Assessing the Effects of Risk Management Practice on the Performance of Construction Projects: The Case of Addis Ababa City

Feven Araya Asfaw

A Thesis Submitted to

The Department of Civil Engineering School of Civil Engineering and Architectural

Presented in Partial Fulfilment of the Requirement for the Degree of Master's in Civil Engineering (Specialization in Construction Engineering and Management)

Office of Graduate Studies

Adama Science and Technology University

June 2023

Adama, Ethiopia

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DECLARATION

I hereby declare that this master thesis entitled "Assessing the Effects of Risk Management Practice on the Performance of Construction Projects: The Case of Addis Ababa City" is my original work. That is, it has not been submitted for the award of any academic degree, diploma, or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation.

Feven Araya	__________________	__________________
Name of the student	Signature	Date

RECOMMENDATION OF ADVISOR

I, the advisor of this thesis, hereby certify that I have closely advised/supervised the student while developing this thesis and read the draft thesis entitled "Assessing the Effects of Risk Management Practice on the Performance of Construction Projects: The Case of Addis Ababa City" Prepared under my guidance by (Feven Araya). Therefore, I recommend submitting the thesis to the department for further review and evaluation.

Fikreyesus Demeke (PHD)	___________________	___________________
Major advisor/supervisor	Signature	Date

APPROVAL PAGE

I, the advisor of the thesis entitled "Assessing the Effects of Risk Management Practice on the Performance of Construction Projects: The Case of Addis Ababa City" developed by (Feven Araya Asfaw), hereby certify that the recommendation and suggestion made by the board of examiners are appropriately incorporated into the final version of the thesis.

Fikreyesus Demeke, (PHD)	________________	________________
Major advisor/supervisor	Signature	Date

We, the undersigned, members, of the board of examiners of the thesis by Feven Araya have read and evaluated the thesis entitles "Assessing the Effects of Risk Management Practice on the Performance of Construction Projects: The Case of Addis Ababa City" and examine the candidate during the open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Masters of Science in Construction Engineering and Management

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LIST OF ACRONYMS

AVE	Average variance extracted
CB-SEM	Covariance based structural equation modeling
HTMT	Heterotrait monotrait Ratio
HOC	Higher order construct
LOC	Lower order construct
M & E	Monitoring and evaluation
PLS	Partial least square
PP	Project performance
RM	Risk management
SEM	Structural equation modeling
SPSS	Statically package for the social science
VIF	Variance inflation factor
VAF	Variant allele frequency

ABSTRACT

Construction project risk is un uncertain event that has a positive or adverse effect on the objective of projects and the negative effects of unmanaged risks are the main concern of many projects. Several studies have addressed this issue previously but the amount of investigation reduces significantly when it comes to modeling the relationship between risk management and project performance and no such study that shows the intermediating effect of construction risks between the two is found. Therefore, the study aims to fill this gap by investigating the relationship between risk management and project performance with construction risk as an intermediate factor between the two. To test this relationship, a hypothesis was drawn and a theoretical model was developed based on literature. research questionnaire was used as a data gathering method and was distributed to research participants in large construction projects in Addis Ababa. Primarily, the collected data was prepared for analysis using SPSS analytical software. Then analysis was conducted using structural equation modeling. The results of the study show economic, political, logistics and management risk factors having the highest impact on the performance of a project. And collectively internal risk factors were found to have the highest impact in comparison with external risk factors. when it comes to the risk management process risk monitoring and evaluation and risk identification had a major impact and contribution to the performance of projects. finally, it was found that the hypotheses drawn by the study was supported and there exists a significant relationship between risk management and project performance. From the results, it can be seen that proper management of construction risks through the process of identifying occurring risks, and their timing, analyzing them qualitatively or quantitatively, developing proper risk response plan and appropriate implementation, and conducting continuous monitoring and evaluation has a significant impact on the outcome of a project. Training and workshops about the advantages of risk management methods should be provided to involved parties.

Keywords; *risk management, construction risk, structural equation modeling*

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

In every country, the construction sector is one of the strongholds for development. It is one of the policy driver's governments use to lift economic growth and enhance the quality of life by establishing facilities. The construction industry also has a strong link with other sectors of the economy (Adedokun & Egbelakin, 2022). The construction industry is driving Ethiopia's real GDP development. According to a 2017 World Bank report, the country's real GDP increased by 10.9% overall, with the construction sector contributing 3.5% of the overall growth. It was also noted a shift from the construction sector's contribution to real GDP growth from 1.3% in 2011 to 3.5% in 2017. Basically, construction project risk is an uncertain event that has a positive or adverse effect and can potentially have damaging consequences on the objectives of construction projects (Yadeta, 2019). The chance that the outcome of a project might go differently than expected is a high possibility because of these associated risks. On the other hand, uncertainty refers to circumstances that are not fully understood in terms of their potential outcomes (Kardes et al., 2013). Even though the construction industry is one of the oldest industries in any civilization, the modern construction industry is still dealing with risks that affect project performance (Le et al., 2020).

Construction risks, if not managed properly have a significant adverse effect on the performance of a project (Mahendra et al., 2013). Over the years the construction industry has shown a poor reputation for coping with risks and many projects fail to meet the deadline and anticipated budget (Iqbal et al., 2015). In this regard, a study conducted on 258 sample projects across 20 nations and five continents reported that 9 out of 10 projects surpassed the budgeted cost and the average overrun is found to be 45% and 34% for rail and bridges projects, respectively (Bott, 2014). Another study conducted in Panama indicated that claims and contract disputes in many construction projects arise from unmanaged risks and it was reported as the main reason for several of the claims and disputes (Serpella et al., 2014). Studies conducted on projects in Africa also reported similar findings indicating that African construction projects are failing due to risks. In some cases, failures have escalated up to 6 - 7% of contract costs, with a 90% failure rate recorded (Nketekete et al., 2017). A study conducted in Nigeria in which out of 105 projects only 40 % had an acceptable deliverable. In contrast, 60 % could not meet the project deliverables. In addition, it can also be seen that only 46 % of the projects were able to meet client satisfaction and only 36 % were completed within the budgeted cost, 40 % met the quality level anticipated. Surprisingly, only 11 % of the projects were completed within the schedule (Amoah & Pretorius, 2020). The construction industry in Ethiopia is no different in facing the challenges associated with risk. It is vulnerable to several risks which are highly likely and their negative impact is most significant if not high or very high (Tessema et al., 2022). Additionally, it has been reported that one of the most inefficient areas of the industry in Ethiopia is schedule delay in which only 8% of the construction projects are completed on time. In contrast, the remaining 92 % are delayed by 352% of the total contractual time, the same goes for highway construction projects in which none of them are completed on time (Cheng & Darsa, 2021). This is also the issue for projects in Addis Ababa in which projects are reported to be delayed and are characterized be cost overruns, and insufficient deliverables and this has resulted in conflicts and disagreements between involved parties. Due to this, it is very important to properly manage and mitigate risks in order to achieve project success (Tessema et al., 2022).

Construction project success is generally based on triple constraints of management cost, time, and quality (Norouzi & Ghayur, 2019). Cost performance is one of the most crucial elements to which project stakeholders give major regard (Mishra & Mallik, 2017). Construction quality performance has also been described as the most important project success factor and risks associated with these elements have a significant impact on the overall performance of a project (Norouzi & Ghayur, 2019). On this note, to achieve project success risk management has been the leading approach in better decision-making as it can aid in maximizing the possibility of opportunities while minimizing the likelihood of potential risks and consequences (Goh et al., 2013). It also helps in meeting obligations and reducing adverse consequences on the cost, time, and quality of construction project performance for clients, contractors or developers, consultants, and suppliers of key project participants (Tessema et al., 2022). Basically, the performance of construction project management can be significantly enhanced by implementing the risk management approach. The objective of the risk management process is to create a structured framework that will help manage project risks, especially critical ones, more effectively and efficiently rather than eliminate all project risks (Bahamid & Doh, 2017).

In addition, risk management in large construction projects is very crucial since these projects are associated with investment appeal, the development of certain branches of industry, and scientific and technological activities (Zailani et al., 2016). Usefulness, reliability, and ease of interpretation should be the primary elements considered in the process of selecting the final RM method (Dziadosz & Rejment, 2015).

Several studies have been conducted on risk management practices and project performance. however, there is still lack of study on modeling the relation between the management of construction risk and project performance. Therefore, the study will fill this gap by developing a hierarchical model that shows the relationship between risk management and project performance with construction risk as an intermediate factor between the two and this is going to be achieved by showing the impact of each category in the model.

1.2. Statement of the Problem

Construction projects consist of a series of activities that have predefined objectives and assigned start and end dates. These projects have often the constraints of a specific time and budget which is the unique characteristics of the industry and the outcomes of these projects make them prone to risks (Qammaz & Maian, 2020). Construction, like many other industries, is a free-enterprise system and has sizeable risks built into its structure (Bott, 2014). Despite being one of the oldest industries in human history, the modern construction industry is still suffering from delays, cost overruns, and low satisfaction levels of involved parties (Le et al., 2020).

Construction project risk is an integrated part of any project and is also present in all types of projects regardless of their size. No project is completely free from risks and, these risks have a significant impact on construction projects (Mahendra et al., 2013). The uncertain nature, occurrence, and impact of construction risk have continued to affect the quality, time, and cost performance of individual projects (Tessema et al., 2022). Poor planning and lack of knowledge on subsequent risk identification and developing risk response strategies for critical risks are indicated, as the cause of the problem that arises, and their effect on the operational performance of construction projects are huge, these effects are characterized by cost and schedule overrun as the construction process progresses. But despite this significant problem, the communication of construction project risk is poor, incomplete, and inconsistent throughout the life cycle of most projects, and this results in the improper management of risk which can be detrimental to construction projects (Serpella et al., 2014). This particular impact of risks on construction projects is worldwide but the situation is even dire in the developing world where corruption carries a significant amount on actual costs and accounts for 10-30% of the value of a single construction contract (Adam et al., 2015). Due to this, it was indicated that many African projects are highly affected by risks, and project delivery in many sub-Saharan African countries lacks efficiency and is characterized by cost overrun, delay, low productivity, and conflict among the stakeholders (Belay et al., 2021). In this regard, Ethiopian construction projects especially in Addis Ababa construction projects are in a similar condition in which most projects are not finalized in accordance with the initial design and idea, they encounter several difficulties and variations that result to lag behind schedule, over budget, or lesser value. The risks that originated during the period of construction are reported to be the reasons for this deviations in project objectives. Basically, Meeting the time, cost, and quality goals that are set is the key to a project's success. Risk can take various forms and can lead to failure in a variety of ways, including schedule overruns, budget overruns, financial losses, fatalities, environmental damage, and many other outcomes. The main reason for this is lack of a formalised project risk management process which degrades productivity, worth, and timeliness while also negatively affecting overall project performance, which in turn drives up project costs for building projects. Through this clients, contractors, stockholders, and the public have suffered the consequences. If risks are not properly analyzed and strategies are not trained to deal with them, the project is likely to lead to failure. Therefore, by taking into account the risks, which typically have a negative effect on a project, projects can be designed to be successful and since the construction industry is the back bone of the economy in Ethiopia specifically in Addis Ababa it is essential to deal with potential risks to minimize the negative effect that they can have on ongoing projects.

