	0	2	14.3	7	58.3	9	26.5
Total	8	100	14	100	12	100.0	34	100
Level of Education								
Advanced Diploma	0	0	0	0	1	8.3	1	2.9
Bachelor	5	62.5	13	92.9	5	41.7	23	67.6
Masters	3	37.5	1	7.1	6	50.0	10	29.4
Total	8	100	14	100	12	100	34	100
Years of experience in CI								
0 - 5	4	50%	0	0%	3	25%	7	20.6%
6 to 10	4	50%	7	50%	3	25%	14	41.2%
11 to 15	0	0%	3	21.4%	3	25%	6	17.6%
16 to 20	0	0%	2	14.3%	3	25%	5	14.7%
21 and Above	0	0%	2	14.3%	0	0%	2	5.9%
Total	8	100%	14	100%	12	100%	34	100%
Years of experience in current position								
0 - 2	5	62.5%	5	35.7%	1	8.3%	11	32.4%
3 - 4	1	12.5%	3	21.4%	4	33.3%	8	23.5%
5 and Above	2	25%	6	42.9%	7	58.3%	15	44.1%
Total	8	100%	14	100%	12	100%	34	100%

5.2.3 Awareness on the concept of Risk Management

Since risk management is one of the core areas of construction project management. Professionals in the road construction projects need to be aware of the concept of risk management and apply its principles for the success of a project. All the thirty-four (34) valid respondents from the client, contractors and consultants were asked if they were aware of the concept of risk management and all confirmed there awareness of risk management principles. This shows that most of the professionals involved in the road construction sector are aware of risk management techniques and the respondents have no trouble in responding to the questionnaire.

Similarly, according Addis (2014: 56), nearly all, ninety-seven percent (97%), of major parties participating in the Ethiopian building construction were aware of the concept of risk management techniques. Therefore, based on the results of the two research studies we can conclude that; there is a good awareness of risk management concept by Ethiopian professionals working at the major stakeholders.

5.2.4 Level of Awareness

Respondents were asked to rate their level of awareness about risk management as high, medium, and low. Furthermost of AACRA’s, contractor’s, and consultant’s manpower rate, their risk management awareness as moderate. As shown below in figure 5.1, most of the respondents (76.6%) expressed their knowledge of risk management as moderate and twenty point six percent (20.6%) replied that they have higher awareness of risk management; two-point eight percent (2.8%) rated their level of risk management as low. This shows that most of the professionals didn’t further their knowledge of risk management and hint that there is no full engagement of risk management techniques in the firms.

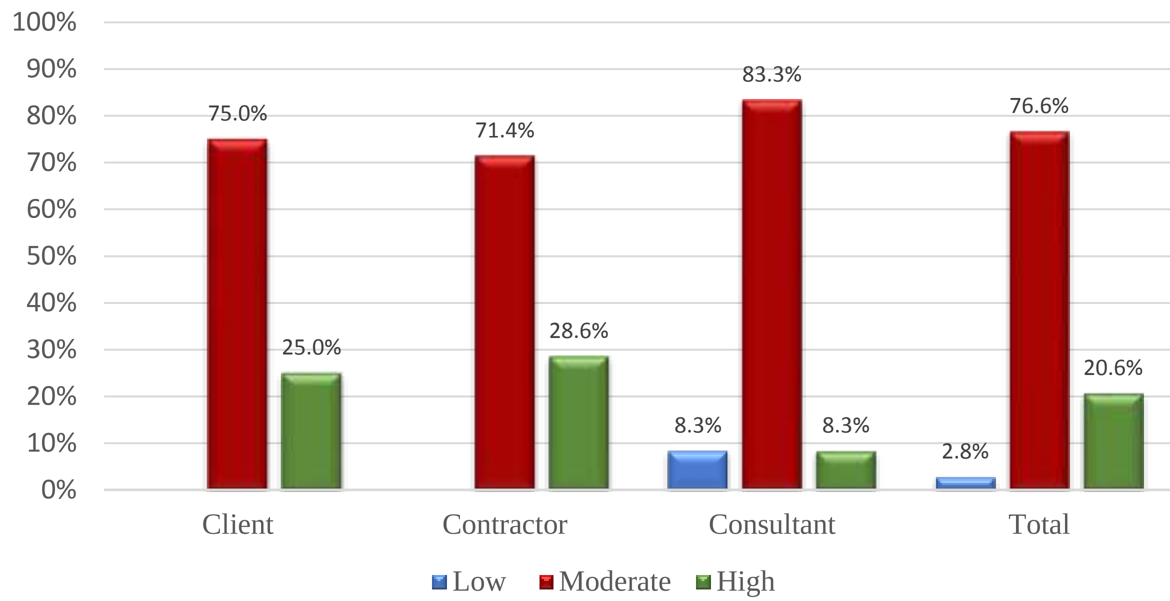


Figure 5.1: Level of Awareness in Risk Management

5.2.5 Means of Risk Management Awareness

Four types of means of gaining risk management awareness were identified regarding the professionals. These were: awareness gained through conversation, university or college, workshop and training, and through reading. In case there are other means, others were put as an option too. However, no other means were identified. More than half of the professionals, fifty-nine percent (59%), were first aware of risk management techniques through university education. This implies that risk management is mostly encompassed in university education curriculum and is the best way of gaining awareness. The rest twenty-four percent (24%) of the respondents gained their awareness through workshop and training. Nine percent (9%) of the professionals expressed awareness of risk management through conversation. This shows how powerful is means of awareness through conversation. Amongst the overall respondents, eight percent (8%) were aware of risk management through reading. The respondents recommend short term trainings, and workshops for increasing the level of awareness of professionals in the Ethiopian construction industry. Figure 5.2 below presents the means of risk management awarness.

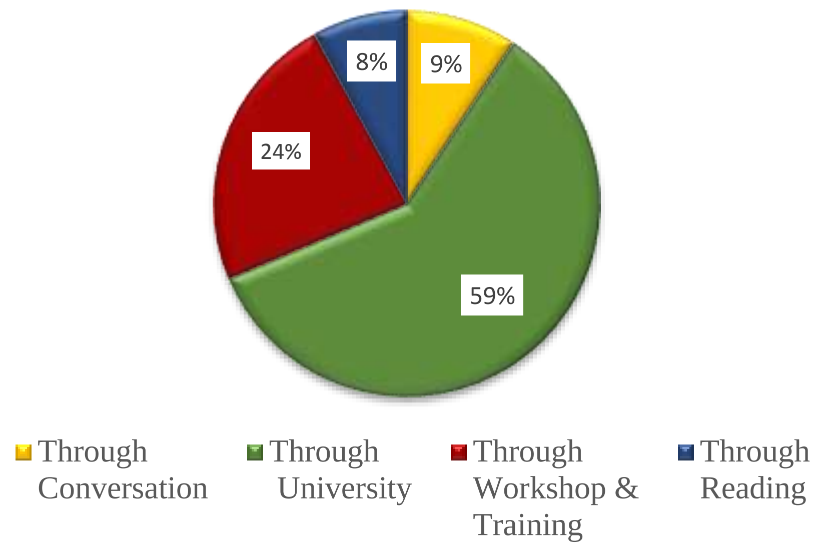


Figure 5.2: Means of risk management awarness

5.2.6 Probability of Risk Factors

Even if they have common ground, different scholars and researchers categorize risk in several ways. According to Nadeem et al (2010:18), risk can be associated to technical, logistical, management-related, environmental, financial, socio-political aspects of a project. Renuka, Umarani and Kamal (2014:33), attempt to generalize the critical risk factors listed by many researchers in different projects like residential, industrial, commercial, and infrastructure in a unique way which include: country risk, environmental and geological risk, statutory compliance risk, design risk, project execution risk, inadequate managerial skills, improper coordination between teams, and resource risk. In this study, twenty-seven sub categories and eight major risk factor groups of technical, logistical, management, environmental, financial, socio-political, contractual, and physical were determined based on current risks facing the road construction sector. A ninth category for other unidentified risk factors was added in the questionnaire too. As discussed in the methodology, a mean score was used to analyze the responses from the questionnaire, furthermore, the probability occurrence of the risk factors was given a rank based on the stakeholder's perspectives. The Cronbach alpha coefficient was calculated to see the consistency of data's and conclude on the reliability of the responses and 0.92,0.92, and 0.77 alpha coefficients were obtained for AACRA, contractors and consultants respectively. This shows that the responses are consistent and are acceptable for data analysis.

Table 5.3 below presents the probability of various risk factors generated based on clients, contractors and consultant's responses.

Risk Factors	Probability of occurrence							
	Clients' Perspectives		Contractors Perspectives		Consultants' Perspectives		Overall Perspectives	
	MS	Rank	MS	Rank	MS	Rank	MS	Rank
1. Technical risks								
1.1 Inadequate site /Geotechnical/ investigation	4.00	**3**	3.29	**7**	3.17	**6**	3.48	**7**
1.2 Incomplete design and design error	4.25	**2**	3.43	**6**	3.08	**8**	3.59	**5**
1.3 Inappropriateness of specifications	3.63	**13**	2.50	**21**	2.58	**14**	2.90	**16**
1.4 Uncertainty over the quality and availability of materials	3.00	**23**	2.86	**17**	2.17	**23**	2.68	**23**
1.5 Scope and design changes	3.88	**6**	3.86	**2**	3.58	**2**	3.77	**2**
1.6 Defect in the quality of work	4.00	**3**	2.79	**18**	3.17	**6**	3.32	**9**
1.7 Improper planning and costing of projects	3.88	**6**	3.21	**9**	2.92	**10**	3.34	**15**
2. Logistical risks								
2.1 Unavailability of skilled labor	3.00	**23**	2.71	**19**	2.42	**19**	2.71	**21**
2.2 Unavailability of construction equipment's, spare parts, fuel	3.38	**19**	2.71	**19**	2.58	**14**	2.89	**20**
3. Management related risks								
3.1 Uncertain productivity of resources	3.88	**6**	2.14	**24**	2.75	**11**	2.92	**19**
3.2 Industrial relations problems	3.63	**13**	2.14	**24**	2.08	**24**	2.62	**24**
4. Environmental risks								
4.1 Unexpected weather conditions	3.88	**6**	3.79	**4**	3.25	**5**	3.64	**3**
5. Financial risks								
5.1 Availability and fluctuation in foreign exchange	3.88	**6**	3.21	**9**	3.33	**4**	3.47	**8**
5.2 Delays in payments	4.00	**3**	3.86	**2**	3.00	**9**	3.62	**4**
5.3 Inflation	3.50	**15**	3.71	**5**	3.42	**3**	3.54	**6**
5.4 Local taxes	3.88	**6**	3.29	**7**	2.25	**22**	3.14	**10**
5.5 Return of funds	3.25	**21**	2.43	**22**	1.92	**26**	2.53	**25**
5.6 Country economic condition	3.25	**21**	3.07	**15**	2.50	**17**	2.94	**17**
6. Socio-political risks								
6.1 Customs and import restrictions and procedures	3.38	**19**	3.21	**9**	2.67	**12**	3.09	**13**
6.2 Incapability of local firms.	3.50	**15**	3.21	**9**	2.67	**12**	3.13	**11**
6.3 Right of way problem	4.38	**1**	4.57	**1**	4.33	**1**	4.43	**1**
6.4 Regulatory changes	3.50	**15**	2.14	**24**	2.42	**19**	2.69	**22**
7. Contractual risks								
7.1 Gap in contract document	3.88	**6**	3.00	**16**	2.42	**19**	3.10	**12**
7.2 Occurrence of disputes	3.00	**23**	3.21	**9**	2.58	**14**	2.93	**18**
7.3 Unavailability of dispute resolution body	2.38	**26**	2.43	**22**	2.08	**24**	2.30	**26**
8. Physical								
8.1 Occurrence of accidents	3.50	**15**	3.14	**14**	2.50	**17**	3.05	**14**
9. Others								
9.1 Additional Risk Factors	1.25	**27**	1.36	**27**	1.42	**27**	1.34	**27**

Mean scores and ranking mechanism were used to rate the level of occurrence of various risks based on stakeholder's perception. For rating the probabilities, we can use the overall perceptions since there is a linear relationship between the stakeholder's perspectives based on Pearson's correlation. This shows that all the stakeholders have agreed to the high probability occurrence of right of way obstacles in the road construction projects. Scope and design change was one of the high severity risk factors with an overall mean sore of 3.77 and it was ranked second. Likewise, as mentioned in the interview with AACRA officials, they have agreed that there is a high probability of scope change which can lead to design change, and this is mainly because of compliance of the public for expanding the roads and high rate of urbanization in Addis Ababa.

Design changes can be also related with defect in design and inadequate site investigation. An overall mean score of 3.64 was calculated regarding to unexpected weather condition and was ranked third. Because of several reasons, the weather condition is changing dramatically, this scenario is also happening to Addis Ababa and is considered as a major risk factor. The likely hood of delays in payments was ranked fourth, the reason behind this risk factor can be AACRA, and/or consultants. Incomplete designs and design errors were considered highly probable by the respondents and ranked fifth with a mean score of 3.59. Over the decades, inflation turned out to be inevitable in the Ethiopian economy. This risk factor was also given high overall mean score of 3.54 and ranked sixth. Inadequate site /geotechnical/ investigations, availability and fluctuations in foreign exchange, and defect in the quality of work take the next rank in their probability of occurrences consecutively. Unavailability of skilled labor, regulatory changes, unavailability and uncertainty over the quality of construction materials, industrial relation problems, return of funds, and unavailability of dispute resolution body resulted in least ranks ranging from 21st to 26th based on the overall mean scores given. Since other unidentified risks was ranked 27th out of 27 alternatives, it implies that there is a very low probability of risk occurrence other than the 26 identified risk factors. Respondents specified lack of wastage/spoil area, and uncertainty over country's peace and security as unidentified risks.

Karl Pearson's correlation factor was calculated to study the relationship between the major stakeholder's perceptions on the likelihood of occurrence of the various risk factors in Addis Ababa's road construction sector. The result should be $-1 \leq r \geq 1$. The value of r is interpreted as follows;

- .00 -.19 “very weak”;
- .20 -.39 “weak”;
- .40 -.59 “moderate”;
- .60 -.79 “strong”; and
- .80 -1.0 “very strong”

The correlation coefficients were calculated at 0.65, 0.73, and 0.82 between client and contractor, client and consultant, and contractor and consultant respectively. All the correlations showed linear positive relationships. The figures tell us that there is a strong positive correlation between the client and contractors and between the client and consultants perceptions; and a very strong positive correlation between the contractors and consultants perceptions on probability of risk. Scatter diagram was used to clearly show the correlation of perception on probability of risk occurrence among the stakeholders. Figure 5.3 below shows Pearson’s correlation results between the client and contractor regarding the perception of probability of risk and subsequently Figure 5.4 shows Pearson’s correlation coefficient between the client and consultants on perception of probability of risks. Contractor and consultants Pearson’s correlation is also plotted in Figure 5.5.