Thus, the construction industry in Ethiopia is challenged by several problems, with construction project risk being the player of a major role as reported by several studies, so far several types of research have been conducted to determine the effects of risks on construction projects. (Adedokun & Egbelakin, 2022) investigated the impacts of construction risk on project performance but did not include the effects of the risk management process. (Chin et al., 2020), investigated the mediating effect of knowledge management between risk management and project performance but the study did not include risk factors affecting project performance. In regard to our country (Birru, 2020) assessed the practice of project risk management for high-rise building construction projects, but fail to show the effects of risk on the performance of cost, time, quality and safety of the projects. Still, there is a gap in identifying and modeling the relationship between construction risk, risk management practices, and project performance. This paper aims to address this gap by developing a theoretical model that shows the cause and effect inter relationship between risk management practice and project performance with construction risk as an intermediate factor between the two.

1.3. Objectives of the Study

1.3.1. General Objective

• The general objective of the study is to analyze the relationships between risk management and project performance with construction risk as an intermediate factor between the two using partial least square structural equation modeling in Addis Ababa.

1.3.2. Specific Objective

• To determine the construction risk factors affecting construction project performance.

• To determine the indicators of the risk management process affecting the success of construction project performance.

• To analyze the relationships between risk management and project performance with construction risk as an intermediate factor between the two using PLS-SEM.

1.4. Significance of the Study

The study as it includes risk and risk management practices has a great significance to several parties. stakeholders in the construction sector will be able to use the model to identify which risks and risk management elements have a significant impact on the performance of the project. It will help understand the degree of impact. Thus, show which ones to prioritize in order to improve cost, time, quality, and safety performance. It is also going to be useful to companies and construction personnel, especially those who want to engage in larger construction projects in providing information on possible risks associated with these projects and their effect to be used to prepare a mitigation plan to combat them. Additionally, since the process of modeling academicals theory in association with risk management process and project performance is very low, especially in Ethiopia this paper contributes to the advancement of the existing theoretical coverage and fills the knowledge gap.

1.5. Scope of the Study

The scope of the study is restricted to construction projects in Addis Ababa city and active building construction projects that are currently running above ten floors are the only focus of the study, any other application areas outside of the above are not considered. And the focus of the subject of the study is restricted to the practices of risk management, construction risk and construction project performance.

1.6. Limitations of the Study

One of the major problems faced by the study was finding properly organized and compiled data in the Addis Ababa city administration building permit and control office which made it difficult and time-consuming to find the population for the study. Furthermore, in the collection of data getting a good response rate was difficult, the questionnaire had to be distributed multiple times and several trips had to be made to the data source in order to obtain the response. This forced the study to be conducted on a relatively smaller data set considering the requirements of the methodology.

1.7. Organization of the Document

The research is organized into five chapters as described below.

Chapter one: Introduction is an introductory part containing discussions on background, research problems, objective of the research, significance of the research, scope, limitation of the research, and organization or layout of the research.

Chapter Two: The literature review provides suitable, related literature on the subject and an overview of risk management, the process of risk management, construction risk, and project management. The chapter also includes the developed hypothesis, the theory behind the hypothesis, and the proposed theoretical model.

Chapter Three: Methodology this chapter addresses the way that the research was carried out. The research method, target population, representative sample, and data gathering approaches which also include the data collection techniques and procedures, processes, and data analysis method are all addressed in this section.

Chapter Four: Results and discussion this chapter summarizes the results of the analysis based on the data gathered through the process of questionnaires. A detailed discussion of the findings is also included.

Chapter Five: Conclusions and recommendations draws the final statement of the overall findings and suggests possible remedies for the problem of the study based on what has been discussed in the previous chapters.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This chapter presents the findings from different literature reviews on the subjects most relevant to construction project performance and their management. Theoretical concepts related to construction risk, project performance, project risk management process (risk identification, risk assessment, risk response, and risk monitoring and evaluation), as well as risk management tools and technique, were presented from the perspectives of various researchers and the research gap is also included. Additionally, the chapter provides the theory behind the developed model stated by several authors since the objective of the study is to develop a model on the relationship between risk management and project performance. After introducing all of the theory that makes the foundation of the research, the theoretical model and hypotheses are presented.

2.2. Construction Project Risk

The construction industry is one of the pillars of the success of modern countries it is one of the main drives of the economy (Alsaadi & Norhayatizakuan, 2021). And the successful completion of projects across different sectors and industries is one of the most important factors that determine the development and growth of many nations (Kissi et al., 2019). Construction project is a set of activities with unique characters such as a long time period, complex processes, financial issues, and dynamic organizational structure (Endris Yadeta., 2020). And these initiatives are becoming more and more in demand to deal with the ever increasing population, strain on land, and increased economic activity (Alsaadi & Norhayatizakuan., 2021). But despite the need for this projects one of the main challenges facing this construction projects these days is managing risks (Ishaq, 2021a). Just as with any other economic activity, the construction business is risky, even though construction projects are perceived to have more inherent risks due to the involvement of many contracting parties, such as owners, designers, contractors, subcontractors, and suppliers, etc. (Iqbal et al., 2015).

Basically, there is a long history behind the concepts of risk and risk management. More than 2400 years ago Athenians used risk assessment techniques before making judgments. However, Risk management as a scientific topic is relatively young (Aven, 2016). Construction risk is defined as a measurement of the likelihood and severity of negative consequences affecting the project's objectives (Serpell et al., 2015). Risk and uncertainty characterize situations where the actual outcome of a particular activity is likely to differ from the anticipated value (Amoah & Pretorius, 2020). Generally, risk and uncertainty are two of the most often used concepts in risk management and despite the close relationship between these concepts, some writers make a distinction between them (Ropel, & Gajewska, 2011). Uncertainty is a risk that cannot be measured, whereas risk is uncertainty that can be measured. Even though construction risks are almost invariably connected with unfavorable outcomes they can also be possible opportunities (Serpell et al., 2015). Construction risks are major concerns associated with every project and should be properly identified in order to avoid negative effects on project performance, in most cases, unmanaged risks from the beginning stages of construction are considered to be the cause of many of the problems that are encountered in the later stages. lack of information, experience, and knowledge are the variables that most studies frequently cite as main causes for this failure (Ropel, & Gajewska, 2011). Risks in the construction sector are constant and present throughout the life cycle of the project (Serpell et al., 2015). And project complexity is always correlated with the degree of risk. The magnitude and complexity of the projects can be used to illustrate the level of risk in the industry (Ropel, & Gajewska, 2011).

2.3. Risk Management

The concept of risk management first emerged in the insurance and banking industries many years ago. Risk management, which is the process of identifying, assessing, and monitoring risks that arise throughout a project, was developed in the United States in the 1930s when it was a common practice to secure businesses from their inception (Serpell et al., 2015). And it has been used as a crucial aspect of the construction industry since the mid-1980s (Yadeta, 2019). Risk management is a decision-making process as it involves having a thorough awareness of known risks and taking the appropriate action to minimize their impact and likelihood of occurrence (Bahamid & Doh, 2017). Which also involves anticipating problems, preventing them from happening, and encouraging and looking for better alternative solutions (Ali & Ahmed, 2020). Determining risks and deciding how they should be prioritized is steel one of the greatest difficulties faced in the construction industry and to overcome this problem project manager understand that risk management is crucial for executing an effective project management strategy since it is an essential procedure for the success of construction projects (Serpell et al., 2015).

Risk management as a discipline that provides tools and techniques to aid the project team to do everything in their power to minimize negative risks (Qammaz & Maian, 2020). And through this, the possibility and impact of unfortunate events can be reduced by using managerial resources in a coordinated and cost-effective manner which maximizes the achievement of project objectives (Yadeta, 2019). Additionally, risk management is a continuous process that enables the project manager to oversee the project throughout its lifespan and be ready for any unforeseen issues that may arise. To archive this the project team must create standard risk management procedures from the beginning so that risks may be properly and efficiently identified and dealt with (GAİN, 2021). If construction risks are not properly managed they pose a grave threat to projects and are among the many problems identified. Underestimating the cost or time duration of the project, unrealistic and overconfident decisions making, and conflicting interests between partners over time were indicated to be the main points where the project faces variation from the original plan (Kardes et al., 2013). Due to this quantifying, the associated potential impact of the identified risk and implementing measures to manage and mitigate the potential impact is very crucial for the success of construction projects. Generally, a systematic process of risk management involves risk identification, risk analysis, and risk response, where risk response has been further divided into four actions which are retention, reduction, transfer, and avoidance (Yadeta, 2019). Steel, in spite of all the benefits, gained the use of risk management technique is very low this is because of less knowledge and awareness of construction personnel involved in projects (Mahendra et al., 2013).

2.3.1. Risk Identification

The first and possibly most crucial step in the risk management process is risk identification, which aims to identify the source and type of risks (Endris Yadeta, 2020). It also clarifies who is responsible for what risks and how to identify probable risk event conditions in the construction project. Correct risk identification procedures provide effective risk management, as they lay the groundwork for the subsequent steps of analysis and control of risks (Banaitiene & Banaitis, 2012). The risk identification process is also associated with the documentation of features of identified risks since new risks may emerge as the project moves through its life cycle, it has been perceived that the identification process of risks is an iterative one (PMI, 2017). The goal of risk identification is to create a list of potential risks that need to be addressed in a project (Ropel, & Gajewska, 2011). Since, accurate risk identification ensures effective risk management by exposing hidden sources of losses that could grow into incidents that are uncontrollable and cannot be managed with undesired consequences (Ugwu et al., 2019). The identification process involves the project team, stakeholders, other managers impacted by or who affect the project, and lastly, external parties who can comment on the completeness of risk identification based on their similar experiences and they all participate in the process (Tadayon et al., 2012). Additionally, project risk management can be adopted to reduce risks and assign them to the parties best suited to control or absorb them should they ever occur by identifying risks in the early stages of designing a construction project and assessing their relative importance. Studies should be conducted early on in the life of a project, well before the decision to move forward with the project is taken (Tadayon et al., 2012). According to (Goh et al., 2013) various methods, like the Delphi method, expert opinion, checklists, and brainstorming, can be used to identify risks. Some of the identification practices are described below.