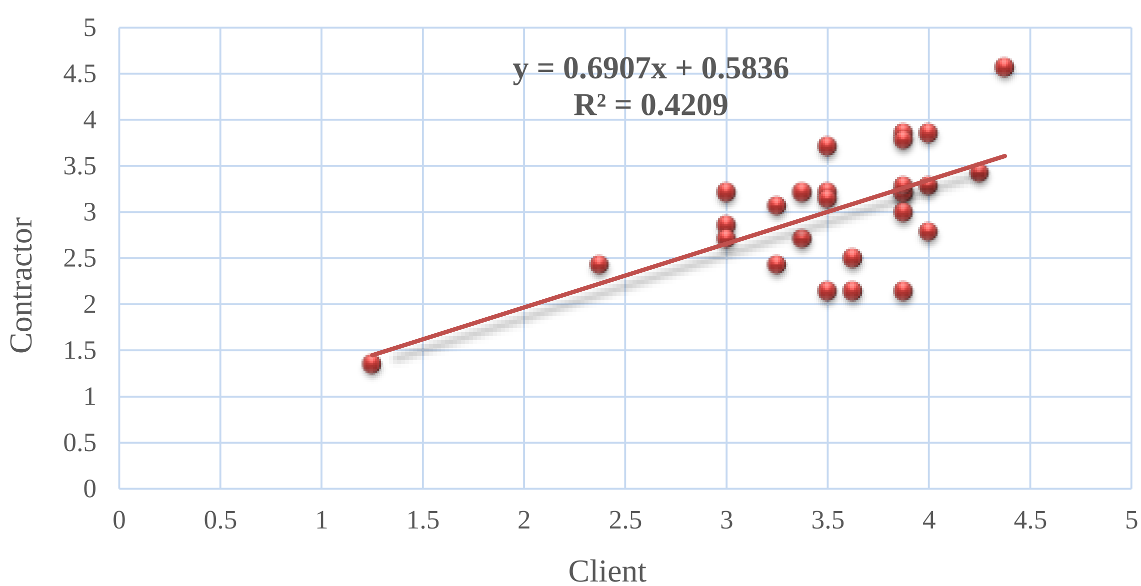


Figure 5.3: Client versus Contractor Pearson’s correlation on perception of probability of risks

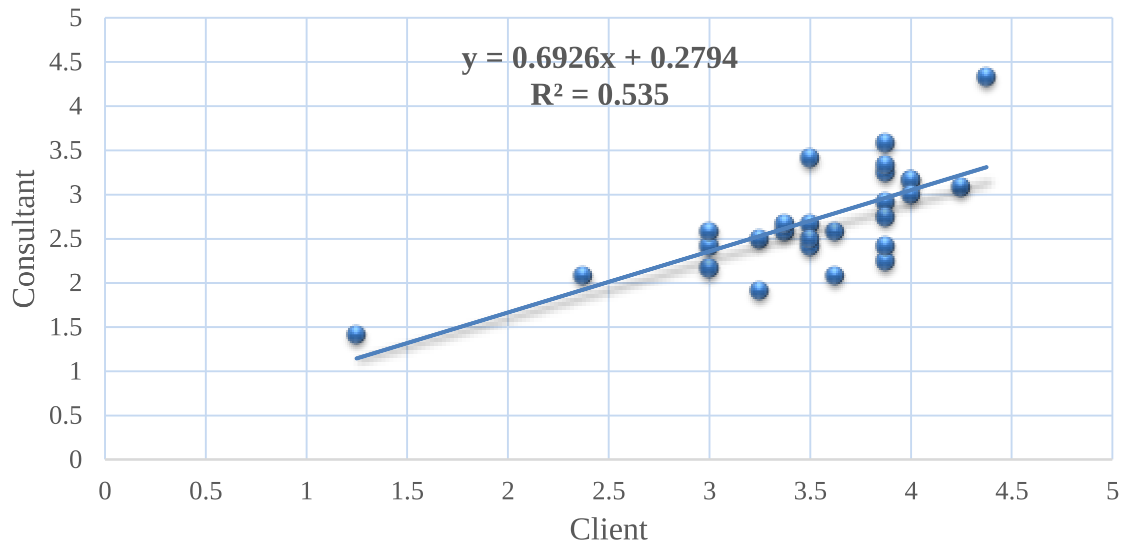


Figure 5.4: Client versus Consultant Pearson's correlation on perception of probability of risks

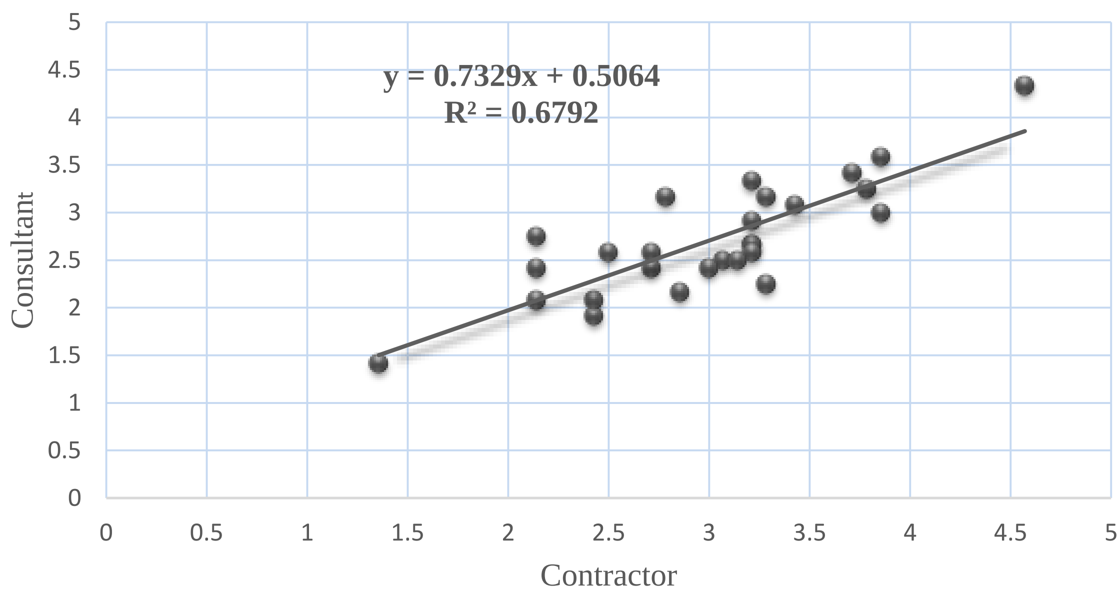


Figure 5.5: Contractor versus Consultant Pearson's correlation on perception of probability of risks

5.2.7 Impact of identified risk factors on Cost, Quality and Time

According to Dan et' al (2011: 151), all risk factors can affect one or more objectives of the project. Therefore, the risks must be identified and managed with detailed analysis and a precise definition for successful achievement of the project objectives. During the questionnaire survey respondents were asked to rate the impact of the identified risk factors. Their responses were generated in respect of mean scores and they were ranked. The alpha reliability coefficient was calculated, and an acceptable, good, and very good consistency was found based George and Malley's (2003, 231) recommendation.

As shown in Table 5.5 below, similar high scores were calculated in the case of technical risk factors. i.e. inadequate site / geotechnical / investigation, incomplete design and design errors, scope and design change, defect in the quality of work, and improper planning and costing of projects. Regarding the socio-political risk of right of way problem, they were ranked first for their impact on cost and time. This implies that technical risk factors and RoW problem is the main reason for cost overruns, delays, and quality problems if they occurred in road projects. Ethiopia's economic condition, regulatory changes, unavailability of dispute resolution body, local taxes, occurrence of accidents, and return of funds were given less points compared to other risk factors. Below Table 5.5 presents the impacts of identified risks on costs, quality, and time of a road construction projects.

Table 5.4: Impact of identified risks on cost, quality, and time of a road construction projects

Risk Factors	Impact on Cost		Impact on Quality		Impact on Time	
	MS	Rank	MS	Rank	MS	Rank
1. Technical risks						
1.1 Inadequate site /Geotechnical investigation	4.15	**2**	3.88	**2**	3.91	**3**
1.2 Incomplete design and design error	3.85	**6**	3.79	**3**	4.32	**2**
1.3 Inappropriateness of specifications	3.65	**8**	3.76	**4**	3.06	**21**
1.4 Uncertainty over the quality and availability of materials	3.41	**12**	3.62	**5**	3.47	**11**
1.5 Scope and design changes	4.03	**3**	3.03	**12**	3.88	**4**
1.6 Defect in the quality of work	3.47	**10**	3.91	**1**	3.56	**10**
1.7 Improper planning and costing of projects	3.91	**5**	3.44	**7**	3.79	**7**
2. Logistical risks						
2.1 Unavailability of skilled labor	2.91	**23**	3.41	**8**	3.06	**21**
2.2Unavailability construction equipment's, spare parts, fuel	3.24	**17**	3.24	**10**	3.65	**8**
3. Management related risks						
3.1 Uncertain productivity of resources	3.35	**14**	3.06	**11**	3.44	**12**
3.2 Industrial relations problems	3.18	**19**	2.88	**14**	3.29	**14**
4. Environmental risk						
4.1 Unexpected Weather condition	3.06	**21**	3.56	**6**	3.85	**5**
5. Financial risks						
5.1 Availability and fluctuation in foreign exchange	4.03	**4**	2.79	**17**	3.35	**15**
5.2 Delays in payments	3.53	**9**	2.62	**20**	3.82	**6**
5.3 Inflation	3.79	**7**	2.82	**16**	3.09	**20**
5.4 Local taxes	3.18	**19**	2.32	**9**	2.32	**26**
5.5 Return of funds	2.53	**26**	2.21	**26**	2.41	**25**
5.6 Country economic condition	3.29	**15**	2.68	**19**	3.29	**16**
6. Socio-political risks						
6.1 Customs and import restrictions and procedures	3.47	**10**	2.24	**24**	3.62	**9**
6.2 Incapability of local firms.	3.26	**16**	3.32	**9**	3.44	**12**
6.3 Right of way problem	4.24	**1**	2.94	**13**	4.74	**1**
6.4 Regulatory changes	2.94	**15**	2.50	**21**	3.15	**19**
7. Contractual risks						
7.1 Gap in contract document	3.41	**12**	2.88	**14**	3.21	**18**
7.2 Occurrence of disputes	3.24	**17**	2.71	**18**	3.41	**14**
7.3 Unavailability of dispute resolution body	2.91	**23**	2.41	**22**	3.03	**23**
8. Physical						
8.1 Occurrence of accidents	2.68	**25**	2.24	**24**	2.50	**24**
9. Others						
9.1 Additional Risk Factors	1.97	**27**	1.83	**27**	2.06	**27**

5.2.8 Significance of Risk Factors

One of the specific objectives of the study was to identify the most significant risk factors on AACRA projects. Cumulative mean score was calculated by multiplying mean score of rate of occurrence of the risks with their impact to identify the significance of the risk factors individually on the major project objectives and as an aggregate of those. As shown in Table 4.6, below, the ROW problem is the first significant risk factor that affects cost and time overruns of a road construction project. Scope and design change; and Inadequate site /geotechnical/ investigation was ranked second and third based on the significance of affecting project cost. Incomplete design errors were identified as the first risk factor in affecting quality of the projects and second for causing delays. Scope and design changes was also identified as the major risk factor related to projects time. Using only the major objectives of a road construction, Cost, Quality, and Time. The potential risk factors on AACRA projects have been plotted and presented in Figure 5.6 below.

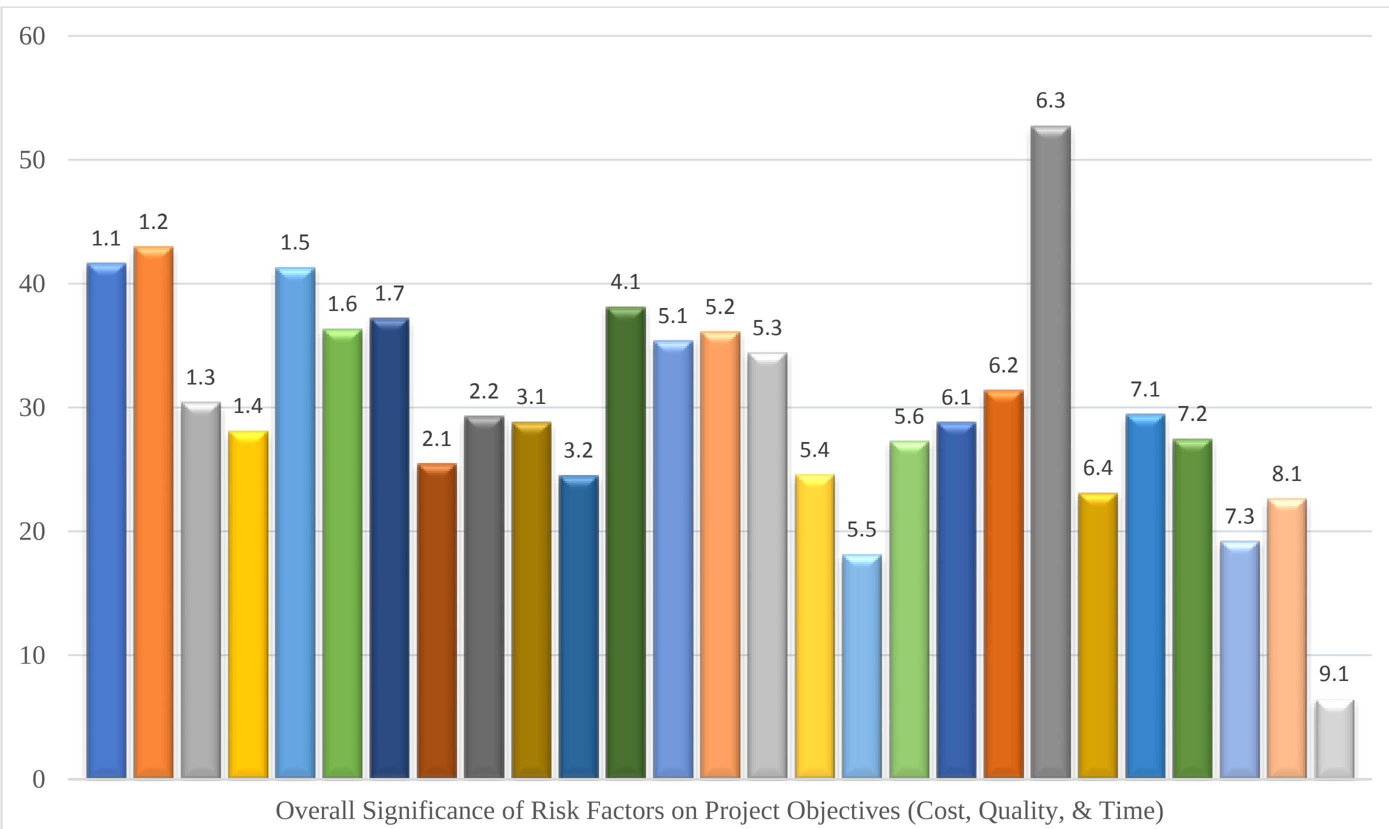


Figure: 5.6: Overall significance of risk factors on project objectives

The result shows that the following are the top five critical risk factors affecting AACRA's project accomplishments:

- Right of way problem;
- Incomplete design and design problems;
- Inadequate site or geotechnical investigations;
- Scope and design changes; and
- Unexpected climate and weather conditions.

The results show that most of the main risk factors were occurring and can be solved at the projects planning and designing phase of a construction project. Furthermore, Technical Risks are identified as the major risk factor groups that are affecting AACRAs project performances. Zou, Zhang, and Wang (2004: 1) likewise identified risks in construction project life cycle and technical risk of "design variations" as the main risk factor deemed to impact aspects of project objectives.

Right of way problem turned out to be the first sub risk category that significantly affect the project objectives and it is grouped under socio-political risks. Abubeker (2015:62) similarly identified the factor Right of way problem has high overall risk significance in AACRA road construction projects. It also states that they have significantly affected project completion time and causes of disputes between parties.

As observed from the survey outputs, environmental risk sub category of unexpected weather conditions was rated as the most significant risk factor. If they are not managed by setting mitigation actions, unexpected weather condition can severely affect project time and cause delay. It also can damage the undergoing construction quality and those delays and quality problems can cause loss of money. Table 5.5: below shows the significance of risk factors on cost, quality, and time of a project.

Table 5.5: Significance of risk factors on cost, quality, and time of a project.