2.3.1.1 Brainstorming Risk Identification Technique

One of the most common methods for idea generation is brainstorming, which is also a very effective method for identifying risks (Ahmed, 2014). All relevant personnel associated with the project gather in a specific place together with a facilitator who controls the overall briefing process of different aspects with the participants and then notes down the factors. The facilitator evaluates the variables before closing and eliminates the unnecessary ones (Chapman & Ward, 2003). Additionally, brainstorming sessions involve getting the main project stakeholders to identify and rank the project's risks (Mahendra et al., 2013). By using this technique, the stakeholders can learn what the other project team members perceive as project risks and draw inspiration from these ideas to uncover new project risks. Because a good brainstorming session requires a mix of project staff with the necessary expertise and seniority, it is crucial to carefully select the individuals who will make up the group (Aloini et al., 2007).

2.3.1.2 Delphi Risk Identification Technique

This method is similar to brainstorming however, the participants are not in the same location and do not know one another (Ahmed, 2014). Project risk specialists use these strategies in an anonymous manner in which each individual has their contribution (Mahendra et al., 2013).

Primarily, without consulting the other participants, the facilitator determines the factors and then summarizes the factors (Ahmed, 2014). Finally, the facilitator compiles the information on significant project risks using a designed questionnaire (Mahendra et al., 2013). The responses are then recalculated and then summarized before being presented to experts for additional comment. This method prevents any one person from influencing the result and minimizes data bias (PMI, 2017).

2.3.1.3 Checklist Risk Identification Technique

Risk Checklists from past projects can be utilized to assist in the risk identification process, or one can make a risk checklist for a particular project the checklist that is prepared and used should be constantly reviewed and improved upon to be used for later projects (PMI, 2013). Checklists are frequently produced by a documentation professional for various project and product documents. Considering that checklists usually indicate potential failure locations in previous projects, they are very useful for recognizing risks. In order to ensure that company knowledge and individual experience are used in the process of identifying risks, project personnel from each discipline, as well as organization staff with experience in similar projects, are interviewed. This method enables project staff to identify risks and provides them with a sense of ownership over the risks they have identified, which should therefore increase their acceptance of steps taken to decrease risks (Tadayon et al., 2012).

2.3.1.4 Historical Data Risk Identification Technique

Examining historic data from previous similar projects uses corporate knowledge (Mahendra et al., 2013). Furthermore, analogies can be made on the basis of existing experience with projects of the same type to help identify the causes of potential risks. By comparing project characteristics, it can be learned more about the things that are common between projects (Ahmed, 2014). However, this strategy can only be effective in a small number of situations because an organization might not have carried out a similar project, or the data from a prior similar project might not have been documented (Mahendra et al., 2013). A beneficial source of information could be database systems that actively manage and report the progress of projects. However, the amount of useful or relevant data that can be saved by such systems is frequently limited (Tadayon et al., 2012).

2.3.1.5 Expert Opinion Risk Identification Technique

Expert opinion is generally based on the knowledge and experiences of subject matter experts (PMI, 2013). It is a procedure used to speak with knowledgeable project participants, stakeholders, and subject matter experts to gather what they perceive as risk (PMI, 2017). Experts or staff with adequate project experience can be of tremendous assistance in preventing or resolving recurring issues and identifying the elements of risk (Ahmed, 2014). For this purpose, all the participants or the relevant persons in the project may be interviewed and questioned (Mahendra et al., 2013).

2.3.2. Risk Analysis

The second stage of risk management is risk analysis. It involves evaluating the information that has been gathered in relation to prospective risks. As a result, a short list of risks with the biggest effects on the project can be created out of all the threats identified during the identification phase (Ropel, & Gajewska, 2011). The possibility of an event occurring, its timing, and its link to other risks are additional factors that must be considered at this stage in addition to the impact of risk. Together, they make it possible for each threat to be addressed more successfully (Ugwu et al., 2019). Risk analysis is typically thought of as the procedure that entails a critical evaluation of potential risks, classifying them according to their importance and enabling the management team to select the most significant ones. It is also believed to be the most difficult step since it determines whether a risk will materialize and how it will affect the project's objectives (Bahamid & Doh, 2017).

The process of risk analysis includes two main activities qualitative and quantitative risk assessment (Ugwu et al., 2019). The likelihood and impact of risk are described using qualitative approaches for risk assessment that are based on descriptive scales. When a quick examination is necessary, these relatively easy procedures can be used (Ropel, & Gajewska, 2011). Among the many factors that must be taken into account at this stage are the impact of risk on a project's objectives and how it can be managed (Ugwu et al., 2019). On the other hand, analysis using quantitative approaches requires a lot of effort. The work should be assessed against the advantages and results of the method of choice; for instance, smaller initiatives may occasionally simply call for identifying risks and acting on them, whereas larger projects need more in-depth analysis (Ropel, & Gajewska, 2011). The process of risk analysis is frequently the quantification stage that aids in determining the importance of specific elements. Both qualitative and quantitative methods can be used for this, and examples of such methods include Monte Carlo simulation, sensitivity analysis, scenario analysis, and decision tree analysis (Dziadosz & Rejment, 2015). Some of these practices are described below.

2.3.2.1 Sensitivity Analysis Risk Assessment Method

Sensitivity analysis is used to identify the project elements that are unclear but will have the biggest influence on the final result. After creating a risk model, a sensitivity analysis is performed to determine how sensitive the model's various components are to the project's outcome (PMI, 2017). Basically, establishing the risk events with the highest impact is the aim of a sensitivity analysis. A specific risk is more sensitive to the objectives of a project the more uncertainty it carries. In other words, the risk events that are most crucial to the project are also the once that are most sensitive, and appropriate action must be done to combat the problem (Ropel, & Gajewska, 2011).

2.3.2.2 Scenario Analysis Risk Assessment Method

The results of a scenario analysis show the effects of several project scenarios or, in the case of simultaneous occurrences, various risks. After conducting this analysis, a fair decision can be made, favoring the alternative that will result in the least amount of loss or danger (Chapman & Ward, 2003). The goal of this analysis is to explore numerous scenarios of risk situations as potential outcomes (Ahmed, 2014).

2.3.2.3 Monte Carlo Simulation

Monte Carlo simulation quantifies how uncertainties and risks affect project budgets and schedules (Chapman & Ward, 2003). This method is based on statistics that are used in a simulation for forecasting, and estimating risks by generating various scenarios (Ropel, & Gajewska, 2011). The software Risk Simulator is most frequently used to run Monte Carlo simulations, as it allows for a more effective simulation process. Although a specific tool in Microsoft Excel can be used to select the data in a random manner for the purpose of simulation the outcomes may not be very reliable (Ropel, & Gajewska, 2011).

2.3.2.4 Decision Trees Analysis

A decision tree diagram is used for decision tree analysis so that problems may be formulated and options can be evaluated extremely effectively (PMI, 2017). In this analysis, graphical models are utilized to depict a project and can be used to show the implications of each project choice (Ahmed, 2014).

2.3.3. Risk Response

Risk response is the critical stage of risk management, which determines whether or not any action will be taken in response to risks which are analyzed throughout the stages of identification, qualification, and quantification. After a variety of options for lowering or eliminating the anticipated risk have been put forth, the best approach is selected as a response strategy (Ugwu et al., 2019). In essence, risk response is the third stage that specifies how to respond to risks that have been identified and it is the type of risks involved that determines the response strategy to be used (Ropel, & Gajewska, 2011). The primary objectives of this stage are to strengthen the level of risk control, reduce the negative impact of risk, and minimize the potential impact. Furthermore, acceptable risk reduction measures must be used after the project risks have been identified and examined. These risk-mitigation measures are mainly based on the characteristics and probable outcomes of the relevant risks, Retention, reduction, control, transfer, and avoidance are among the distinct risk reaction strategies and they are discussed below (Bahamid & Doh, 2017).

2.3.3.1 Risk Retention

Risk Retention involves acknowledging the existence of a certain risk situation and taking deliberate measures to accept the amount of risk without making any extra efforts to control them (Bahamid & Doh, 2017). Retaining risks is the best option when it cannot be transferred to a third party or avoided, and to reduce the impact of risk in this situation, it must be controlled (Potts, 2009). When other options are not financially feasible, risk retention may also be possibly the best way (Ropel, & Gajewska, 2011). On top of this early mitigation of risks minimizes the likelihood and impact of risk, and is frequently more effective than late restoration (Luka, 2014).

2.3.3.2 Risk Reduction

Risk reduction is a strategy used to lower the risks and consequences of the risk to levels that are tolerable (Bahamid & Doh, 2017). Having a comprehensive view of the project makes it simple to see issues that are hurting the project. Changes should be made to the exposed areas in order to lower the impact of risk. This reduces the possibility of dangers, thereby minimizing potential threats (Potts, 2009). Adding expenses that can result in long-term rewards is one strategy to lower risks in a project. Some projects spend money on insurance or employ professionals to handle high-risk tasks. These specialists might come up with answers that the project team hasn't thought about before (Ropel, & Gajewska, 2011).

2.3.3.5 Risk Avoidance

Risk avoidance is the refusal to acknowledge risks in order to make sure that the danger won't persist (Bahamid & Doh, 2017). By considering alternatives for the project, many risks can be reduced through avoidance. Because the technique is less stressful for the users, risks may be avoided and work can go smoothly as a result (Ropel, & Gajewska, 2011). Additionally, reviewing the project's goal is essential since risks are classified as having a negative impact on the overall project. To avoid risks, changing the scope of the project is the best course of action. A project could be vulnerable to a number of risks that could affect how successful it is (Chileshe & Boadua, 2012).

2.3.3.6 Risk Transfer

Without affecting the overall level of risk or diminishing how important the risk sources are, risk transfer is the transfer of ownership risk from one party to a different third party (Bahamid & Doh, 2017). Risk transfer is the best course of action if it can be managed by a different actor who has more expertise or capacity. Depending on the nature of the risk, this actor could be the client, contractor, subcontractor, designer, etc. (Potts, 2009). It should be recognized that the risk is only shifted to the party with the best management capabilities it is not entirely eliminated (Ropel, & Gajewska, 2011).

2.3.4. Risk Monitoring and Control

The goal of risk control is to reduce risks, regulate variances, and enhance project value and in order to effectively fulfill project objectives, risks are managed in this stage of the risk management process by putting proper precautions in place (Renault & Agumba, 2016). Risk control aids in the identification of new risks, the monitoring of those that have already been identified, and the removal of old concerns from the project and risk assessment. The underlying presumptions for monitoring and controlling are to check the status of construction risks (Ropel, & Gajewska, 2011). Generally, implementing a risk response plan, tracking and detecting risks, keeping an eye on residual risks, spotting new risks as they emerge, and assessing the efficiency of the risk management process are all parts of risk monitoring and control. Also, responses taken in risks should also be documented for future reference and project plans. Choosing other tactics, carrying out a backup plan, taking remedial action, and altering the project management plan can all be part of risk monitoring and control (PMI, 2017).

2.4. Hypothesis Development

A hypothesis is often described as an attempt by the researcher to explain the phenomenon of interest. Hypotheses can take various forms, depending on the question being asked and the type of study being conducted. A key feature of all hypotheses is that each must make a prediction. Hypotheses are the researcher's attempt to explain the phenomenon being studied, and that explanation should involve a prediction about the variables being studied. These predictions are then tested by gathering and analyzing data, and the hypotheses can either be supported or refuted on the basis of the data (Marczyk et al., 2005). Through the theoretical background of previous studies attained by conducting a literature review, a hypothesis was developed and it is presented below.

H1: There is a significant relationship between risk management and project performance.

H2: There is a significant relationship between risk management and construction risk.

H3: There is a significant relationship between construction risk and project performance.

H4: Construction risk mediates the relationship between risk management and project performance.

The theoretical bases for the developed hypothesis are discussed as follows.

2.4.1. Relations between Risk Management and Project Performance

Risk management procedure is very crucial in building projects and reducing the risks associated with construction projects, it is a practical way to improve project performance (Nagarajan & Ganapathi, 2023). Cost, time, and quality performances are the primary factors used to assess how well a construction project is performing (Yadeta, 2019). Although many elements may contribute to project success, risk management process has been highlighted as a leading practice throughout the years. Due to this several researches indicate the need to examine the relationship between risk management and project performance in the construction industry (Chin et al., 2020). Thus, previous studies have established the existing relationship between risk management and construction project performance, according to (Nagarajan & Ganapathi, 2023) construction projects will perform better in terms of cost, time, and quality as a result of risk management practices, in addition, companies will be able to prevent financial, commercial, economic and environmental problems during project execution. Another study (GAİN, 2021) came to the same conclusion, as the results of the investigation on the relation of risk management and project success criteria show that independent risk management processes factors like risk identification, assessment, and reaction had a substantial impact on eight out of ten project performance success criteria. In another study that determines whether project risk management has a substantial impact on project performance, risk identification, risk analysis, risk evaluation, and risk response were found to have a significant impact on the performance of a project (Alsaadi & Norhayatizakuan, 2021). (Muhammad Huzaifa Butt et al., 2021) also reported a strong positive impact of risk identification process & Engineer/Architect Selection process on project performance. (Amoah & Pretorius, 2020) conducted a study on smaller construction projects and concluded that the application of risk management process is associated with an improvement in project cost, quality, and time. On the other hand, the study where the knowledge management process was used as an intermediate factor in the investigation of the cause-and-effect relationship between risk management and project performance found that there is a strong, positive casual association between the two parameters (Chin et al., 2020). Based on this theory a review of several literatures has been conducted and as a result, four latent variables of the risk management process and there underling indicators have been identified. In addition, project performance with its four indicators cost, time, quality, and safety have also been identified. the factors are presented in table 2.1 below.

Table 2. 1: Risk management indicators

(Source)	**Risk Identification Indicators**
(Dziadosz & Rejment, 2015)	Identification of risk owner
(Szymański, 2017)	Determination of occurring risk
	Identifying entities affected by risks
(Kuijp, 2017)	Availability of primary project documentation
(Ropel, & Gajewska, 2011)	Categorization of risk
(PMI, 2013)	Documentation of risk characteristics

(Tadayon et al., 2012)	Risk discussion
	Risk Analysis Indicators
(PMI, 2008)	Performing qualitative risk analysis (risk prioritization)
	Performing quantitative risk analysis
(Dziadosz & Rejment, 2015)	Determination of degree of risk impact
	Determination of Timing of identified risk
(Szymański, 2017)	Determining the probability of risk occurrence
(Schieg, 2006)	Describe risk situation and events completely and precisely
	Risk Response Indicators
(Renault & Agumba, 2016)	Developing possible alternative options for treating risks
(Szymański, 2017)	Analyzing costs of different risk response strategies
(Dziadosz & Rejment, 2015)	Identifying/developing risk response strategies
(Kuijp, 2017)	Planning risk response
	Risk Monitoring and Evaluation Indicators
(PMI, 2013)	Risk response plan implementation
	Evaluating risk process effectiveness
(Szymański, 2017)	Tracking identified risk
(Kissi et al., 2019)	Mid-term and end-term risk evaluation
(Renault & Agumba, 2016)	Monitor risks regularly
(Ropel, & Gajewska, 2011)	Identify new risks that emerge
	Project Performance Indicators
(Doloi et al., 2011)	On-time project delivery
	On-budget project delivery
(Amoah & Pretorius, 2020)	Quality performance
	Construction safety

2.4.2. Relation of Construction Risk Factors and Project Performance

Construction risk is an unforeseen event that occurs during the entire life cycle of construction projects (Adedokun & Egbelakin, 2022). And the most detrimental effects of this risk can be summed up as failing to complete the project by the required completion date and meet the necessary operational and quality standards (Tadayon et al., 2012). On the other hand, assessing risks, their causes, and features will enable the project team to develop practical mitigation strategies in order to deal with them (Kassem, 2022). Several studies have reported the impact that construction risks have on project timelines, costs, and quality performance (Amoah & Pretorius, 2020). Through this, it has been discovered that the focus of most projects is on the objective rather than the risk factors. risk considerations, their likelihood of occurrence, and their impact on the overall project is not properly emphasized. Because of this Inadequate technical information, such as particular specifications, is disregarded at the design stage, and overruns are realized towards the end of the project (Nketekete et al., 2017). (Bukar & Ibrahim, 2021), identified risks associated with project performance such as construction risks related to site conditions and labor productivity, physical risks related to structures and worker safety, technical risks related to incomplete designs and scope changes, financial risks related to increases in market price and payment delays, organizational risks related to the unnecessary workforce and communication, conflict of interests, and environmental related to natural disaster to have a significant impact. Also, the risk management process of resource issues, environmental 19 issues, coordination challenges, and project flexibility has been shown to have a good relationship with project performance (Zailani et al., 2016). (Nagarajan & Ganapathi, 2023) also emphasized the importance of dealing with risks, such as financial risks, which could bankrupt the companies should be promptly handled. It is also essential to reduce or mitigate political & environmental risks since these risks have the potential to negatively affect the profitability of the company. Technical risks can be minimized by design, contractual risks can be avoided through contracts, and logistical and transportation risks can be reduced through action or treatment plans including insurance, transit vehicle selection, and lifting equipment. Risks of natural disasters, pandemics, and force majeure must also be addressed. The casual relationship between construction risk and project performance was also established in the study that correlated the impact of internal and external construction risks on the performance of construction projects (Al-Mhdawi et al., 2022).

Based on this theory a review of several literatures has been conducted and as a result, ten latent variables of construction risks of which five are comprised of internal risks and the other five represent external risks and identified and are presented on Table 2.2 below.

Table 2. 2: Internal risk factors

	Internal Risk Factors	(Ali & Ahmed, 2020)	(Ibrahim et al., 2019)	(Ahmed, 2014)	(Yadeta, 2020)	(Ishaq et al, 2021)	(Chileshe & Boadua, 2012)	(TEFERI, 2020)	(Cheng & Darsa, 2021)	(Tessemaa et al, 2020)	(Luka, 2014)	(Nagarajan Muthukrishnan, 2021)	(Iqbal et al, 2015)	(Ejeta et al., 2021)
Financial Risks	High inflation rate	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
	Delayed payments	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
	Financial failure of contractor	✓				✓	✓	✓	✓			✓		
	Inappropriate type of project bidding and award	✓		✓	✓				✓					
	Poor cash flow management	✓		✓		✓						✓		
	Poor financial control on site					✓								
Logistics Risks	Equipment availability	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	Lack of skilled Labour	✓	✓			✓	✓	✓	✓	✓			✓	
	Shortage in material	✓		✓	✓	✓	✓		✓	✓			✓	
	Lack of competent &qualified professionals					✓	✓	✓	✓	✓		✓		✓
	Risk of defective material from supplier	✓		✓	✓		✓	✓					✓	

	Late delivery of materials					✓		✓	✓			✓		
	Poor construction materials quality					✓		✓		✓				✓
	Transportation problem to site location	✓							✓					
	Equipment failure			✓		✓								
Management Risks	Improper scope of work definition		✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
	Poor communication between involved parties	✓		✓		✓	✓	✓	✓					
	Poor resource management	✓		✓				✓	✓					
	Unclear project planning due to project complexity	✓		✓				✓	✓					
	Lack of essential information	✓	✓	✓	✓									
	Quality and performance control						✓			✓	✓			
	Delay in decision making					✓			✓					
	Waiting time for approval and inspection				✓				✓					
	Projects supervision and administration				✓	✓								
Construction Risks	Accidents/safety during construction	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓
	low labor and equipment productivity	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓
	Improper planning and scheduling	✓			✓	✓		✓	✓		✓	✓		
	Unforeseen site ground conditions		✓		✓		✓	✓		✓			✓	✓
	Construction mistakes and rework				✓	✓		✓	✓	✓				✓
	Risk of insufficient technology				✓	✓	✓	✓		✓			✓	

	Poor communication & coordination among staff				✓	✓	✓		✓				✓	
	Poor performance of subcontractor				✓	✓	✓		✓				✓	
	Improper cost estimate					✓		✓			✓		✓	
	Delays due to lack of availability of utilities					✓			✓				✓	
	Testing and acceptance	✓	✓	✓		✓	✓	✓	✓	✓	✓			
Design Risks	Design changes by client	✓			✓	✓		✓	✓	✓		✓	✓	✓
	Defective design	✓	✓	✓	✓	✓			✓			✓	✓	
	Gaps between the implementation and the specifications	✓		✓		✓				✓		✓	✓	
	Inaccurate estimation of quantities of work	✓	✓	✓	✓							✓		
	Lack of Coordination between design	✓		✓	✓			✓						
	Lack of consistency between bill of quantities, drawings and specifications	✓		✓	✓			✓						
	Number of bidders/increasing competition		✓			✓		✓						
	Awarding the design to unqualified designers	✓		✓				✓						