Risk Factors	Significance of Risk factors on Cost (CMS)	Rank	Significance of Risk factors on Quality (CMS)	Rank	Significance of Risk factors on Time (CMS)	Rank
1. Technical risks						
1.1 Inadequate site /Geotechnical/ investigation	14.45	**3**	13.53	**2**	13.63	**6**
1.2 Incomplete design and design error	13.82	**5**	13.61	**1**	15.51	**2**
1.3 Inappropriateness of specifications	10.59	**12**	10.93	**8**	8.88	**19**
1.4 Uncertainty over the quality and availability of materials	9.13	**20**	9.68	**12**	9.28	**18**
1.5 Scope and design changes	15.20	**2**	11.43	**7**	14.64	**3**
1.6 Defect in the quality of work	11.51	**9**	12.98	**4**	11.81	**8**
1.7 Improper planning and costing	13.05	**7**	11.48	**6**	12.65	**7**
2. Logistical risks						
2.1 Unavailability of skilled labor	7.89	**24**	9.25	**15**	8.29	**22**
2.2Unavailability construction equipment, fuel	9.35	**19**	9.35	**14**	10.54	**13**
3. Management related risks						
3.1 Uncertain productivity of resources	9.80	**16**	8.94	**16**	10.06	**14**
3.2 Industrial relations problems	8.31	**21**	7.54	**20**	8.62	**20**
4. Environmental risk						
4.1 Unexpected Weather condition	11.12	**10**	12.94	**5**	14.01	**4**
5. Financial risks						
5.1 Availability and fluctuation in foreign exchange	14.00	**4**	9.71	**11**	11.65	**9**
5.2 Delays in payments	12.77	**8**	9.47	**13**	13.84	**5**
5.3 Inflation	13.45	**6**	10.01	**10**	10.94	**11**
5.4 Local taxes	9.96	**15**	7.29	**21**	7.29	**24**
5.5 Return of funds	6.40	**26**	5.58	**25**	6.11	**26**
5.6 Country economic condition	9.69	**17**	7.87	**19**	9.69	**17**
6. Socio-political risks						
6.1 Customs and import restrictions	10.71	**11**	6.90	**22**	11.16	**10**
6.2 Incapability of local firms.	10.21	**14**	10.39	**9**	10.76	**12**
6.3 Right of way problem	18.75	**1**	13.02	**3**	20.96	**1**
6.4 Regulatory changes	7.90	**23**	6.72	**24**	8.45	**21**
7. Contractual risks						
7.1 Gap in contract document	10.57	**13**	8.93	**17**	9.93	**16**
7.2 Occurrence of disputes	9.49	**18**	7.94	**18**	10.01	**15**
7.3 Unavailability of dispute resolution body	6.68	**25**	5.54	**26**	6.95	**25**
8. Physical						
8.1 Occurrence of accidents	8.16	**22**	6.81	**23**	7.62	**23**
9. Others						
9.1 Additional Risk Factors	2.64	**27**	2.45	**27**	1.34	**27**

5.2.9 Risk Allocations

Risks should be allocated to party or parties that have significant share on the manifestation of the risk or that can manage it well. While allocating the risks we should consider whether the party can resist the cost impact of the risk, consequences that can cause, and if they can be shared. Theoretically, the approaches to allocate the risk can be classified into two main approaches i.e. qualitative and quantitative approaches (Yamguchi et al., 2001:46). Contract documents are used to allocate various risks among stakeholders more often. However, since risks have multidimensional characteristics, they can influence each other and stakeholders may have different perception compared to the contract document. The perceptions of the parties in allocation of the risk factor groups are presented below;

A. Technical Risk Factor Group

According to the clients' perception; technical risk factors of improper planning and costing; inadequate site /geotechnical/ investigation, incomplete design and design error, inappropriateness of specifications should be allocated to consultants. While, negligible portion of the respondents shared this risk factors to client. Scope and design changes was assigned to the client with full proportion. Even if the above works are given to the consultant to execute, the contractor will be still liable to defect in quality of work due to inadequate site /geotechnical/ investigations, design errors and inappropriateness of specifications. In addition, Hmaid (2005: 50) noted that contractors should be concerned about defective design issues because they could be responsible about any critical issue that happen due to incorrect design. Eighty-percent (80%) of the respondents allocated defect in quality of work, and scope and design changes to consultants while defect in the quality of work were totally allocated to contractors and uncertainty over the quality and availability of materials were fully allocated to the contractors by the client. This shows that client’s staffs are not willing to accept the risk related to quality and availability of construction materials. In my opinion when any type of construction material is not available in the country the client should be corporative and take necessary measures. In addition, the quality of the materials should be supervised by consultants. Therefore, the likelihood of using poor construction materials for the project will be minimized. Figures 5.7 below present technical risk factors allocation based on: clients' perceptions.

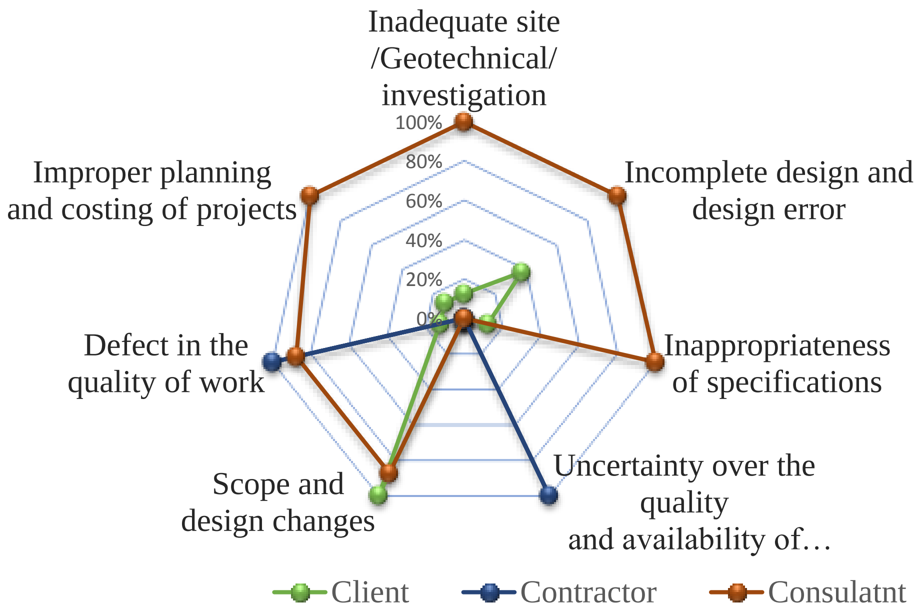


Figure 5.7: Technical risk factors allocation based on client's perception.

Based on the radar diagram, we can conclude that contractor's perception for improper planning and costing, inadequate site /geotechnical/ investigation, incomplete design and design error, inappropriateness of specifications are allocated to consultants; while, some of the respondents shared this risk factors to the clients. Similarly, defect in quality of work, and scope and design changes were also allocated to consultants but shared with the contractors and the clients respectively. Contractors allocated the risk of uncertainty over the quality and availability of materials to themselves.

Consultants are believed to be more technical than the contractor when they are hired by the client. They are responsible for technical issues. However the technical risks are better managed if they are managed jointly with client and contractors. In the survey of consultant's perception, even if 10% to 20% of the respondents didn't allocate the risk of improper planning and costing, inadequate site /geotechnical/ investigation, incomplete design and design error, inappropriateness of specifications to themselves, and the rest were accepted as their own responsibility. Ninety percent (90%) of the respondents allocated defect in the quality of work and uncertainty over the quality and availability of materials to contractors. Scope and design changes were mostly allocated to the client then to consultants. Consultants allocated the risk of uncertainty over the quality and availability of materials to contractors.

The overall perception implies that most of the professionals agreed that the risk will be well managed if they are rationally shared among stakeholders; especially between contractors and consultants. In order to manage technical risks, consultants are obliged to provide indemnity insurance for their services. Contractors are obliged to retain some proportion of their interim payments until the final acceptance of the project. This will help the client to manage risk related some quality problems that may be noticed after provisional acceptance of the project. Based on the current practice AACRA have design supervision department that design and also reviews designs made by consultants. Therefore, AACRA should take responsibility of "incomplete design and design errors" with consultants because they should review the designs prior to their execution for avoiding risks that may rise because of this risk factor. Additionally, according to MoUD, with regards to the General Condition of Contract (1994: 14), the contractor that undertakes the work will have to provide performance bond of 10% of the contract price to manage risks related to poor performance of contractors. Inadequate site /geotechnical/ investigation will lead to delay and cost overrun if they are not managed well. According to the overall survey consultants should take the responsibility to manage risks that may rise due to site /geotechnical/ investigations.

Figures 5.8 and 5.9 below present technical risk factors allocation based on: contractors' and consultants' perceptions respectively.

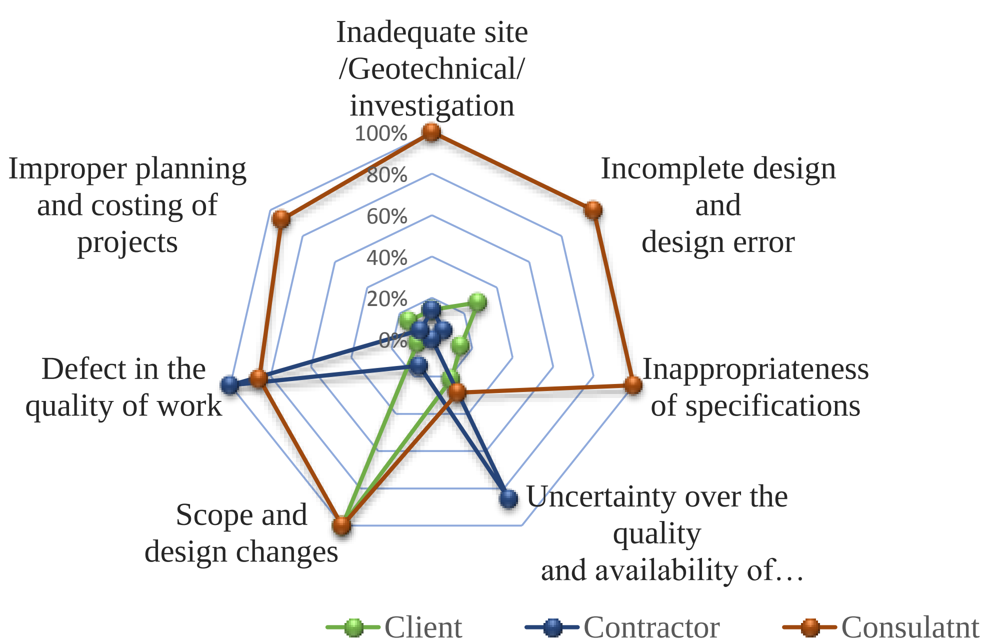


Figure 5.8: Technical risk factors allocation based on contractors' perception

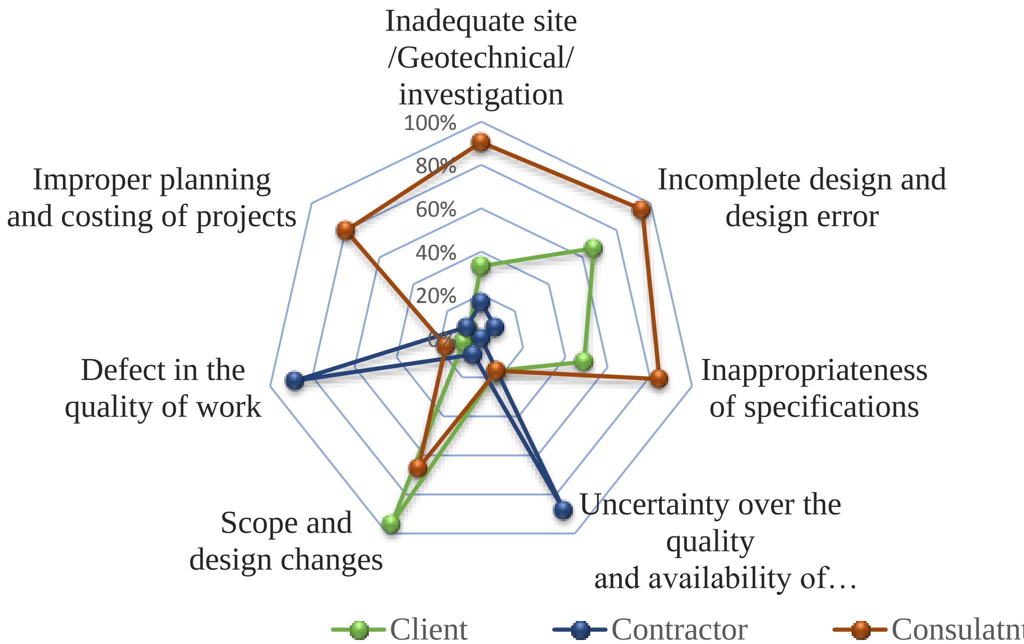


Figure 5.9: Technical risk factors allocation based on consultants' perception

B. Logistical and Management Risk Factor Groups

Logistical and Management risks mostly affect the contractor. However, Clients and Consultants have a predominant role for managing those risks. According to the Contract Document, Logistical and Management risk effects are allocated to the contractors. For instance, the contractor is liable to quality problems and delays arising from unavailability of skilled labor and uncertain productivity. Correspondingly, Industrial relation problems, unavailability of skilled labor, unavailability of construction equipment, spare parts, fuel, and uncertain productivity of resources were allocated to contractors based on client's and consultant's perception. A very small proportion of the participants allocated these risks to clients and consultants.

Unavailability of construction equipment, spare parts, fuel were allocated to client and contractors based on contractor's perception. Fifty-seven percent (57%) of the respondents shared allocation of industrial relation problems to the consultants, the rest risk factor groups in these categories were allocated to the contractors. This implies that contractors believe that unavailability of construction equipment, spare parts, and fuel should be solved or given mitigation measures jointly with the client. Figures 5.10, 5.11 and 5.12 below present logistical and management risk factors allocation based on: clients', contractors' consultants' perceptions respectively.

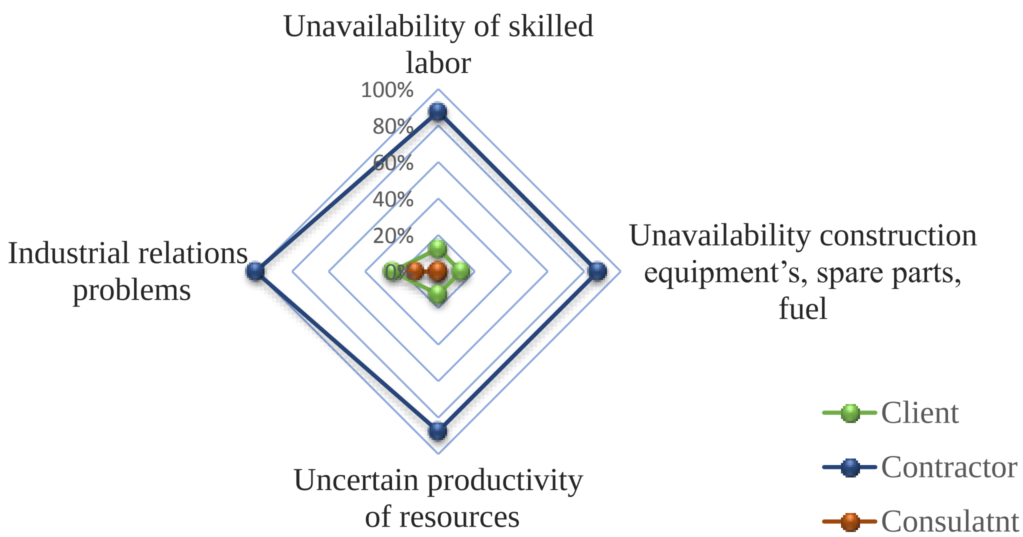


Figure 5.10: Logistical and management risk factors allocation based on client's perception

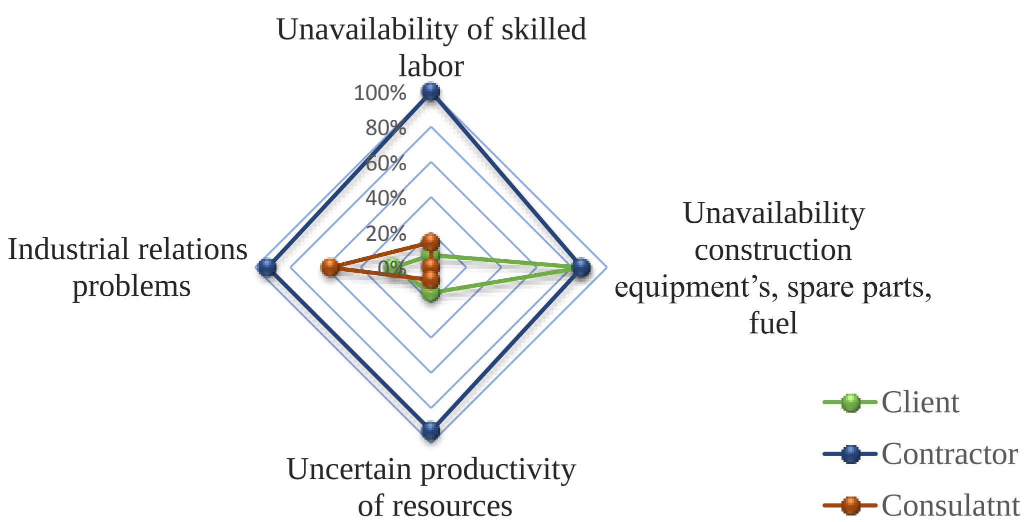


Figure 5.11: Logistical and management risk factors allocation based on contractors' perception

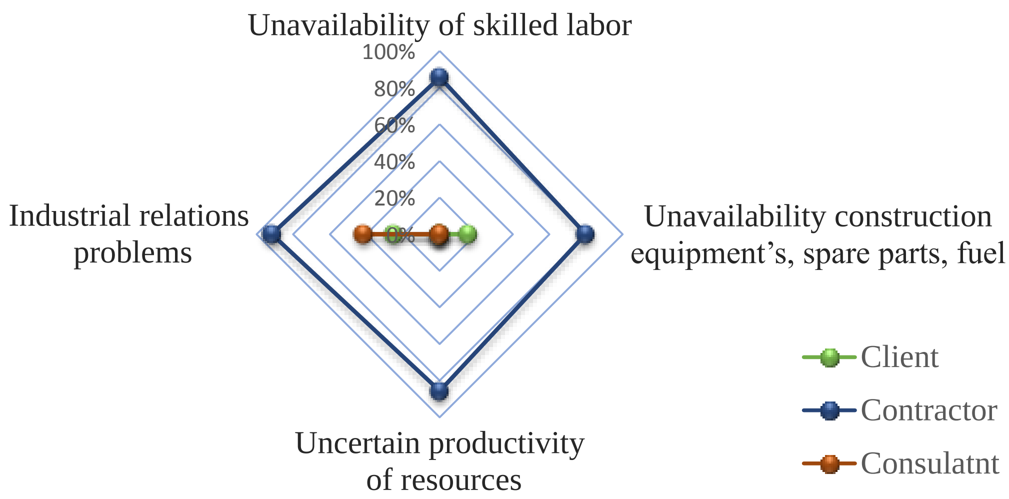


Figure 5.12: Logistical and management risk factors allocation based on consultants' perception.