Table 2. 3: External risk factors

	External Risk factors	(Ali & Ahmed, 2020)	(Ibrahim et al., 2019)	(Ahmed, 2014)	(Yadeta, 2020)	(Ishaq et al, 2021)	(Chileshe & Boadua, 2012)	(TEFERI, 2020)	(Cheng & Darsa, 2021)	(Tessemaa et al, 2020)	(Luka, 2014)	(Nagarajan Muthukrishnan, 2021)	(Iqbal et al, 2015)	(Ejeta et al., 2021)
Political Risks	Changes in governments laws and regulations	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	Political insecurity and instability	✓	✓	✓	✓	✓	✓		✓	✓			✓	✓
	theft/robbery of material at site	✓	✓			✓	✓	✓	✓			✓	✓	
	Bribe and corruption		✓		✓	✓	✓		✓		✓	✓	✓	
	Risk of labor disputes and strikes		✓		✓				✓	✓		✓	✓	✓
	Taxation on imported materials		✓											
Legal Risks	Difficulty to get Permits and ordinances	✓	✓	✓	✓	✓	✓		✓	✓			✓	
	Delays in resolving disputes		✓	✓		✓	✓			✓			✓	
	Legal disputes among the parties of the contract		✓		✓	✓	✓							

	Ambiguity of work legislations				✓							✓		
	Authorities and regulations requirements				✓									
	Import and export restrictions	✓	✓	✓	✓	✓	✓			✓			✓	✓
Environmental Risks	Adverse weather conditions	✓		✓	✓	✓								
	Difficulty to access the site (Remote sites)			✓	✓	✓							✓	
	Natural disasters	✓	✓	✓	✓	✓	✓	✓	✓				✓	
Economic Risks	Exchange rate					✓		✓	✓	✓		✓		
	Increase in prices of materials					✓	✓	✓	✓			✓		
	Increase in interest rates				✓	✓						✓	✓	
	Economic instability and Market condition		✓			✓	✓	✓						
	Price Fluctuations/ Fuel/Oil Prices		✓			✓								
	Increase in cost of labour					✓						✓		
Social Risks	Religious differences	✓			✓									
	Culture differences	✓			✓									
	Holidays and celebrations				✓									
	Language barrier				✓									

2.5. Structural Equation Modeling

Structural equation modeling (SEM) is a technique for analyzing complex theoretical correlations between numerous variables (Hair & Alamer, 2022). It is a multivariate statistical method for predicting and testing multivariate causal relationships (Adedokun & Egbelakin, 2022) and the current successes of SEM can be attributed to the ability of the method to combine and evaluate, the measurement model (confirmatory factor analysis) and a structural model in a single statistical test (Hair et al., 2014). SEM generates a model by combining factor analysis and path analysis. The model also involves multiple latent independent variables measured by multiple indicators of the construct, including one or more latent dependents variable measured with multiple indicators (Adedokun & Egbelakin, 2022). Basically, two methods of SEM have been proposed covariance-based structural equation modeling (CB-SEM) and partial least squares structural equation modeling (PLS-SEM), also known as composite-based structural equation modeling (Hair & Alamer, 2022).

2.5.1. Covariance Based Structural Equation Modeling (CB-SEM)

CB - SEM is a factor-based approach and implies a common factor model which is another feature of the methodology. In other words, the covariance among the indicators is just a product of the factor. The primary purpose of the model is to test existing theoretical frameworks, such as measurement and structural models. This is accomplished by comparing the observed covariance matrix with the calculated theoretical model (Hair & Alamer, 2022). Over the past several decades, CB - SEM has been frequently used in the field when the sample size is high, the data are normally distributed, and most crucially, the model is accurately stated. To put it another way, the right variables are picked and connected together when turning a theory into a structural equation model. However, many professionals in the field and researchers point out that, in practice, it is frequently challenging to locate a data collection that satisfies these conditions (Kwong-Kay, 2013).

2.5.2. Partial Least Squares Structural Equation Modeling (PLS-SEM)

PLS-SEM is a prediction-oriented method to SEM, typically utilized for exploratory research but is also suitable for confirmatory research (Ringle et al., 2012). It is a general method of estimating the cause-and-effect relationships of constructs in path models that involve latent constructs (unobserved) which are indirectly measured by various (observable) indicator variables (Memon et al., 2013). in recent years (PLS-SEM), has grown in popularity due to the features that allow researchers to apply the model to more sophisticated and complex paths in this situation by using hierarchical latent variable models (Becker et al., 2012).

The partial least square structural equation model has two sub-models the outer (measurement model) and the inner (structural) model (Kwong-Kay, 2013). The measurement model is a part of the general model that specifies latent constructs. It also identifies different situations where reflective and formative measurements vary (Ringle et al., 2012). While the inner model specifies the relationships between the independent and dependent latent variables (Hair & Alamer, 2022) in addition, a variable in PLS might be either endogenous or exogenous (Kwong-Kay, 2013). Where exogenous constructs function as independent variables without an arrow pointing toward them, and endogenous constructs are explained by other constructs and have arrows pointing toward them. These constructs are frequently thought of as dependent variable, but they can also function as independent variables when they are between two other constructs and has an arrow pointing to them (Hair Jr et al., 2014).

PLS-SEM approach is an approach that can obtain solutions with smaller sample sizes compared to CB-SEM (Hair & Alamer, 2022). The sample size can have an impact on the parameter estimations, model fit, and statistical power of SEM. The model in contrast to CB-SEM, can be used with much smaller sample sizes (Hair & Alamer, 2022) The other superiority of these models is its ability to accommodate complex models, the standard PLSSEM technique rarely has convergence problems even with very complicated models which is defined as a large model containing about 10 constructs and 50 indicators (Henseler & Chin, 2010). Thus, through the repeated use of indicator variables, the method can be used to develop large and complex hierarchical models (Akter et al., 2011). Predictive accuracy is another feature that is conducted well in this model (Wong, 2013). The path model repeatedly iterates back and forth, optimizing the measurement model first, followed by the structural model, and then returning to the measurement model, followed by another iteration of the structural model, and so on, until the goal of optimizing prediction is reached (Hair & Alamer, 2022). The model also does not automatically require normally distributed data and combines formatively measured constructs with ease. it is crucial to keep in mind that using non-normally distributed data with CB-SEM may lead to inflated results, therefore biased estimations also, formative measures are not accurately predicted (Hair & Alamer, 2022). Furthermore, the model provides a more accurate estimate of mediating effects by accounting for the measurement error (Akter et al., 2011).

2.5.2.1 Formative measurement scale

Formative indicators are indicators that are not interchangeable among themselves they cannot be removed from the model without changing the meaning of the construct. The indicators also cause the latent variable in such type of a model. In general, these formative indicators can have positive, negative, or even no correlations with each other (Kwong-Kay, 2013). there is no need to report the indicator reliability and validity of formative measurement scales. This is because outer loading, composite reliability, and the square root of average variance extracted (AVE) are meaningless for a variable made up of uncorrelated measures (Hair & Alamer, 2022).

2.5.2.2 Reflective Measurement Scale

Reflective indicators are highly correlated and interchangeable. They can be eliminated without affecting the meaning of the construct. reflective indicators are associated with their construct through factor loading, which is the bi-variant correlation between the construct and the indicator (Hair & Alamer, 2022). Indicator reliability, internal consistency reliability, and discriminant validity of these indicators which are the base of the constructs should be carefully investigated (Kwong-Kay, 2013).

2.5.3. Higher Order Constructs

Higher-order constructs, also known as hierarchical latent variable models or hierarchical component models, are the explicit representations of multidimensional constructs that exist at a higher level of abstraction and are connected to other constructs at a similar level of abstraction, completely mediating the influence from or to their underlying dimensions (Becker et al., 2012). These constructs involve testing measurement structures at two levels at the lower order component (LOC) and higher order component (HOC) of the model (Kotler & Keller, 2021). There are two approaches to estimating hierarchical models the two-stage approach and the repeated indicator approach (Becker et al., 2012).

The hierarchical component model or repeated indicators approach was proposed by (Lohmöller, 1989). The repeated indicator approach is an approach in which all the variables of the first-order constructs are used in the higher-order constructs (Becker et al., 2012). PLS technique can estimate the model even though this method repeats the number of indicators used. The manifest indicators are repeated to reflect the higher-order construct. All indicators for the first-order and second-order elements must be reflective as a requirement for the repeated indicators technique to be adopted (Ciavolino & Nitti, 2010). The two-stage approach is another approach which as the name suggests is done in two stages. In the first stage, the reliability and validity of the lower order construct (LOC) are measured and the values of loading of LOC are used in the second stage for structural model measurement (Ciavolino & Nitti, 2010).

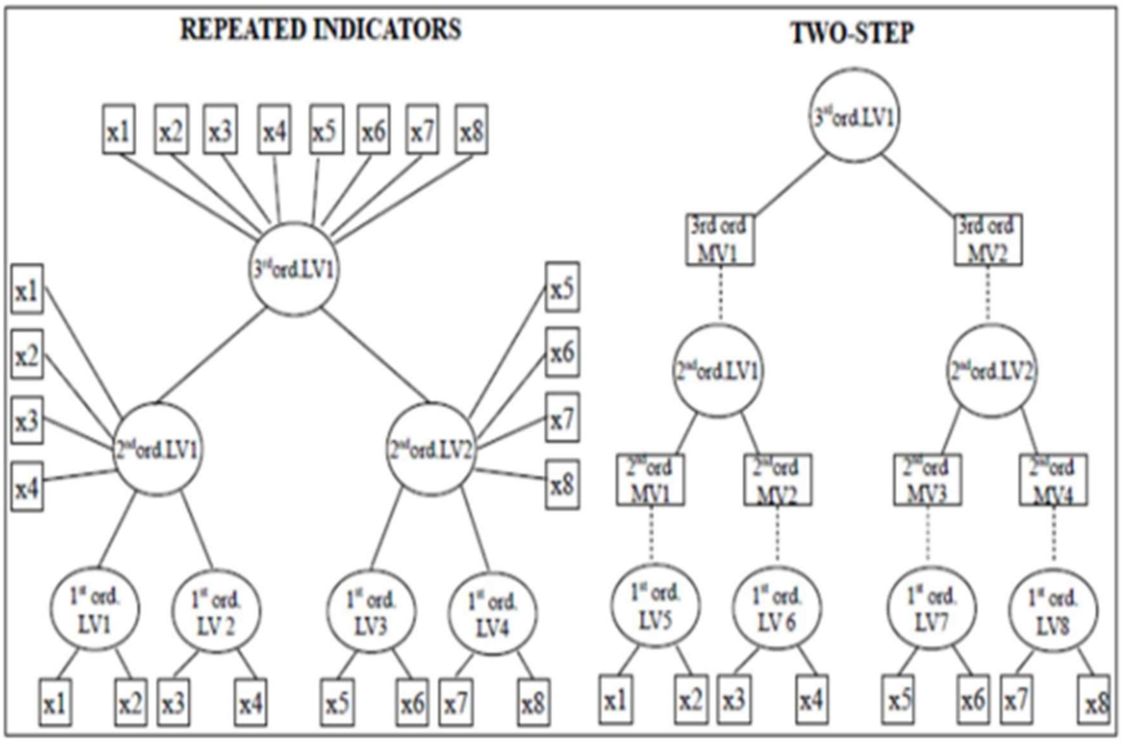

Figure 2. 1: Higher-order construct analysis approaches

Source (Ciavolino & Nitti, 2010).

2.5. Theoretical Research Model

Previous studies provide the theoretical basis to construct the model for this study (Doloi et al., 2011). A review of the literature was used to generate a theoretical model for testing the relationship between independent and dependent variables (Kassem, 2022). The developed theoretical model is presented in Figure 2.1 below.

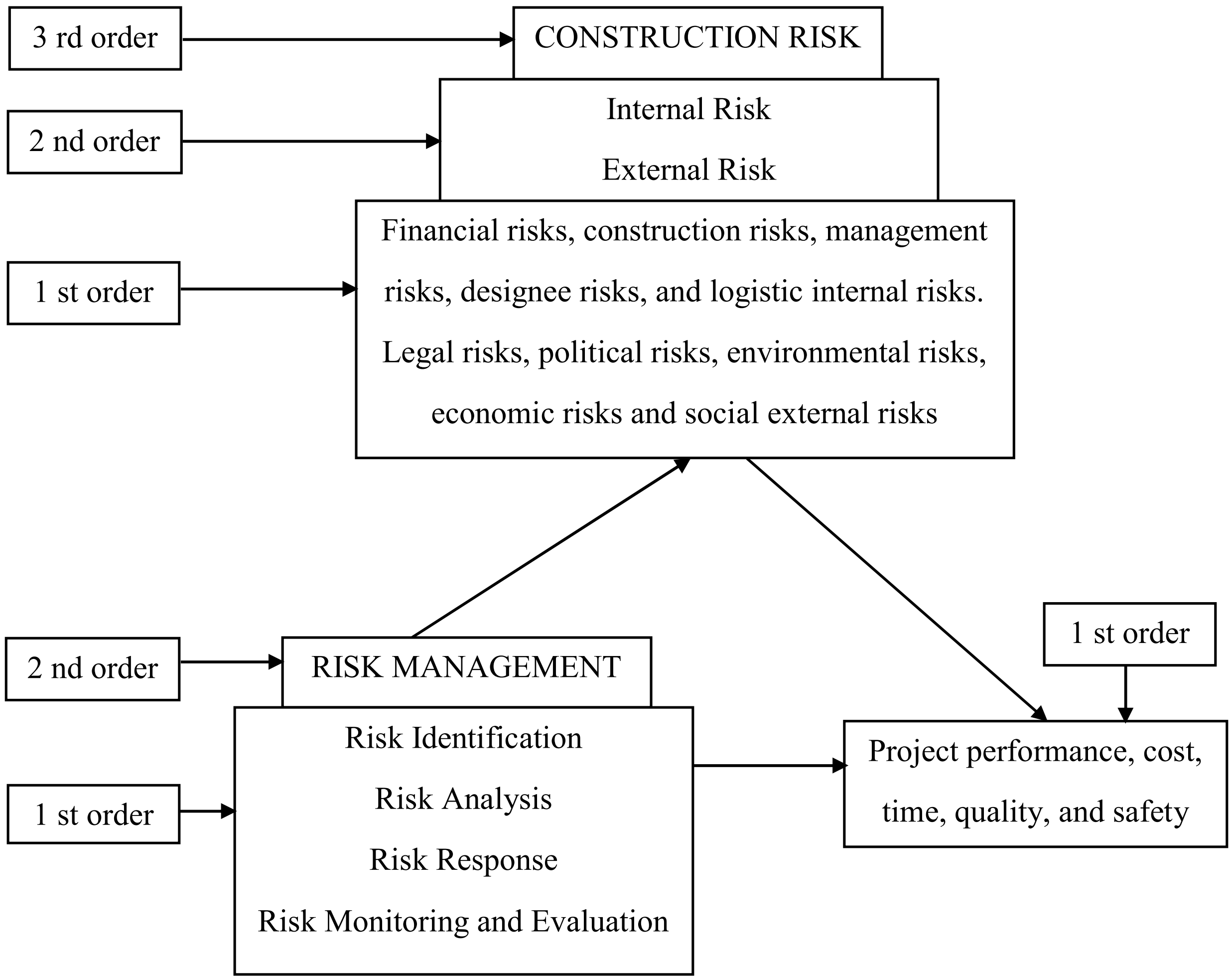

Figure 2. 2: Theoretical model

The developed theoretical model shows the interrelationship between risk management, project performance, and constriction risks, in which construction project risk is designed as a reflective-formative-formative third-order construct which contains internal and external risk as a second-order construct and Financial risk, construction risk, management risk, designee risk, logistic risk, Legal risk, political risk, environmental risk, economic risk, and social risk factors as a first order construct each with their own indicator. On the other hand, risk management is designed as a reflective-formative second-order construct that contains risk identification, risk analysis, risk response, and risk monitoring and evaluation as a first order each with its own indicators. Finally, project performance which is designed as a reflective first-order construct in terms of cost, time, quality, and safety. Furthermore, it can be seen from the model that project performance is the dependent variable which is influenced by the independent variable of risk management. The intermediating factor construction risk act as both which is influenced by risk management and intern influences project performance.

2.6. Research Gap

Construction risk management is one of the most researched study areas and several types of research have been conducted concerning the practice and the effect it has on construction projects. However, academics have given minimal attention to modeling and testing the relationship that exists. Some of the prior studies on this area include a study conducted on the management of large-scale construction projects although the study identified construction risks that affect the performance of construction projects it was limited only to the design phases (El-Dash et al., 2006). Another research undertaken by Butt et al (2021) studied the overall effect of risk management on project performance but the study only focused on the design stage of the construction process. Furthermore, (Kassem, 2022) developed a model that shows the relationship between internal and external risk factors with project performance but the study did not consider the impact of risk management which is an essential part to achieve project success. (Chin et al., 2020) investigated the mediating effect of knowledge management between risk management and project performance but the study did not include risk factors affecting project performance. On the other hand, the study by Kissi et al (2019) investigated the effect of risk management only in the context of monitoring and evaluation and did not include other processes of risk management in the model. In regard to our country (Birru, 2020) assessed the practice of project risk management for high-rise building construction projects, but fail to show the effects of risk on the performance of cost, time, and quality of the project. Although much of the research conducted regarding risk management and the effect of construction risks on project performance has properly identified and addressed the problem, the studies decrease significantly when it comes to modeling the relationship. As far as to the knowledge of this study no such research that addresses construction risk as an intermediate factor between risk management and project performance is found and filling this gap is the contribution of the study. In addition, previous researches fail to model risk management and construction risk as a hierarchical model as presented in this study. Therefore, the current study would fill this gap by developing a hierarchical model that shows the relationship between risk management and project performance with construction risk as an intermediate factor.

CHAPTER THERE

RESEARCH METHODOLOGY

3.1. Introduction

Once the theoretical foundation has been developed and the hypotheses have been stated using the theoretical justifications the next step is to develop the study design, and this chapter presents the approaches, methods, instruments, techniques, procedures, etc. that are used to collect and analyze data. The topics covered in detail in this chapter are research design, population and sampling, data collection, and data analysis. A brief illustration of the research design is also provided for a better understanding of the structural flow of the study.

3.2. Study Area Description

The Federal Democratic Republic of Ethiopia's capital, Addis Ababa, is one of the fastest growing cities in Africa and is home to 25% of the nation's urban population. It serves as both the country's growth engine and a key tenet of its aim to develop a middle-income, carbon-neutral, and resilient economy by 2025. The city has substantial development hurdles despite the strong economic growth trends. Furthermore, the cost of delivering infrastructure is increasing due to the physical development trends seen in recent years. Addis is growing sprawling, with urban extension development surpassing population increase. An estimated 46% of the land is unoccupied or underutilized as a result of this increase. Since Addis is the center of the economy several infrastructures including construction buildings are undertaken every year to boost the growth of the city.

3.3. Research Method

The research methodology adopted by this study was exploratory research method since the aim of this study is to investigate the causal correlations between risk management and project performance through hypothesis testing thus, this method is the most suitable form for this study. In addition, quantitative research approach which enables researchers to establish statistical evidence on the strength of the relationship between variables was deemed to be appropriate for this particular study.

3.4. Research Design

Research design which provides a general framework for data gathering, measurement, and analysis is presented in Figure 3.1. below, it clearly shows the methods and procedures used to collect and analyze data to solve the research problem.