C. Financial Risk Factor Group

Financial related risks mostly affect the client and contractor of a project. Among the six identified risk factor groups, clients' respondents allocated to themselves four of them namely: return of funds, country economic condition, delays in payments, and inflation. Fifty percent (50%) and Eighty-eight (88%) of the respondents allocated availability and fluctuation in foreign exchange to the clients and contractors respectively. Country economic condition and delays in payments were allocated to the consultants.

Contractor's respondents allocated return of funds, country economic condition, availability and fluctuation in foreign exchanges, and inflation to the client. Delays in payments and local taxes were allocated to the consultants and clients respectively. This implies that the contractors' payments are delayed because of the consultants' procedures for approving payments and also due to the client's reasons.

Except local taxes which is allocated to the contractor, all the financial risk factor groups were allocated to the client based on consultants' perceptions. Availability and fluctuation in foreign exchange allocation were shared with the client. When there is inflation, the client is contractually liable for adjusting the direct costs of the contractor's contract-price based on the agreement.

However, fluctuation in foreign exchange can affect both the contractors and clients since all the unit prices of the contracts cannot be adjusted.

Since financial risks can cause a significant loss to the project, they are better managed if they were shared by all participating stakeholders to manage the risks. Hmaid (2005, 54), also suggests that Financial risks like Inflation and exchange rate fluctuation risks should be best shared between the owner and the contractor by including contract clauses that define the required parameters and conditions for sharing the risks. This is suggested in order manage better under different conditions. Figures 5.13, 5.14 and 5.15 below present financial risk factors allocation based on: clients', contractors' and consultants' perceptions respectively.

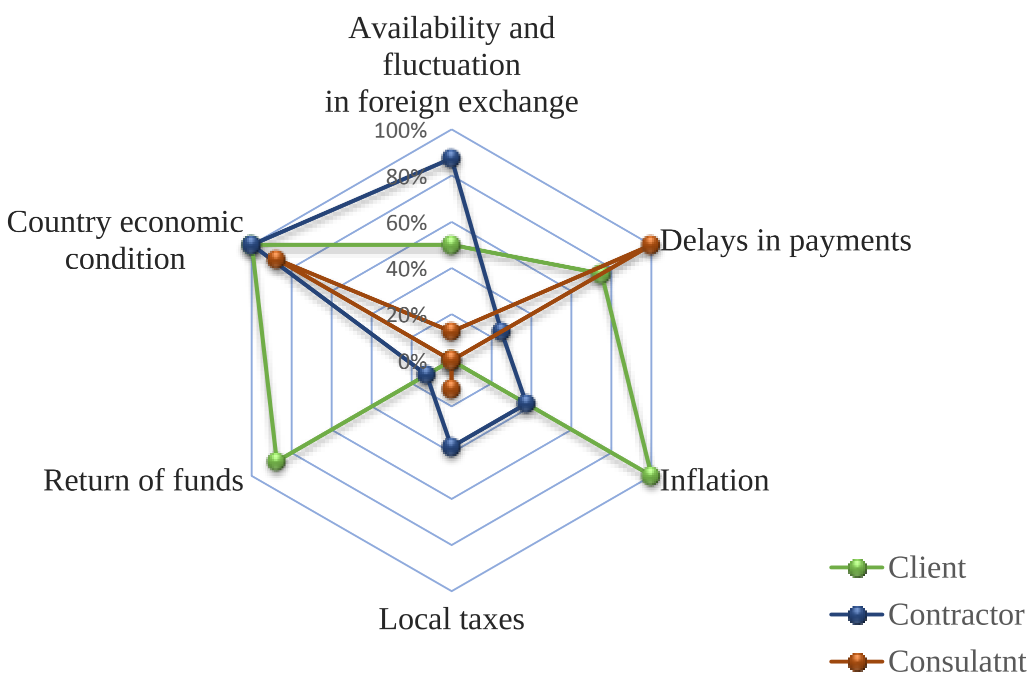


Figure 5.13: Financial risk factors allocation based on client's perception

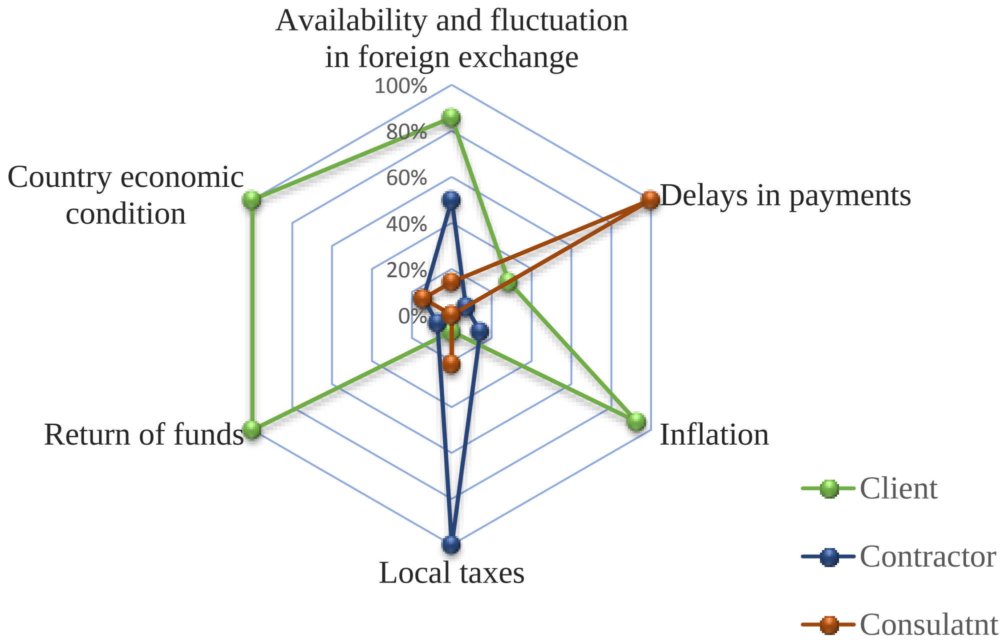


Fig 5.14: Financial risk factors allocation based on contractors' perception

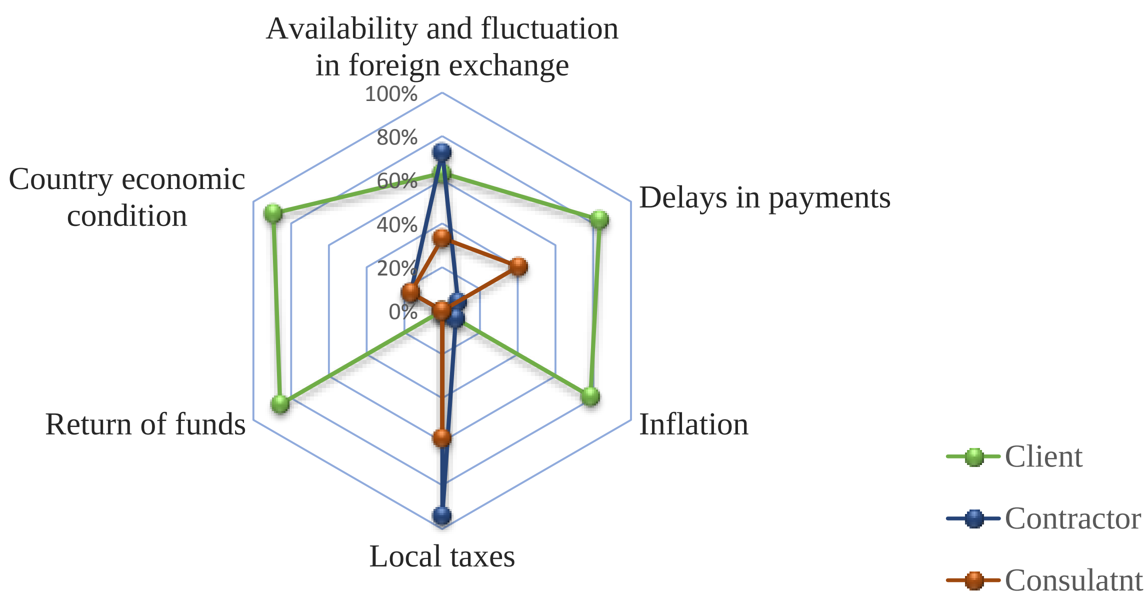


Fig 5.15: Financial risk factors allocation based on consultants' perception

D. Socio-political Risk Factor Group

Risks related to socio-political aspects are inevitable to any construction project. They can exist from inception up to completion of a project. Even if most of the socio-political risks occur because of external factors, they have the capacity to impact project objectives and parties. Therefore, someone should be responsible for that damage. According to clients' and consultants' perceptions, customs and import restrictions, regulator changes, and incapability of local firms were allocated to the contractor. They agreed that regulatory changes have shared concern with the consultants. The major risk factor of RoW is allocated to the client based on their perceptions.

Contractors agreed that they face the risks of customs' procedures, import restriction and incapability of local firms' risk factors. They allocated regulatory changes and RoW factors to the client. Some of the contractors shared these socio-political risks to all the major stakeholders. Figures 5.16, 5.17 and 5.18 below present: socio-political risk factors allocation based on: clients', contractors' and consultants' perceptions.

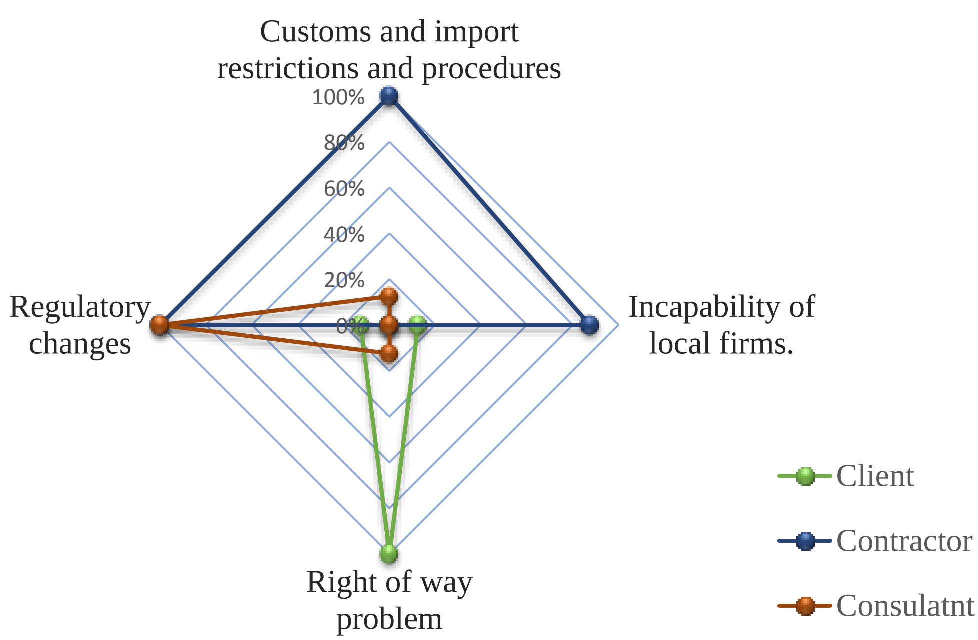


Figure 5.16: Socio-political risk factors allocation based on client's perception

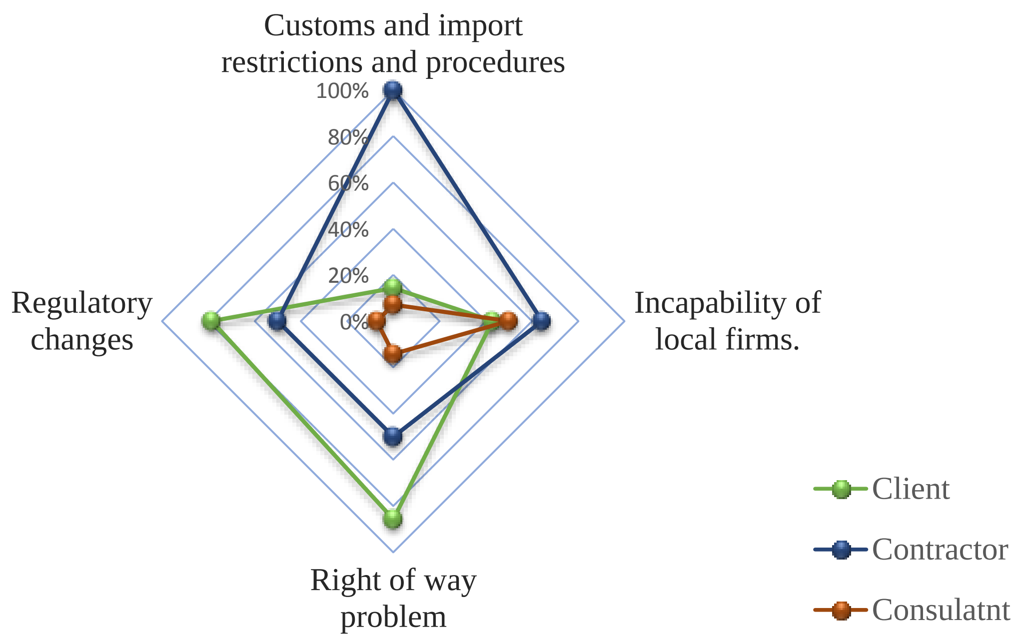


Figure 5.17: Socio-political risk factors allocation based on contractor’s perception

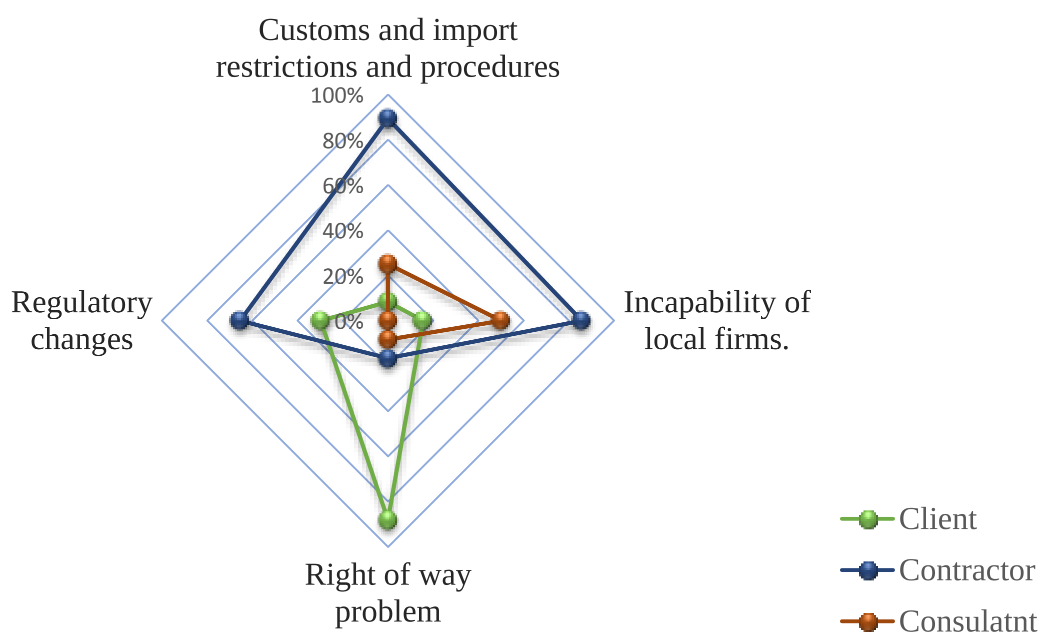


Figure 5.18: Socio-political risk factors allocation based on consultant’s perception

E. Contractual Risk Factor Groups

In this study, three contract-related risks were identified, and they include: gap in contract document, disputes, and unavailability of dispute resolution body. The norm in the construction industry is that contract documents are prepared by the consultant and the work agreement is signed between the contractors and the Clients after they have checked the inclusion of all the necessary clauses. However, clients and consultants' representatives allocate the risk of gap in the contract document to clients and consultants. Dispute resolution mechanisms are stated in the general conditions of public contracts. However, if there is a case in which there will be delays because of unavailability of a dispute resolution body for some period, the client will cover all the losses regarding the project. Clients and consultants share the costs regarding unavailability of a dispute resolution body while the contractors will be responsible for occurrences of disputes.