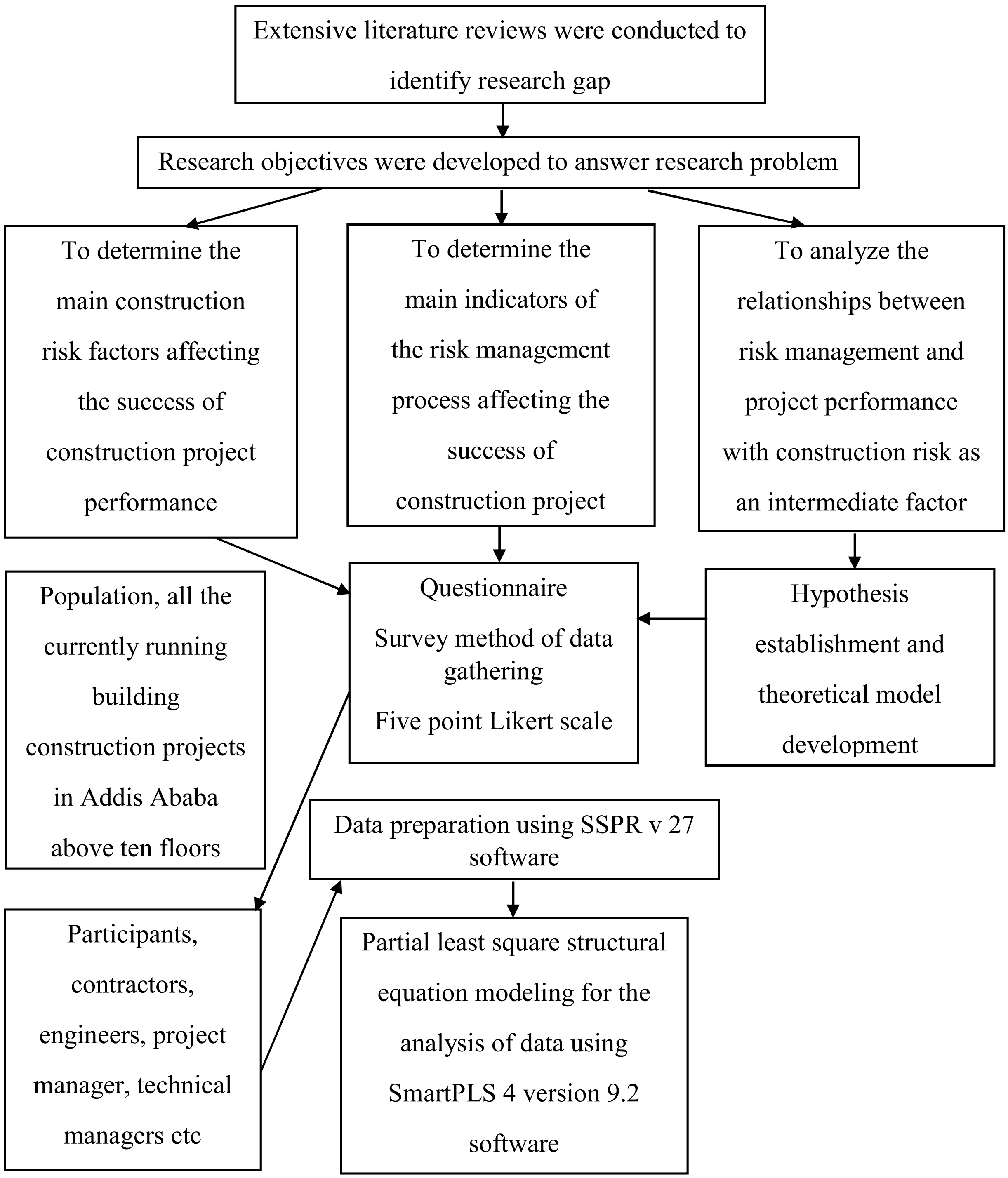

Figure 3. 1: Research design of the study

3.5. Populations and Sampling

Addis Ababa was chosen as a place of study because of the availability of mass large-scale construction projects as compared to other study areas. The population of the study was chosen to be all of the actively running construction projects in Addis Ababa that are above 10 floors. The projects were chosen in this way to make sure that the participants of the study were involved in larger constructions and had better experience since large scaled constructions have a higher chance of encountering and dealing with major construction risks throughout the entire process of construction. According to the Addis Ababa City Administration Building Permit and Control Office, 28 projects are currently running ten floors and above construction projects. Therefore, 28 building construction projects are the population of this study.

The population size of the study was small due to this the entire population was taken for analysis which was found to be 28 actively running projects. On the other hand, the target groups of investigation for this study are contractors of larger building projects and the participants are engineers and construction managers that are involved in site construction.

3.6. Data Collection

For this study Survey research method was adopted using a questionnaire as the primary instrument for data collection. Since data collection is a process of collecting data from different sources either primary or secondary both methods were used for the study. primary data collection was done through survey study.

3.6.1. Primary Data Collection

Primary data collection which is a process of gathering data directly from a source was the primary method used by this research for the collection of data from the field. For this purpose, questionnaire that is developed from research objectives was distributed to research participants, which were engineers, project managers, and contractors.

3.6.1.1 Questioner Survey

To achieve the objectives of the research, questionnaires were deemed to be the most effective tool for gathering information. The process of questionnaire development included defining and identifying indicators from literature. Literature review was carried out to identify the various risk factors and risk management indicators impacting building project performance in Ethiopia.

The review outcome generated and categorized risk factors into ten influential groups in which five are external risk factors and five are internal risk factors on the other hand risk management practice was grouped into four categories overall comprising 76 construct and indicator items. In order to examine and test the hypothesis of the study, survey method was used for data gathering. A questionnaire survey was designed by organizing and structuring the identified indicator items in the form of a question for respondents to complete in order to evaluate the performance of the projects in which they have participated in. The questions were designed in an affirmative manner by using a 5-point Likert scale to determine the overall impact of risk and risk management on project success. The first section of the questionnaire is consisted of background information of the respondents such as educational background, working experience, and job position, the second section focuses on construction risk factors to be rated based on their effect on project performance and the third and final part is about risk management practices to be rated also based on their effect on project performance. General summery of the questionnaire is described in appendix A. The questionnaire used for data collection in this study was distributed through face-to-face encounters with the participants. The data was distributed either on construction sites of the selected projects or on the construction office of the project holders and through this process, 120 questionnaires were distributed to the randomly selected participants.

3.6.2. Secondary Data Collection

For this study through the process of desk study a theoretical model containing four hypotheses that aspire to test the relationship between risk management, construction risk, and project performance was developed. Furthermore, the definition and identification of indicators were conducted through a similar process in which the indicators of internal and external risks were primarily identified from several works of literature based on the World Banks list of low-income and medium-low income countries, Risk management and project performance indicators were also identified and categorized from literature. The review outcome generated ten constructs of construction risk of which five are comprised of internal risk and the other five hold external risks and four constructs of risk management and one construct of project performance.

3.6. Data Analysis

The process of preparing data for analysis, conducting the analysis, reporting the results, and, drawing a discussion what is referred to as a data analysis. after the process of data collection from the study participants, missing value analysis, identification of outliers, and descriptive data analysis were conducted using SPSS version 27 software, This study also adopted the partial least square-structural equation modeling (PLS-SEM) tool for the statistical analysis of the data generated to create the cause-and effect relationship between risk management and project performance with construction risk as an intermediate factor between the two and test the established hypothesis. The theoretical model proposed by the study has a general sample size of 81 which is considered a small sample size for structural equation modeling and involves a second and third-order hierarchical model which contains formative constructs which are reflective in the first-order. The model also includes construction risk as an intermediate factor between risk management and project performance. The model is complex in nature with 19 latent constructs and 76 indicator variables and since PLS-SEM is a better methodology in accommodating these factors it has been adopted as the method of analysis by the study.

Additionally, the study adopted the repeated indicator approach with a reflective-formative-formative measurement model which is reflective in the first order, formative in the second order, and third order. But the repeated indicator approach does not apply to formative measures which are a part of the model of the study. To accommodate for this factor an extension of the repeated approach which is a two-stage approach that uses the repeated indicator approach in the first stage and a causal model in the second which is a latent variable score-based approach (the values of the constructs from the first stage are used to estimate the structural model in the second stage) has been adopted by the study. SmartPLS 4 version 9.2 software was used for analysis.

3.7. Measurements Model Reliability and Validity

Factor Loading

Indicator loading should be above 0.70. Furthermore, values between 0.4 - 0.7 should not be removed immediately from the model as long as the average variance extracted (AVE) is above 0.5. For this study most of the results are above 0.7 and the indicators with a loading value below 0.70 have an AVE value of 0.50 and above. The results are presented in Table 3.1 below.

Table 3. 1: Factor loading

	Const -rs	Desig -rs	Econ- rs	Envir -rs	Fina- rs	Legal -rs	Logis -rs	Mana -rs	Politi -rs	Pp	Risk- Id	Risk- an	Risk- me	Risk- res	Soc i-rs
Const-rs3	0.623														
Const-rs4	0.705														
Const-rs5	0.872														
Const-rs6	0.752														
Desig-rs1		0.757													
Desig-rs2		0.836													
Desig-rs3		0.847													
Desig-rs4		0.607													
Desig-rs5		0.706													
Econ-rs1			0.63												
Econ-rs2			0.797												
Econ-rs3			0.842												
Econ-rs4			0.762												
Econ-rs5			0.608												
Envir-rs1				0.838											
Envir-rs2				0.767											
Envir-rs3				0.827											
Fina-rs1					0.648										
Fina-rs2					0.787										
Fina-rs3					0.804										
Fina-rs4					0.736										
Legl-rs1						0.806									
Legl-rs2						0.775									
Legl-rs3						0.482									

Legl-rs4						0.79									
Logs-rs1							0.707								
Logs-rs2							0.786								
Logs-rs3							0.798								
Logs-rs4							0.809								
Logs-rs5							0.767								
Logs-rs6							0.745								
Man-rs1								0.735							
Man-rs2								0.79							
Man-rs3								0.737							
Man-rs4								0.711							
Man-rs5								0.738							
Man-rs6								0.568							
Polit-rs1									0.722						
Polit-rs2									0.808						
Polit-rs3									0.665						
Polit-rs4									0.71						
Pp1										0.819					
Pp2										0.847					
Pp3										0.82					
Pp4										0.663					
Risk-Id1											0.721				
Risk-Id2											0.639				
Risk-Id5											0.791				
Risk-Id6											0.818				
Risk-Id7											0.766				
Risk-an2												0.704			

Risk-an3											0.711			
Risk-an4											0.896			
Risk-an5											0.83			
Risk-me1												0.622		
Risk-me2												0.715		
Risk-me3												0.706		
Risk-me4												0.787		
Risk-me5												0.79		
Risk-me6												0.754		
Risk-res1													0.853	
Risk-res2													0.907	
Risk-res3													0.871	
Risk-res4													0.614	
Soci-rs1														0.9
Soci-rs2														0.8

For this study, indicators that did not meet the established parameter has also been in countered, which are risk identification indicator 3, construction risk indicators 1 and 2, political risk indicator 5, social risk indicator 3 and 4, and legal risk indicator 5 were also found to be an insufficient representation of the constructs and have been removed from the model.

Internal Consistency Reliability

Internal consistency reliability a value of 0.7 and above is established as a threshold estimate for both composite reliability and Cronbach's alpha reliability measures. As it can be seen in Table 3.2 below, the values of Cronbach's alpha are between 0.703 and 0.862 whereas composite reliability was found between 0.811 and 0.897 both of the values are found to be within the range. Hence, internal consistency reliability has been established.

Table 3. 2: Internal consistency reliability

	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
Const-rs	0.725	0.83	0.553
Desig-rs	0.809	0.868	0.571
Econ-rs	0.782	0.851	0.538
Envir-rs	0.745	0.852	0.658
Fina-rs	0.737	0.833	0.557
Legal-rs	0.703	0.811	0.527
Logis-rs	0.862	0.897	0.592
Mana-rs	0.808	0.862	0.513
Politi-rs	0.707	0.818	0.530
Pp	0.797	0.868	0.625
Risk-Id	0.806	0.864	0.562
Risk-an	0.799	0.867	0.623
Risk-me	0.826	0.873	0.535
Risk-res	0.833	0.889	0.672
Soci-rs	0.76	0.892	0.805

Construct Validity

The construct validity of a model in PLS-SEM is established through convergent validity and discriminant validity.

Convergent Validity

As a general rule, values of 0.50 or higher show that the construct has convergent validity. The values of AVE for the study were found to be between 0.513 and 0.805 which satisfies the set criteria, convergent validity is established. The values of AVE are presented in Table 3.3 above.

Discriminant Validity

Discriminant validity is established through Fornell and Larcker criterion, hetrotrate mononitrate ratio, and cross-loading.