Contractors have a little different perception of allocation of contractual risks. According to them, all the contractual risks would be allocated to the client the gap in the contract document and occurrence of dispute would be allocated to consultants and contractors. Noticeably, if there is dispute between the parties, even if the severity will be different, all the parties will be liable to loss of time and money. Therefore, the parties should discuss on how to solve future disagreements. The parties should also review and clearly state and allocate responsibilities in the contract document before signing of the contract and included in the contract document if there are ambiguous issues that can cause dispute through the project life cycle. Figures 5.19, 5.20 and 5.21 below present the contractual risk factors allocation based on: clients', contractors' and consultants' perceptions respectively.

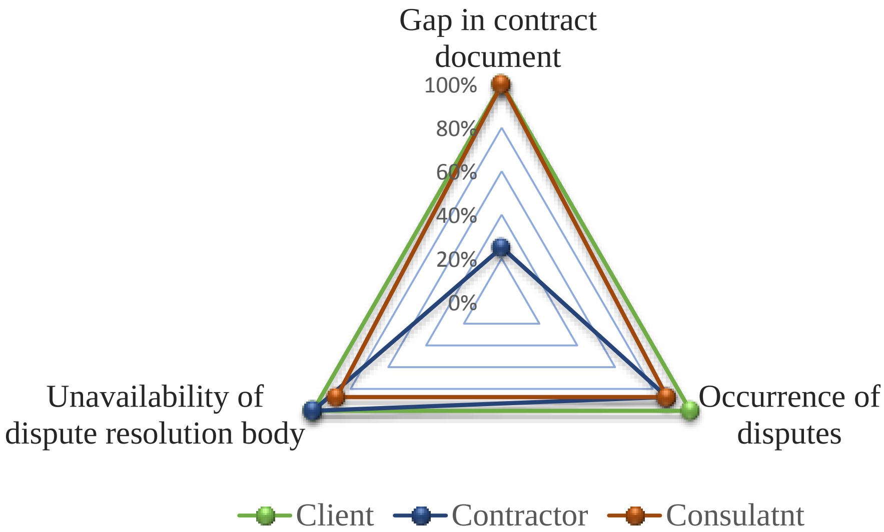


Figure 5.19: Contractual risk factors allocation based on client's perception

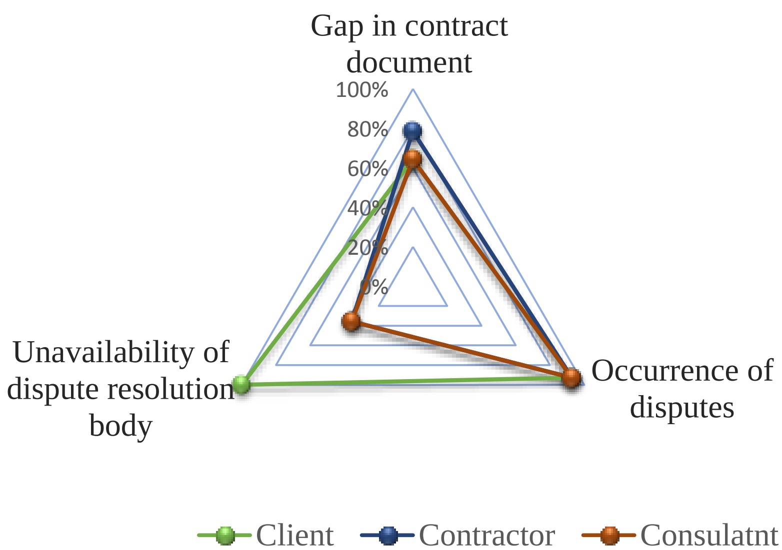


Figure 5.20: Contractual risk factors allocation based on contractors' perception

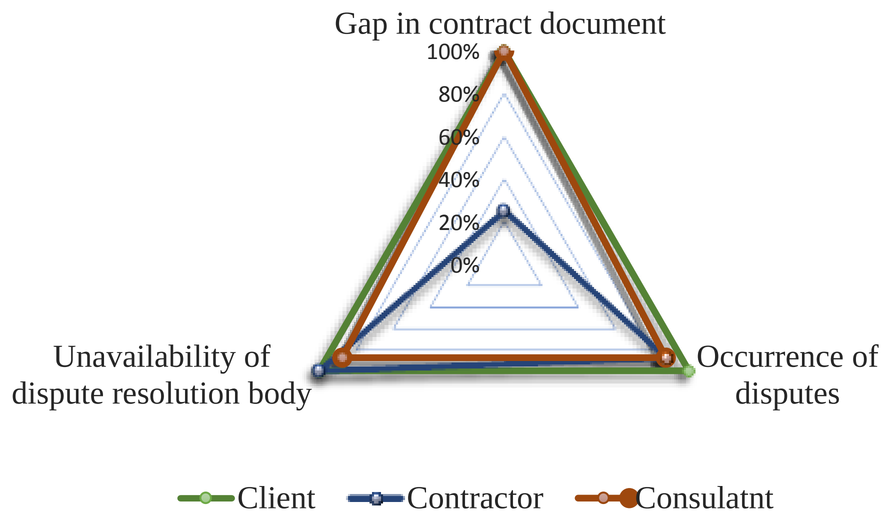


Figure 5.21: Contractual risk factors allocation based on consultants' perception

F. Environmental, Physical and Other Risk Factor Groups

According to the client' perception, Contractors and Consultants have been marked to be responsible for the occurrence of accidents. The clients accepted to bear the risk over unexpected weather condition. But, according to the contract documents, the employer shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workman or other person in the employment of the contractor or any sub-contractor, save and except an accident or injury resulting from any act or default of the employer, his agents, or servants.

Other unidentified risk factors were given shared responsibility to all parties according to clients', contractors' and consultants' perception. Figures 5.22, 5.23 and 5.24 below present the environmental, physical and other risk factors allocation based on; clients', contractors and consultants' perceptions respectively.

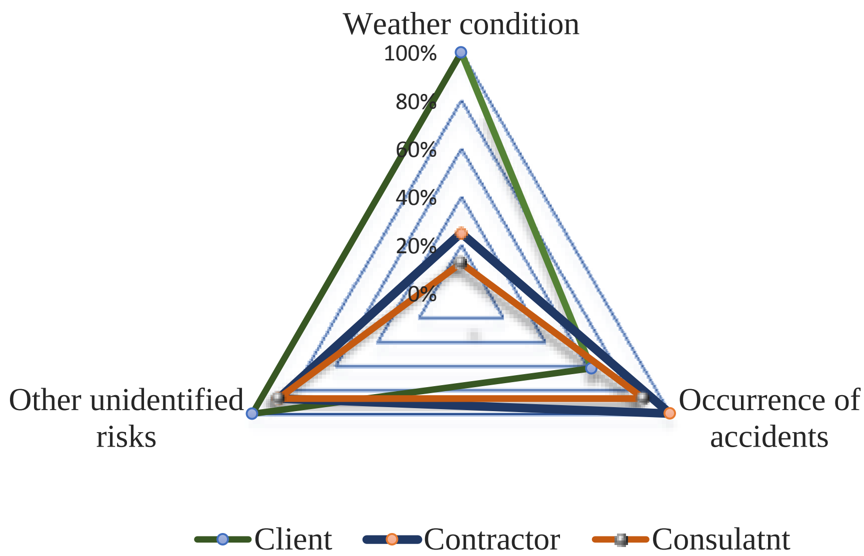


Figure 5.22: Environmental, physical and other risk factors allocation based on client's perception

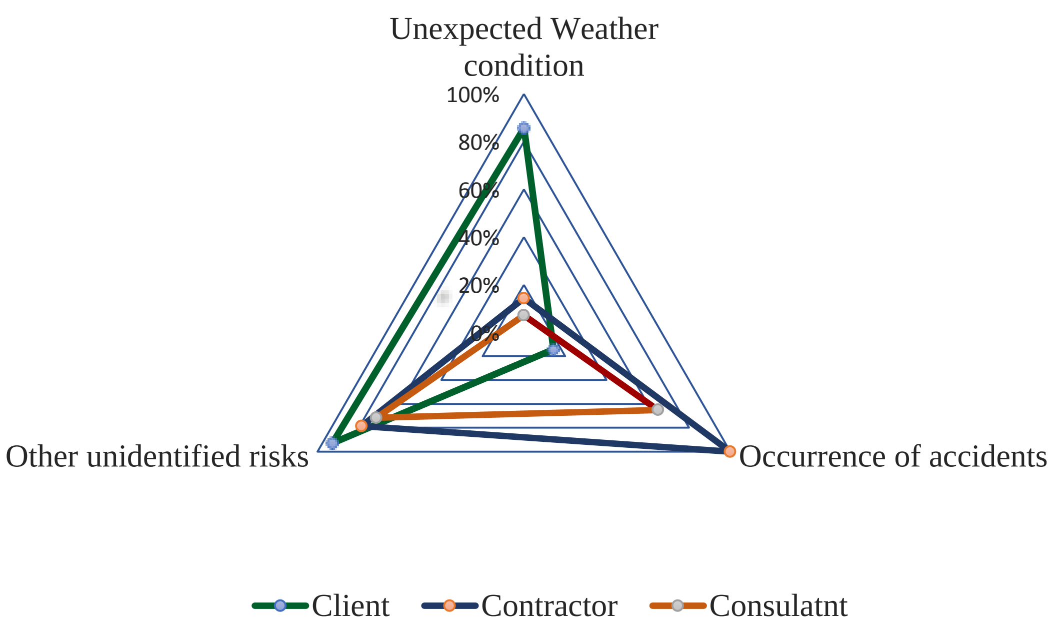


Figure 5.23: Environmental, physical and other risk factors allocation based on contractors' perception

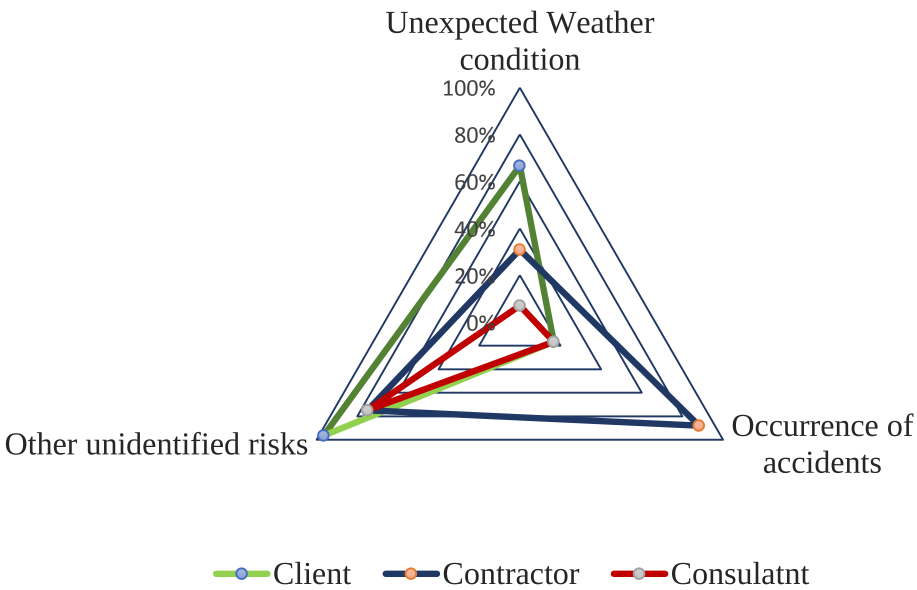


Figure 5.24: Environmental, physical and other risk Factors allocation based on consultants' perception

5.2.10 Importance of Risk Management throughout the Project Life Cycle

Construction risks have distinct characteristics through the project life cycle. According to (Wubishet, 2008: 8), during the feasibility and construction planning phase of construction project; risk is associated with three major decisions (go, may go or review, and no go) that can be made under the risk types of appraising, financing and defining the project, During the design, risks are associated with experience and capacity of the designer, design completeness, design changes and design freezing under design related risk type, During the construction works phase, risks are associated with the experience and capacity of the contractors, low balling, risk allocations, adversarial relations, locations, quality failures, negative cash flows and accidents under tender, contract and construction related risk type, During the construction project product transfer phase; risks are associated with defects remedy and their estimation under defects liability related to risk types.

As mentioned in the literature review, every project, not just those in the construction industry, goes through a series of identifiable phases, wherein it is 'born', it matures, it carries through to old age and it 'expires' (F. Lawrence, 2003: 7). The complete phase of a project is called project life cycle. Different identifications of construction phases have been identified by scholars and institutes. However, for this study the project life cycle was divided into five phases namely: feasibility, planning and design, tendering, construction, turnover and startup. After the analysis of the survey it was found that most of the professionals have agreed that planning and design is the most important phase for risk management. This agreement goes with what was discussed in the literature review by Dale et' al (2005:2), that risk should be considered at the earliest stages of project planning. Yet risk management is also very important at the other phases too. Based on the mean score construction phase, feasibility phase, tendering phase, turnover and start up phases take the next places successively. The values given to all the phases are illustrated in Figure 5.25 below.

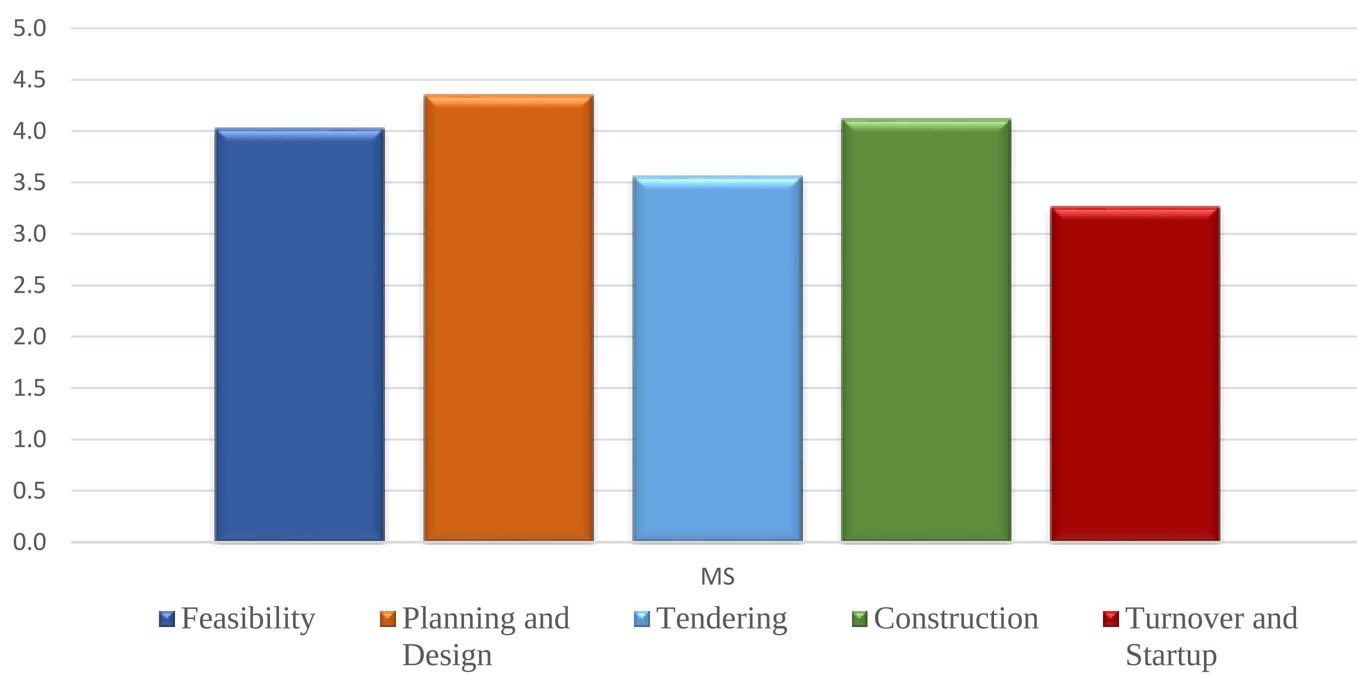


Figure 5.25: Importance of risk management at various phases of a project life cycle

5.2.11 Risk Management Practice

A. General

We find different risk management techniques in various literatures, through the risk management processes. As discussed in the literature review, Risk Management is a very wide area of knowledge and its applications in a project or within an organization can be qualitatively or quantitatively described. The respondents were asked if they used risk management techniques at the road construction projects and all the respondents from the client, contractor and consultant answered that they use risk management techniques.

Formal Risk Management Techniques can helpful when they are used by integrating risk management into the project process or into firm's policy. However, during the survey, one of the questions related to integrated formal risk management techniques and all client representatives respond that there are no integrated formal risk management techniques. Thirty Six percent (36%) and seventeen percent (17%) of the contractors' and consultants' representatives say that there is a formal integrated risk management, while the rest sixty four percent (64%) and eighty three percent (83%) of the contractors and consultants responded that there is no formal risk management technique.

B. Practice of Risk Management at different cycles of a project

Risk Management principles can be applied at each phase of a construction cycle for effective implementation of road construction projects. Since AACRA is undertaking its projects with traditional design bid build (DBB) delivery system, we can study projects' life cycles using the five PMBoK's phases of a construction cycle. According to the survey there is no risk management practice at the feasibility stage. Contractors use risk management at tendering cycle more than other cycles. Contractors will calculate their prices for bid; the most common technique they use while costing is allocating contingencies. Eighty eight percent (88%), 79%, and 50% of surveyed clients, contractors, and consultants use risk management at the construction cycle. Different mechanisms can be used for managing risk at this cycle. However, the current practice at projects' turnover and startup phase is very rare. Figure 5.26 below illustrates the practice of risk management at various phases of a project life cycle.

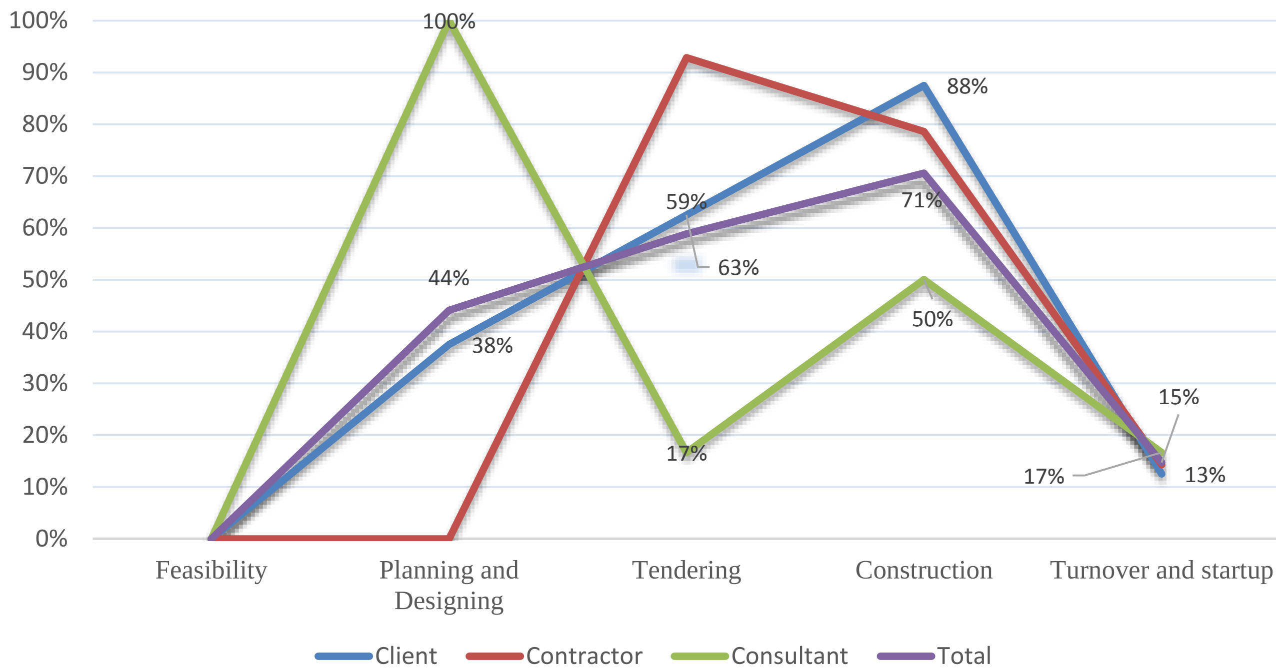
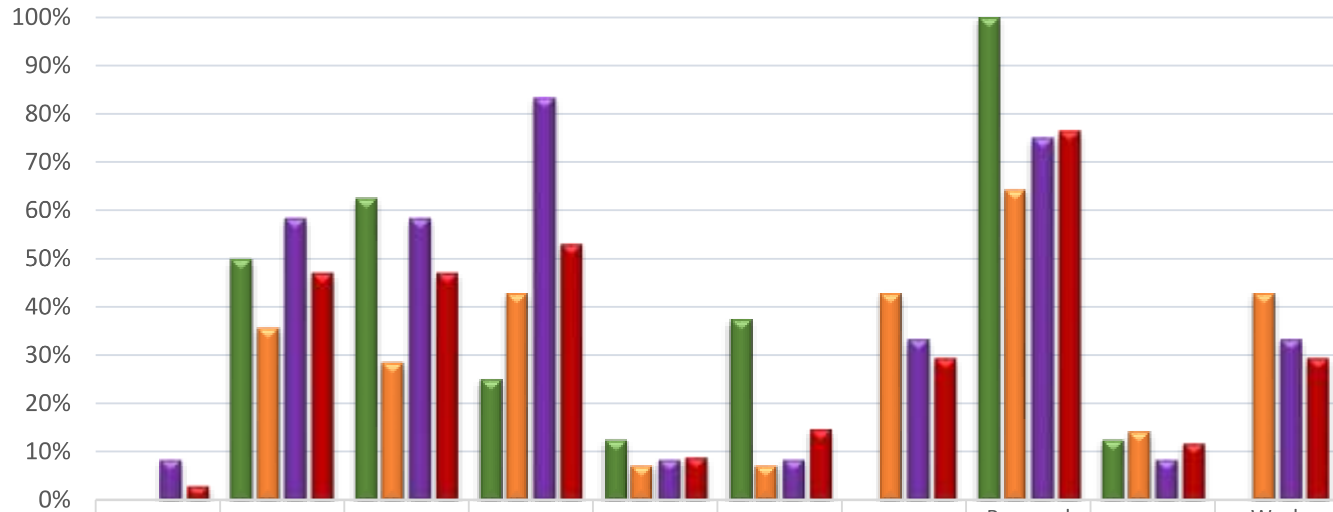


Figure 5.26: Practice of risk management at various phases of a project life cycle

C. Practice of Risk Identification Mechanisms

Risk Identification is the first step in risk management process. Risk identification can be applied to all phases of a construction project and will affect the later processes of risk management. Therefore, we should identify potential risks with their probable causes and effects. If we fail to do so, we may encounter a great loss of the project. Based on the literature review, there are quantitative and qualitative risk identification mechanisms. These mechanisms were included into the questionnaire. Based on the survey result, only 3% of the total respondents (only consultants) answered that they are implementing quantitative mechanisms. While personal experience or project history was identified as the most widely used mechanism. Expert's opinion gets the next rank with 53% of the total survey. Both workshop and meetings, and audits or physical inspections became the third widely used mechanisms in the road construction sector. Figure 5.27 below illustrates the practice of risk identification mechanisms.

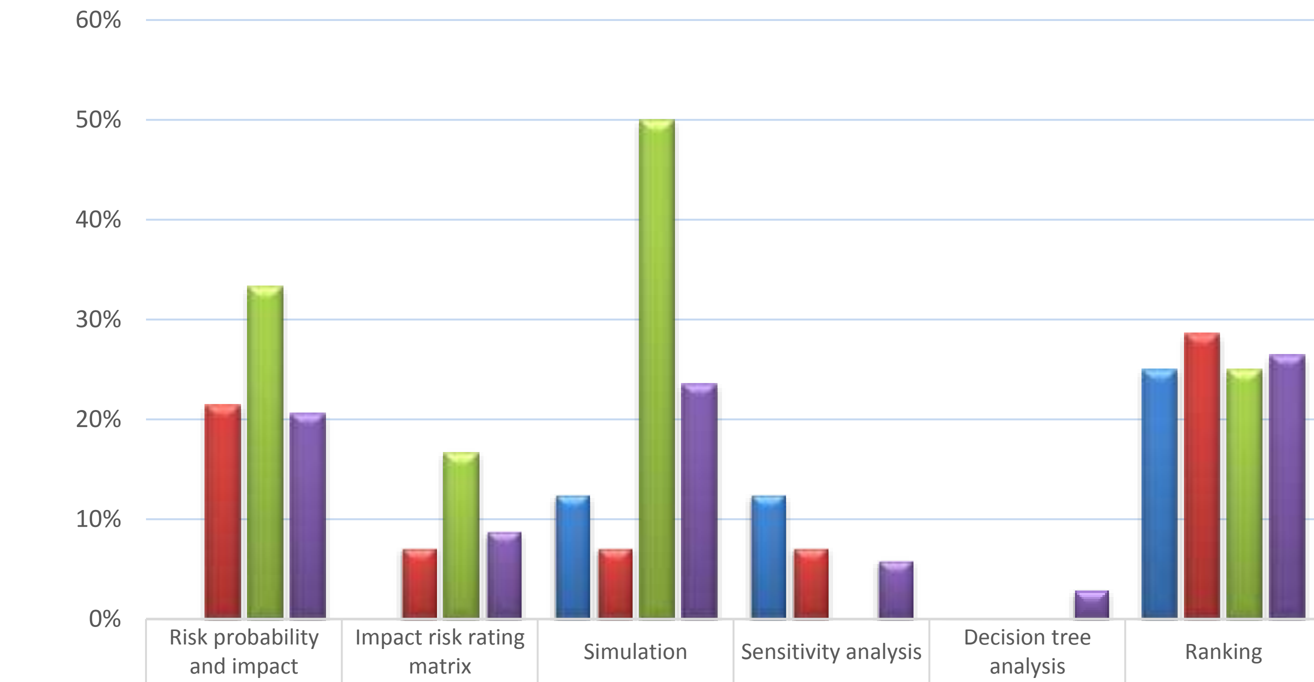


	Quantitative Analysis	Workshop and Meetings	Audits or Physical Inspections	Experts Opinion	Survey and Questionnaire	Interview/ focus group discussion	Checklists	Personal Experience or Projects History	SWOT analysis	Work breakdown structure analysis
Client	0%	50%	63%	25%	13%	38%	0%	100%	13%	0%
Contractor	0%	36%	29%	43%	7%	7%	43%	64%	14%	43%
Consultant	8%	58%	58%	83%	8%	8%	33%	75%	8%	33%
Total	3%	47%	47%	53%	9%	15%	29%	76%	12%	29%

Figure 5.27: Practice of risk identification mechanisms

D. Practice of Risk Quantification Mechanisms

Risk quantification or assessment is a vital stage of risk management. Risk is quantified to assess the possible effect of the risks in the project. We may use qualitative and quantitative mechanisms. When we have sufficient data and knowhow, the best mechanism is quantitative approach. The survey in this respect revealed that, the practice is very low in the road construction sector. Further, the overall survey results showed that ranking, simulation, risk probability and impact analysis took the lead with 26%, 24%, and 21% respectively. Among the parties, the consultant was found out to be more familiar with simulation than others. Decision tree analysis, sensitivity analysis and impact risk rating matrix were found to be the least risk quantification mechanisms. Figure 5.28 below illustrates the practice of risk quantification mechanisms.

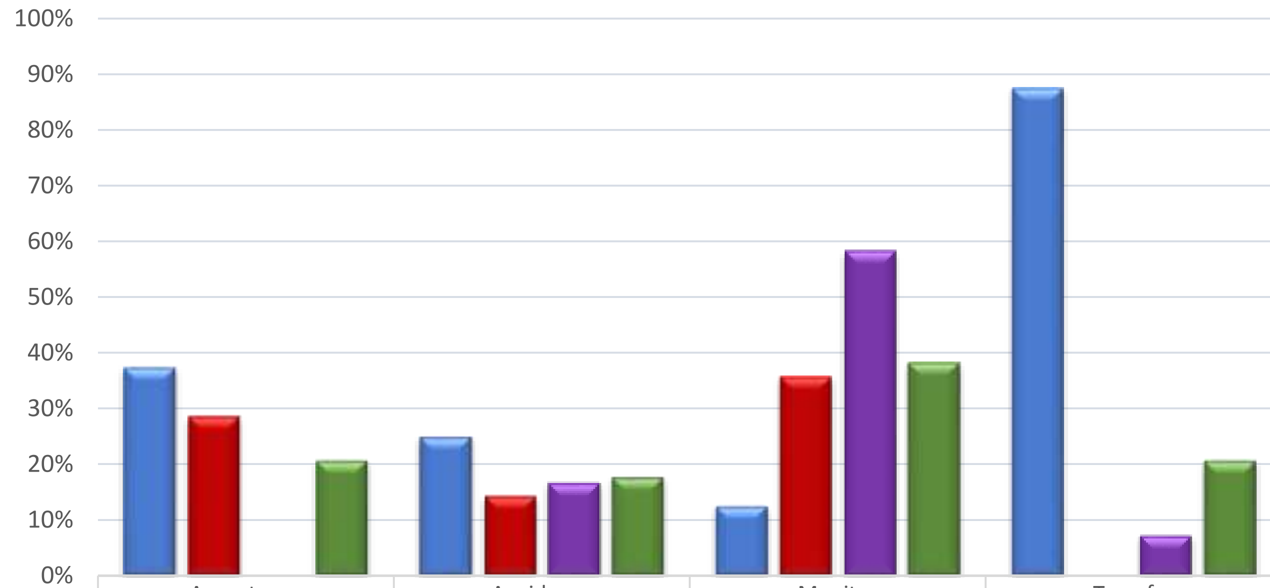


	Risk probability and impact	Impact risk rating matrix	Simulation	Sensitivity analysis	Decision tree analysis	Ranking
Client	0%	0%	13%	13%	0%	25%
Contractor	21%	7%	7%	7%	0%	29%
Consultant	33%	17%	50%	0%	0%	25%
Total	21%	9%	24%	6%	3%	26%

Figure 5.28: Practice of risk quantification mechanisms

E. Risk Response Strategies

Risk response strategies are incorporated in a company's policy more often. There are four main risk response strategies, and these are: monitoring, avoidance, transferring, and acceptance that can be effective risk response strategy accordingly. Among the contractors, only 29% of them said that they accept and take into consideration project risks. Risk avoidance was the other type of risk response mechanism used in the sector. Kevin (2010:38) also discussed that avoidance of risk can be effectively implemented in a project and risks can be avoided by not doing a portion or all the scope of the project which contains risk. The survey also implies that the most widely used mechanism in AACRA is transferring risks. However, as discussed under the section of the desk study, when there is a severe RoW problem in the projects, AACRA accept the risk and its consequences and involves in construction of public road project. Similarly, the survey also illustrated that AACRA is using acceptance as a risk response strategy. The AACRA officials said that when the planned project has a bigger scope or volume of work and complexity they transfer the risk by outsourcing the construction of the project. Similarly, the survey showed that the AACRA respondents have agreed that they transfer some of the project's risks to other parties. The consultants agreed that monitoring is the most widely used strategy in their executions. Figure 5.29 below illustrates the practice of the risk response strategies.

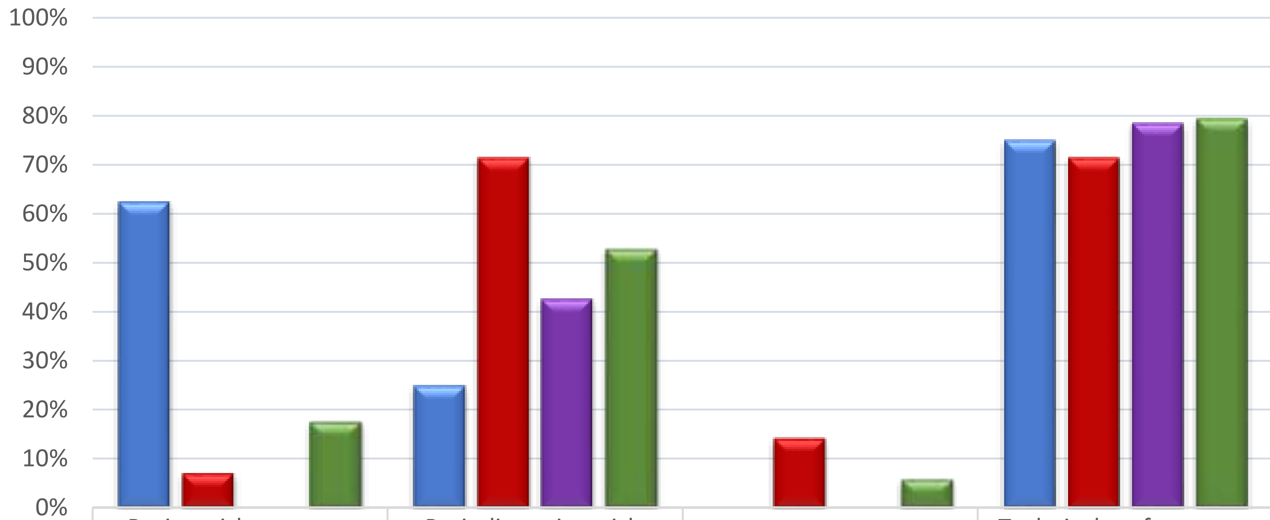


	Acceptance	Avoidance	Monitor	Transfer
Client	38%	25%	13%	88%
Contractor	29%	14%	36%	0%
Consultant	0%	17%	58%	7%
Total	21%	18%	38%	21%

Figure 5.29: Practice of risk response strategies

F. Risk Response Control Mechanisms

Our risk management strategy should be controlled and evaluated after all. Therefore, different risk response control mechanisms have been developed by scholars. The response control mechanism is periodically implemented and produced in reports. Among the five identified risk response mechanisms in this study, technical performance measurement is the most widely used mechanisms with 75%, 71%, and 79% response rate in respect of clients', contractor's, and consultant's representatives. While non-of the parties use additional risk response planning mechanism. It was also found that, 71% of the contractors use periodic project risk reviews for risk response control mechanism while insignificant portion of the parties, which are the contractors use earned value analysis. Figure 5.30 below illustrates the practice of risk response control mechanisms.



	Project risk response audits	Periodic project risk reviews	Earned Value Analysis	Technical performance measurement
Client	63%	25%	0%	75%
Contractor	7%	71%	14%	71%
Consultant	0%	43%	0%	79%
Total	18%	53%	6%	79%

Figure 5.30: Practice of risk response control mechanisms

5.2.12 Additional Comments and Opinions from Respondents

The final section of the questionnaire requests the respondents to give their additional comments and opinions on risk management. Accordingly, the some of the respondents say that, the risk management practice in Ethiopian construction industry is in its development stage and more has to be done on adopting good risk management culture in the industry. However, recently many local contractors are establishing risk management department to incorporate in to their management system. The respondents also recommend that risk management will be effective if the firms apply it in project base. They also suggest that risk management should be practiced on the planning stage of the project to increase our influence on risk minimization. In addition, they suggested that all management levels in a firm and various stake holder should have a good communication amongst them.

5.2.13 Summary

From the questionnaire survey it is found out that professionals in Ethiopian road construction sector are aware of risk management concept mainly through university education. Based on the perception of the stake holders in the sector right of way obstacles in the road construction projects is the most probable risk factor. Consecutively, Scope and design change, and unexpected weather conditions become the most probable risk factors. The risk factors were ranked based on their impact on project objectives i.e. cost, quality, and time and high scores were given for technical risk factors. i.e. inadequate site / geotechnical / investigation, incomplete design and design errors, scope and design change, defect in the quality of work, and improper planning and costing of projects. Regarding the socio-political risk of right of way problem, they were ranked first for their impact on cost and time.

Based on the risk factors probability and impact, their significance were calculated and the following becomes the most significant risk factors in the projects:

- Right of way problem;
- Incomplete design and design problems;
- Inadequate site or geotechnical investigations;
- Scope and design changes; and
- Unexpected climate and weather conditions.

Based on the questionnaire survey it is understood that there is a gap in allocation of risk factors. Personal experience, project's history, meetings, physical inspections and expert's opinion become the most widely used risk identification mechanism based on the survey. The overall survey result shows that ranking is the most widely used risk quantification mechanism. Furthermore, ACCRA uses risk transferring mechanism as a risk response strategy more frequently. Whereas, consultants and contractors are using risk monitoring as a risk response strategy more frequently. In the road construction projects technical performance response mechanisms become the most widely used risk response control mechanism.

CHAPTER SIX

CONCEPTUAL RISK MANAGEMENT FRAMEWORK

6.1 Introduction

The desk studies, case studies, and questionnaires revealed that the risk management practice in the road construction sector is at its maturity stage and there are no formal guidelines in the Ethiopian public road construction sector. In addition, the study showed high probability of risk occurrences in the projects that lead to cost overruns, delays, and quality problems. This chapter is intended to develop a risk management framework for AACRA. The risk management framework presented here is intended to result in an effective management of project and can be used at firm and project level. The framework encompasses holistic and feasibility phase risk management approach. Unlike standards, the framework did not give a total line of managing risk but rather it gives a way for a practical solution for minimizing project risks.

6.2 Background for Developing Risk Management Framework

AACRA is currently in organizational change by implementing new strategies and planning to implement new contract types, and there is a high probability of risk occurrences that could impact project objectives. Similarly, Ward and Chapman (2001: 20-21), suggested that we should consider using a systematic risk management in the following circumstances.

- When we have a serious concern when something could go wrong;
- When we are introducing technical or organizational novelty or change;
- When there are specific targets that must be met;
- When there is unexpected new development in a project;
- At major decision points or points of change in the life cycle of a project;
- To help resolve particular issues, e.g. procurement strategy, contingency allowances;
- Where cost uncertainty is great at the time of commitment to substantial expenditure (cost uncertainties can often be hidden, e.g. large provisional sums; disputes resolution cost and litigation; weather; geotechnical, archaeological and contamination risks);
- When required to do so by funders, or insurers; and
- When consequences can be catastrophic but the likelihood so remote that the event of concern is outside of normal experience.

Risk management framework allows the fundamentals and managerial measures to be implemented in all different levels of the organizations (Chia and Daniel, 2009:9). A risk management culture is essential for identifying, communicating, and managing project risks. This culture is defined by the values in which we operate. The following attributes depict Project RM values required for the development of a successful risk management culture (Caltrans, 2012: 3):

- Risk decision- making based on balancing project values such as cost, schedule, and quality;
- Stewardship;
- Efficiency;
- Teamwork;
- Joint ownership of risks and responsibilities; and
- Accountability.

6.3 Conceptual Risk Management Frame work for AACRA

The following risk management framework is produced for holistic approach and feasibility phase after studying the project life cycle, current risk management practice and the various challenges of AACRA's and ERA's projects. The risk management frame work is adapted from PMBOK and ISO 31000 standards. The following risk management framework will minimize the impact of various project risks through proper mitigation plans for achieving project success. In addition, the holistic frame can help AACRA for developing a risk management guideline and policy at firm level. Since the risk assessment practice by consultants in Federal road projects is identified to have some gaps, and lacks uniformity, the following risk management framework for feasibility stage can be used by ERA and enforced on consultants. Fig 6.1 below presents the proposed risk management frame work (Holistic Approach) and Figure 6.2 subsequent illustrate the proposed feasibility phase risk management framework.

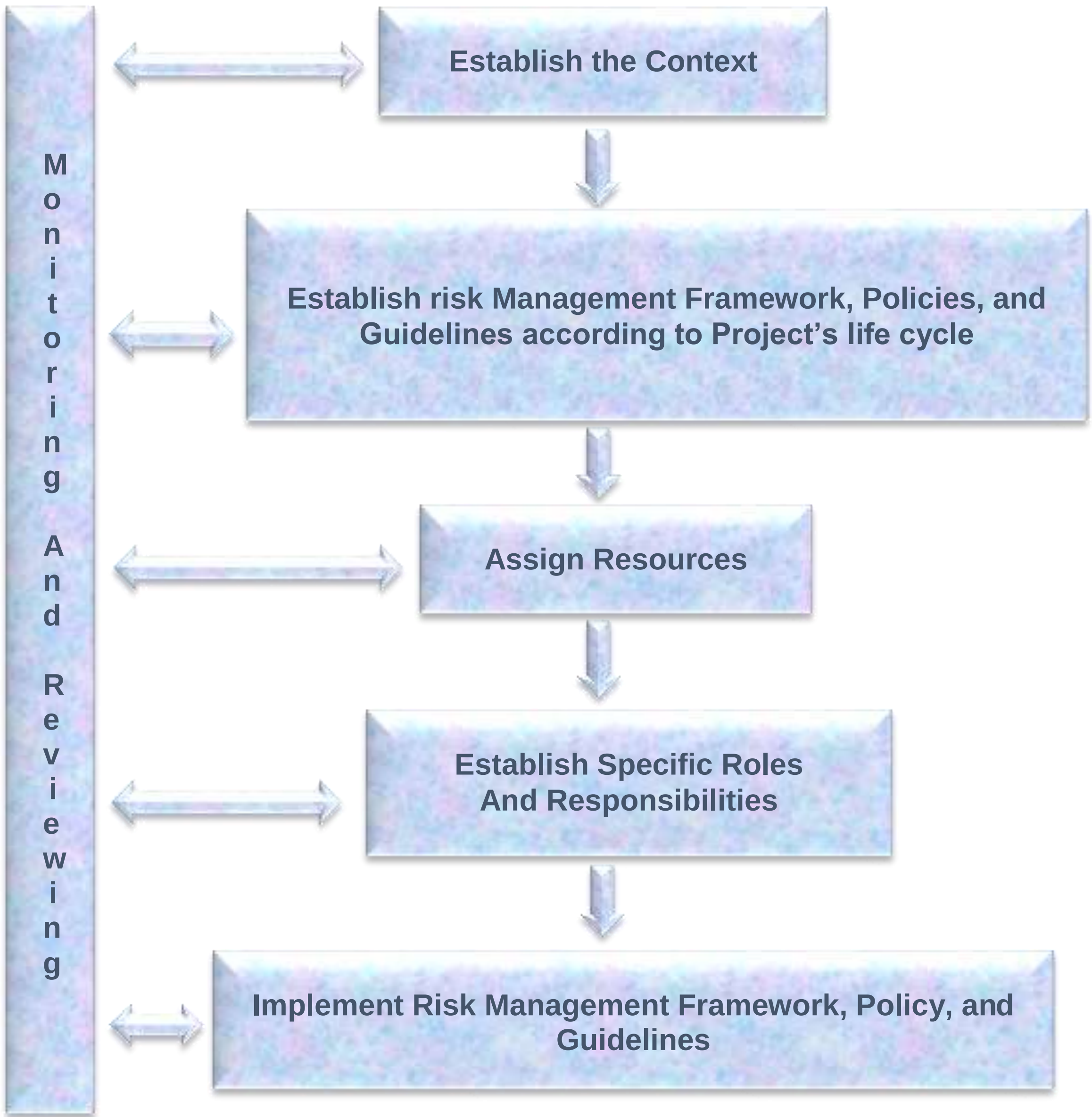


Fig 6.1: Proposed risk management framework (Holistic approach)

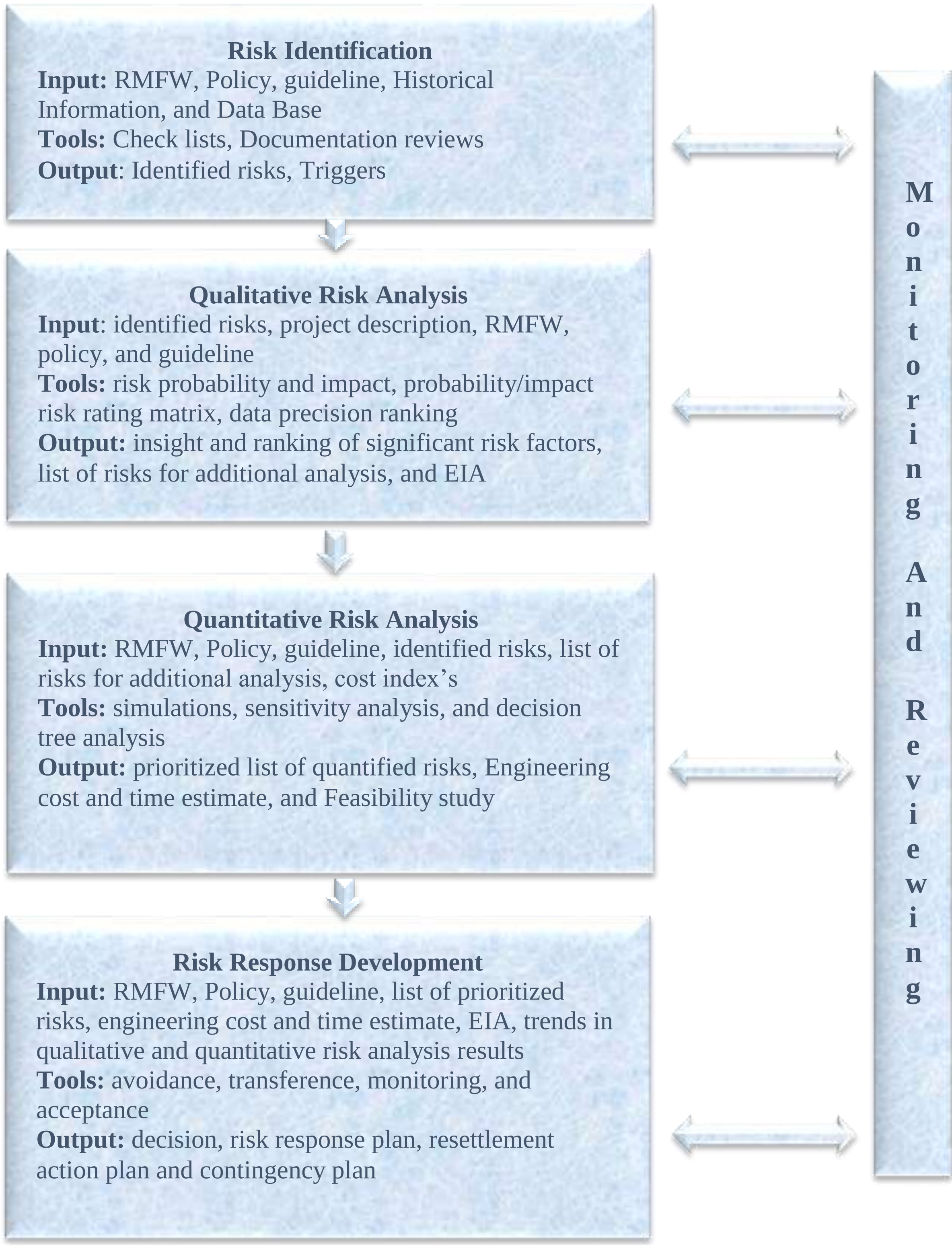


Figure 6.2: Proposed feasibility phase risk management framework

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Based on the desk studies, case studies and questionnaire surveys, the following conclusions were derived:

- Even if, the staffs of the major stakeholders in the road construction projects are aware of the concept of risk management mainly through university educations, its practice is in its infant stage.
- Right of Way obstacles become the first probable risk factor among others risk factors by getting 4.43 mean score out of five based on the questionnaire survey. Consecutively, scope and design changes, and unexpected weather conditions were ranked second and third respectively.
- From the desk studies it is concluded that Addis Ababa City Roads Authority and Ethiopian Roads Authority are not implementing a formal risk management framework, policy or guideline.
- The desk study reveals that Addis Ababa City Roads Authority identifies its projects for execution using their socio-political influence, traffic flow, Addis Ababa's master Plan and from public demands. However, Addis Ababa City Roads Authority does not conduct feasibility studies of the identified projects before their execution, except when it becomes mandatory by financers.
- ERA enforces implementation of feasibility study, resettlement action plan, and environmental impact assessment of the projects before there construction. However, regarding the Addis Ababa City Roads Authority, the practice related to environmental impact assessment and resettlement action plan is very weak.
- Risk assessment and mitigation plan is performed by the consultants in design-build federal road projects. However, the risk assessment in the federal design build projects is not uniform and has no restriction in using specific guideline by the client.

- The identified twenty-six (26) risk factors are found to impact project's cost, quality, and time very significantly. Based on the analysis using the probability and impact of the identified risks, the following become the most significant risks in AACRA's projects:
  - Right of way obstacles;
  - Incomplete design and design problems;
  - Inadequate site or geotechnical investigations;
  - Scope and design changes; and
  - Unexpected climate and weather conditions.
- Based on the respondents additionally to the twenty-six (26) risk factors unavailability of wastage/spoil area, and county's peace and security was listed as unidentified risks by the survey.
- Risks should be allocated to the party or parties which can manage it well. Based on the perception of the major stakeholder, the following need consideration:
  - Technical risks should be allocated to consultants except risks related to change in scope of the work;
  - Contractors can manage logistical and management risks well;
  - Client can bear financial risk more than others;
  - Except Right of way obstacle which can be well solved by the client, the rest socio-political risk factors are well managed by the contractor;
  - Contractual risks are given a shared responsibility to all the major stakeholders;
  - Physical risks can be well managed by the major parties involved; and
  - Risks related to unexpected weather and climatic conditions should be allocated to the contractor.
- Personal experience, project's history, meetings, physical inspections and expert's opinion are the most widely used risk identification mechanism consecutively in Ethiopian road construction sector.

- Consultants widely use simulation as a risk quantification mechanism than other mechanisms. The overall survey result shows that ranking is the most widely used for risk quantification mechanism.

- ACCRA uses risk transferring mechanism as a risk response strategy more frequently. Whereas, consultants and contractors are using risk monitoring as a risk response strategy more frequently.

- Technical performance response mechanisms are the most widely used risk response control mechanism in the road construction sector.

7.2 Recommendations

The following recommendations are forwarded for possible use by pertinent policy makers:

- Risk management guidelines and policies can be developed by the public road construction authorities and consequently risk management trainings and workshops should be exercised to increase the level of risk management awareness.

- The proposed holistic risk management framework can be used for developing risk management guidelines and principles in AACRA. In addition, the proposed risk management framework for the feasibility phase can be used at AACRA's projects.

- ERA can use the proposed frame work. Since there is lack of formal risk management in the firm.

- AACRA should plan project's life cycle and the scope well by considering future developments and traffic flow. In addition, AACRA should study project's feasibility study before there executions for avoiding economic loss from projects execution.

- ACCRA can manage the risk of right of way by developing an effective and detailed resettlement action plan and by coordinating with various utility offices ahead of the construction time.

- AACRA's design review team should be well established with road design and geotechnical expertise to review designs and geotechnical reports more efficiently to avoid design errors and gap in geotechnical investigations.

- AACRA can allocate project risks for a party that can manage the risks better and some risks can be shared among parties for developing accountability and effective project management.

- AACRA can implement various project delivery and/or contract types according to the project's property.

- ERA should give assignment for consultants to execute risk assessments and mitigation plans for all of its projects other than design-build (DB) projects. In addition, ERA should develop a formal guideline for the consultants.

7.3 Future proposed research areas

I recommend further research to be conducted on the subject of;

- ✓ Improving the risk management practice of procurement, contract administration, design and supervision teams in ERA and AACRA.
- ✓ Improving the risk management practice of local contractors and consultants.
- ✓ Studying the risk management practice of other sectors like Dams, and Railway Construction.
- ✓ Studying the role of insurances and banks in managing risks in Ethiopian construction industry.

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APPENDIX A. QUESTIONNAIRE

ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

(CONSTRUCTION TECHNOLOGY AND MANAGEMENT STREAM)

QUESTIONNAIRE

A Study on Development of a Conceptual Risk Management Framework:

A Case Study on Addis Ababa City Roads Authority

Researcher: Emran Hassen

Advisor: Dr. Alemayhu Ambo

Dear Madam/Sir

My name is Emran Hassen. I am currently studying for my MSc. in Civil Engineering (Construction Technology and Management stream) at Addis Ababa Institute of Technology. I am doing my thesis entitled: A Study on Development of a Conceptual Risk Management Framework: A Case Study on Addis Ababa City Roads Authority.

The Ethiopian construction industry has been booming in the last two and half decades. However, the industry is facing different challenges. Accordingly, Addis Ababa's road construction projects are facing different risks. Since applied researches are believed to mitigate practical problems, I am motivated to do a research in this respect. I am confident that the completed research will provide pertinent information and give practical suggestions to alleviate the current challenges in AACRA's road's construction projects by providing conceptual Risk Management Framework.

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(ii) To study the allocation of each identified risk factors based on stakeholders' perception;

(iii) To give insight of risk management practice and key risk factors in federal road projects; and

(iv) To provide practical suggestions and recommendations pointing toward upgrading the risk management practice in AACRA and ERA.

I will be pleased and be very grateful if you contributed to the success of thesis. I believe your experience and educational background will greatly contribute to the achievement of my research. So, it is with great respect that I request you to participate in this questionnaire. I want to make sure that your identity will be kept strictly confidential and the information you provide only be used for academic purposes. I will be happy to share to you the findings of this research when it is completed.

Thank you,

Emran Hassen
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Tel: 0910 610 602
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Section 1: General information

1.1 Name of organization (Optional): ____

1.2 Respondent's organization/company type?

Client ☐ Contractor ☐ Consultant ☐

1.3 Respondent's position:

☐ Top Level Management (Example: Owner of organization, Director, Deputy Director)

☐ Middle Level Management (Example: Project Manager, Resident Engineer, Contract Engineer)

☐ Lower Level Management (Example: Site Engineer, Site Supervisor/inspector, Office Engineer)

1.4 Respondent's educational level and area of training: ____________

1.5 Respondent's experience in construction industry (Years): _____________

1.6 Respondent's experience at current position (Years): _____________

Section 2: Level of awareness

2.1 Are you aware of the concept of risk management?

☐ Yes ☐ No

2.2 If your answer to question number 2.1 is yes, how do you evaluate your knowledge of risk management? ....

☐ Low ☐ Moderate ☐ High

2.3 If your answer to question number 2.1 is yes, how did you become to be aware of risk management?

☐ Through conversation with colleagues ☐ Through university education

☐ Through workshop and training ☐ Through reading

☐ Through other means, please specify ________________________________

2.4 What should be done to increase the awareness of risk management?

____

____

____

Section 3: Risk in a project and Risk Management

Symbol	Meaning
1	Insignificant
2	Low
3	Medium
4	High
5	Very high

Symbol	Meaning
G1	Client
G2	Contractor
G3	Consultant

3.1 Based on the keys provided below, please rate the probability of occurrence of risk factors in road construction project in your company/organization and rate their impacts on project objectives (Cost, Quality, and Time), allocate each risk factor to the major stake holders (Client, Contractor and Consultant)?

Risk Factors	Probability of occurrence					Impact															Risk Allocation		
						Cost					Quality					Time							
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	G1	G2	G3
1. Technical risks																							
1.1 Inadequate site /Geotechnical investigation																							
1.2 Incomplete design and design error																							
1.3 Inappropriateness of specifications																							
1.4 Uncertainty over the quality and availability of materials																							
1.5 Scope and design changes																							
1.6 Defect in the quality of work																							
1.7 Improper planning and costing of projects (Underestimating)																							
2. Logistical risks																							
2.1 Unavailability of skilled labor																							
2.2Unavailability construction equipment's, spare parts, fuel																							
3. Management related risks																							
3.1 Uncertain productivity of resources																							
3.2 Industrial relations problems																							
4. Environmental risk																							
4.1 Unexpected Weather condition																							

Risk Factors	Probability of occurrence					Impact															Risk Allocation		
						Cost					Quality					Time							
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	G1	G2	G3
5. Financial risks																							
5.1 Availability and fluctuation in foreign exchange																							
5.2 Delays in payments																							
5.3 Inflation																							
5.4 Local taxes																							
5.5 Return of funds																							
5.6 Country economic condition																							
6. Socio-political risks																							
6.1 Customs and import restrictions and procedures																							
6.2 Incapability of local firms.																							
6.3 Right of way problem																							
6.4 Regulatory changes																							
7. Contractual risks																							
7.1 Gap in contract document																							
7.2 Occurrence of disputes																							
7.3 Unavailability of dispute resolution body																							
8. Physical																							
8.1 Occurrence of accidents																							
9. Others																							

If there is any other unidentified risk by the survey please specify;

____

____

3.2 Based on risk exposure, please rate the importance of risk management at each stage of construction project cycle?

Project cycle	Importance of risk management				
	1	2	3	4	5
Feasibility					
Planning and Designing					
Tendering					
Construction					
Turnover and Startup					

Section 4: Level of practice of Risk Management

4.1 Does your company practice risk management techniques?

☐ Yes ☐ No

4.2 If your answer to question number 4.1 is yes, answer the following:

(i) Is risk management formally integrated with the project process or in to your company's policy?

☐ Yes ☐ No

(ii) At what cycle of the project does your company frequently use risk management (you can tick more than one)?

☐ Feasibility ☐ Planning and Designing ☐ Tendering ☐ Construction ☐ Closing

(iii) a) What do you use to identify risks ?

☐ Quantitative analysis (i.e. Decision tree analysis, Monte-carlo simulation etc.)

□ Workshops and Meetings with responsible parties

□ Audits or physical inspections

□ Experts opinion

□ Survey and questionnaire

□ Interview/focus group discussion

□ Checklists

□ Personal Experience or Projects History

□ Strengths, weaknesses, opportunities and threats (SWOT) analysis

□ Work breakdown structure analysis

□ Others, please specify________________________________

(iii) What risk quantification method do you usually use?

□ Risk probability and impact □ Impact risk rating matrix

□ Simulation □ Sensitivity analysis □ Decision tree analysis □ Ranking □ Others, please specify ____________________

(iv) What risk response strategy do you usually use?

□ Acceptance □ Avoidance □ Monitor □ Transfer

(v) What is the risk response control mechanism usually used?

□ Project risk response audits □ Periodic project risk reviews

□ Earned value analysis □ Technical performance measurement □ Additional risk response planning □ Others, please specify ______________________________

Section 5: Additional comment

5.1 Please comment and share your experiences and opinions on risk management practice?

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Thank you again for your time,

Emran Hassen Abdu

APPENDEX B: INTERVIEW QUESTIONS

ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

(CONSTRUCTION TECHNOLOGY AND MANAGEMENT STREAM)

INTERVIEW QUESTIONS

A Study on Development of a Conceptual Risk Management Framework:

A Case Study on Addis Ababa City Roads Authority

Researcher: Emran Hassen

Advisor: Dr. Alemayhu Ambo

Dear Madam/Sir

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Addis Ababa Institute of Technology
Tel: 0910 610 602
Email: emranhassen@gmail.com
Addis Ababa

Section 1: General

Please provide the following information

1.1 Name ____________________________

1.2 Department ________________________________

1.3 Position ___________________________________

Section 2: Use of Risk Management

2.1 Are you aware of risk management? ☐ Yes ☐ No

2.2 Does your company practice risk management techniques? ☐. Yes ☐ No

2.3 If yes, what is your guidance while managing risk?

____

2.4 Which department or team is responsible for managing risks in your organization?

____

2.5 Please explain your project's life cycles or phases?

____

____

____

2.6 At what stage of a project is risk identified in your organization?

____

2.7 What techniques are used for assessing the level of occurance and impact of risks?

____

2.8 How do you allocate risks to the different parties involved in a project?

____

2.9 What is the common risk response planning and monitoring strategy in your organization?

____

2.10 What is your procedure related to risk management in preliminary study and design of the projects?

____

2.11 What is the practice related to scheduling and quantity surveying?

____

2.13 What is the practice related to quantity surveying?

____

2.14 What type of delivery and/or contract type is implemented and why do you decide for using this specific type?

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2.15 What does the practice look like in risk management and site supervision during the construction stage?

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2.16 What is the process you follow during commissioning?

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2.17 How often do you come across delay, cost overrun or quality difficulties?

____

____

2.18 What are the most significance risk factors?

____

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____

2.19 What means did you use in meeting project's objectives?

____

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______________________________________..

Thank you again for your time,

Emran Hassen Abdu

APPENDEX C: ERA's Design-Build Responsibility and Risk Allocation Matrix

In the following table, a list of possible risks are presented and divided between the contracting parties.

Note: C: Contractor; E: Employer; J: Jointly shared

No.	Risk	Risk Details	Result	Borne by (Contractor, Employer, Jointly shared)
1	**DESIGN**			
		Definition of scope	Delays in project delivery, costs of rework on design, costs of reconstruction, costs of maintenance	E
		Project definition		E
		Establishing performance requirement		E
		Preliminary survey/base map		C
		Geotechnical investigation		C
		Establish/define initial subsurface conditions		C
		Specific geotechnical analysis		C
		Plan conformance with regulations/guidelines/Works Requirement		C
		Plan accuracy		C
		Design criteria		E
		Conformance to design criteria		C
		Design review process		J
		Design quality control		J
		Design quality assurance		C
		Changes in scope		E
		Constructability of design		C

No.	Risk	Risk Details	Result	Borne by (Contractor, Employer, Jointly shared)
2	**RIGHT-OF-WAY**			
		Establishing ROW limits	Delay in project time schedule and increase costs	C
		ROW plan approval		E
		Acquire right-of-way		E
		Complete relocation		E
		Additional ROW requirement due to alignment change		E
3	**ENVIRONMENTAL**			
		Define initial project environmental impacts	Delays in project delivery, increased costs of construction	E
		Define parameters for impacts		E
		Environmental investigation		E
		Environmental mitigation		C
		Environmental compliance		C
		Known hazardous waste-mitigation		C
		Unknown/undefined hazardous waste-mitigation		J
		Obtain environmental approvals-construction related		C
4	**UTILITY RELOCATION, LOCAL ADMINISTARTION PERMIT**			
		Establishing final/actual local administration or pertinent offices impacts		C

No.	Risk	Risk Details	Result	Borne by (Contractor, Employer, Jointly shared)
		Identification of utility impacts from preliminary design		C
		Establish utility locations/conditions		C
		Defining required utility relocations from preliminary design		C
		Relocation of utilities under agreement during contract		E
		Damage to utilities under construction		C
		Payment to utility owners		E
		Verification of utility locations/conditions		C
		Coordination with utility relocation efforts during contract		C
		Unforeseen delays due to utility owner and third party		E
		Utility/third-party delays resulting from modified design		E
		Coordinating with third parties		E
		Coordination with other projects		E
		Performance of utility work		E
		Coordinating with other government agencies		E

No.	Risk	Risk Details	Result	Borne by (Contractor, Employer, Jointly shared)
		Community relations		J
		Public safety		C
5	**CONSTRUCTION**			
		Safety/safety QA	Poor maintenance performance , low level of service, costs of re-tendering	C
		Construction quality/workmanship		C
		Schedule		C
		Materials quality		C
		Materials documentation		C
		Material availability		C
		Initial performance requirements of QA plan	Increased costs of maintenance, Maintainer default, poor maintenance performance	C
		Final construction/materials QC/QA plan		C
		Construction/materials QA		C
		Construction QC		C
		Construction QA procedural compliance auditing		C
		Construction independent assurance (IA) testing/inspection		J

No.	Risk	Risk Details	Result	Borne by (Contractor, Employer, Jointly shared)
		Geotechnical issues like slide, rock fall during Improvement Works period		C
		Geotechnical issues like slide, rock fall during Defects Liability Period and Warranty		c
		Construction staking		C
		Erosion control		C
		Spill prevention		C
		Accidents within work zone/liability		C
		Third-party damages		C
		Operations and maintenance during construction		C
		Maintenance under construction-new features		C
		Maintenance under construction-existing features		C
		Extraordinary / Emergency maintenance		C
		Maintenance of traffic		C
		Damage to utilities under construction		C
		False work		C
		Shop drawings		C
		Equipment failure/breakdown		C

No.	Risk	Risk Details	Result	Borne by (Contractor, Employer, Jointly shared)
		Work methods		C
		Early construction/at-risk construction		C
		Community relations		J
		Performance of defined mitigation measures		C
6	**FORCE MAJEURE/ACTS OF GOD**			
		Strikes/labor disputes-onsite labor	Delays in project delivery, costs of reconstruction	C
		Off-site strikes or riots		E
		Ordinary weather condition		C
		Extraordinary (Exceptionally adverse) weather condition		E
		Earthquake		E
		Epidemic, terrorism, rebellion, war, riot, sabotage		E
		Archaeological, paleontological discovery		E
		Suspension of any environmental approval		E
		Changes in law		E
7	**DIFFERING SITE CONDITIONS/CHANGED CONDITIONS**			
		Changed conditions		C

No.	Risk	Risk Details	Result	Borne by (Contractor, Employer, Jointly shared)
		Differing site conditions		C
8	**WARRANTY OF WORKS**			
		Deterioration of various components of the permanent works	Warranty Bond and Cost of Reconstruction	C