Fornell and Larcker Criterion

Fornell and Larcker discriminant validity is established for this study, since the square root of AVE which is indicated in bold in Table 3.3 below was found to be greater than that of the correlation with the other underlying inter constructs. To achieve this risk analysis indicator 1, was found to have a better correlation with other constructs as compared to its own and has been removed from the model.

Table 3. 3: Fornell and larcker criterion

	Const-rs	Desig-rs	Econ-rs	Envir-rs	Fina-rs	Legal-rs	Logis-rs	Mana-rs	Politi-rs	Pp	Risk-Id	Risk-an	Risk-me	Risk-res	Soci-rs
Const-rs	0.743														
Desig-rs	0.423	0.756													
Econ-rs	0.286	0.671	0.734												
Envir-rs	0.251	0.467	0.549	0.811											
Fina-rs	0.294	0.359	0.234	0.342	0.746										
Legal-rs	0.221	0.182	0.13	0.188	0.352	0.726									
Logis-rs	0.51	0.385	0.322	0.231	0.56	0.284	0.769								
Mana-rs	0.526	0.6	0.524	0.518	0.513	0.186	0.659	0.716							
Politi-rs	0.279	0.506	0.589	0.532	0.419	0.334	0.404	0.529	0.728						
Pp	0.475	0.392	0.314	0.325	0.377	0.229	0.653	0.526	0.39	0.79					
Risk-Id	0.387	0.453	0.392	0.498	0.37	0.321	0.494	0.523	0.397	0.607	0.75				
Risk-an	0.274	0.429	0.317	0.384	0.432	0.199	0.515	0.51	0.301	0.553	0.708	0.789			
Risk-me	0.447	0.53	0.416	0.417	0.543	0.271	0.627	0.568	0.429	0.572	0.658	0.698	0.731		
Risk-res	0.189	0.547	0.384	0.485	0.392	0.116	0.399	0.516	0.369	0.424	0.68	0.694	0.725	0.82	
Soci-rs	-0.116	-0.182	-0.127	-0.196	-0.091	-0.164	-0.138	-0.155	-0.081	-0.271	-0.179	-0.082	-0.163	-0.117	0.897

Cross Loading

Cross loading the values of the study (highlighted) indicate that the items were correlated with their own parent constructs and did not load well onto other constructs of the study which means that they are not correlated with other constructs in the study. Thus cross loading discriminant validity is established. The result is presented in Table 3.4 below.

Table 3. 4: Cross loadings

	Const -rs	Desig -rs	Econ-rs	Envir -rs	Fina-rs	Legal -rs	Logis -rs	Mana -rs	Politi -rs	Pp	Risk-Id	Risk-an	Risk-me	Risk-res	Soc i-rs
Const-rs3	0.623	0.428	0.317	0.228	0.147	0.033	0.224	0.429	0.152	0.303	0.263	0.222	0.274	0.213	-0.3
Const-rs4	0.705	0.184	0.025	0.055	0.242	0.327	0.366	0.186	0.141	0.365	0.309	0.19	0.353	0.131	-0.0
Const-rs5	0.872	0.31	0.228	0.24	0.256	0.073	0.438	0.476	0.288	0.403	0.3	0.221	0.343	0.084	-0.0
Const-rs6	0.752	0.387	0.331	0.243	0.209	0.196	0.456	0.502	0.237	0.329	0.277	0.189	0.352	0.165	-0.0
Desig-rs1	0.251	0.757	0.516	0.344	0.204	0.119	0.189	0.418	0.328	0.251	0.278	0.235	0.291	0.4	-0.1
Desig-rs2	0.333	0.836	0.532	0.45	0.334	0.138	0.328	0.528	0.436	0.356	0.402	0.325	0.457	0.505	-0.1
Desig-rs3	0.332	0.847	0.585	0.504	0.383	0.224	0.383	0.524	0.519	0.385	0.396	0.459	0.516	0.442	-0.1
Desig-rs4	0.371	0.607	0.398	0.15	0.218	0.113	0.29	0.398	0.27	0.234	0.34	0.305	0.35	0.369	-0.1
Desig-rs5	0.319	0.706	0.493	0.228	0.152	0.062	0.225	0.361	0.3	0.207	0.262	0.256	0.338	0.321	-0.0
Econ-rs1	0.033	0.499	0.63	0.32	0.128	0.151	0.257	0.284	0.467	0.087	0.123	0.191	0.298	0.226	-0.0
Econ-rs2	0.194	0.501	0.797	0.504	0.237	0.215	0.234	0.388	0.41	0.212	0.324	0.178	0.293	0.276	-0.0
Econ-rs3	0.236	0.581	0.842	0.493	0.19	0.079	0.22	0.377	0.527	0.294	0.327	0.179	0.341	0.285	-0.2
Econ-rs4	0.237	0.409	0.762	0.418	0.225	0.080	0.289	0.419	0.474	0.284	0.309	0.363	0.325	0.278	-0.0
Econ-rs5	0.289	0.484	0.608	0.245	0.06	-0.02	0.199	0.437	0.294	0.216	0.296	0.249	0.272	0.336	-0.1
Envir-rs1	0.127	0.4	0.446	0.838	0.251	0.092	0.184	0.41	0.354	0.273	0.409	0.389	0.441	0.477	-0.1
Envir-rs2	0.16	0.251	0.372	0.767	0.277	0.169	0.124	0.414	0.39	0.143	0.324	0.19	0.23	0.296	-0.0
Envir-rs3	0.309	0.447	0.499	0.827	0.308	0.204	0.235	0.441	0.542	0.338	0.457	0.32	0.314	0.381	-0.2
Fina-rs1	0.229	0.156	-0.00	0.097	0.648	0.248	0.417	0.183	0.188	0.309	0.289	0.322	0.417	0.261	-0.0
Fina-rs2	0.25	0.402	0.357	0.349	0.787	0.222	0.454	0.509	0.359	0.23	0.228	0.239	0.35	0.226	-0.1
Fina-rs3	0.164	0.339	0.254	0.269	0.804	0.177	0.377	0.466	0.32	0.229	0.247	0.273	0.287	0.272	-0.0
Fina-rs4	0.215	0.216	0.146	0.31	0.736	0.347	0.401	0.403	0.373	0.312	0.305	0.398	0.49	0.368	-0.0
Legal-rs1	0.15	0.142	0.08	0.116	0.239	0.806	0.248	0.117	0.242	0.228	0.306	0.236	0.247	0.11	-0.1
Legal-rs2	0.025	-0.00	-0.03	0.105	0.176	0.775	0.034	-0.08	0.047	0.082	0.15	0.127	0.116	0.032	-0.1
Legal-rs3	0.256	0.237	0.092	0.212	0.198	0.482	0.274	0.212	0.333	0.11	0.052	-0.01	0.135	0.023	-0.1

Legal-rs4	0.216	0.16	0.188	0.156	0.364	0.79	0.242	0.25	0.329	0.184	0.299	0.139	0.23	0.119	-0.1
Logis-rs1	0.337	0.422	0.359	0.398	0.506	0.272	0.707	0.562	0.347	0.499	0.432	0.469	0.51	0.367	-0.2
Logis-rs2	0.332	0.239	0.274	0.195	0.452	0.156	0.786	0.507	0.352	0.481	0.312	0.36	0.475	0.29	0.0
Logis-rs3	0.445	0.314	0.165	0.105	0.478	0.241	0.798	0.484	0.26	0.62	0.516	0.487	0.574	0.413	-0.0
Logis-rs4	0.371	0.25	0.301	0.17	0.402	0.167	0.809	0.547	0.376	0.528	0.411	0.392	0.487	0.272	-0.0
Logis-rs5	0.488	0.24	0.155	0.04	0.451	0.3	0.767	0.525	0.264	0.433	0.264	0.329	0.389	0.207	-0.1
Logis-rs6	0.387	0.299	0.229	0.141	0.259	0.176	0.745	0.407	0.262	0.397	0.271	0.286	0.414	0.242	-0.1
Mana-rs1	0.494	0.347	0.31	0.323	0.424	0.106	0.592	0.735	0.317	0.437	0.45	0.393	0.53	0.421	-0.1
Mana-rs2	0.334	0.381	0.391	0.409	0.319	0.228	0.504	0.79	0.575	0.35	0.427	0.294	0.337	0.314	0.0
Mana-rs3	0.288	0.486	0.395	0.45	0.359	0.114	0.384	0.737	0.35	0.241	0.284	0.301	0.346	0.326	-0.0
Mana-rs4	0.293	0.582	0.436	0.375	0.413	0.112	0.467	0.711	0.302	0.367	0.297	0.426	0.41	0.354	-0.2
Mana-rs5	0.213	0.518	0.526	0.39	0.389	0.001	0.394	0.738	0.44	0.336	0.338	0.464	0.39	0.441	-0.0
Mana-rs6	0.555	0.285	0.211	0.298	0.273	0.229	0.425	0.568	0.297	0.457	0.396	0.279	0.365	0.321	-0.0
Politi-rs1	0.264	0.31	0.475	0.435	0.343	0.15	0.292	0.382	0.722	0.293	0.273	0.194	0.32	0.214	0.0
Politi-rs2	0.234	0.417	0.447	0.426	0.373	0.293	0.324	0.358	0.808	0.339	0.35	0.29	0.321	0.315	-0.0
Politi-rs3	0.182	0.379	0.355	0.367	0.262	0.231	0.364	0.481	0.665	0.319	0.272	0.245	0.361	0.305	-0.1
Politi-rs4	0.088	0.359	0.455	0.277	0.2	0.327	0.124	0.274	0.71	0.108	0.235	0.087	0.198	0.209	-0.0
Pp1	0.404	0.346	0.223	0.213	0.328	0.211	0.501	0.414	0.359	0.819	0.467	0.351	0.365	0.235	-0.2
Pp2	0.324	0.265	0.218	0.221	0.356	0.259	0.569	0.427	0.354	0.847	0.486	0.437	0.417	0.268	-0.2
Pp3	0.424	0.332	0.272	0.292	0.259	0.119	0.57	0.44	0.234	0.82	0.577	0.524	0.564	0.484	-0.2
Pp4	0.352	0.303	0.291	0.319	0.245	0.133	0.401	0.381	0.3	0.663	0.365	0.435	0.463	0.349	-0.1
Risk-Id1	0.341	0.413	0.359	0.31	0.343	0.216	0.399	0.446	0.282	0.389	0.721	0.575	0.392	0.481	-0.0
Risk-Id2	0.307	0.144	0.033	0.179	0.097	0.202	0.271	0.293	0.073	0.327	0.639	0.408	0.336	0.303	-0.0
Risk-Id5	0.304	0.407	0.339	0.524	0.29	0.25	0.382	0.466	0.372	0.434	0.791	0.566	0.532	0.554	-0.1
Risk-Id6	0.327	0.367	0.281	0.43	0.327	0.205	0.375	0.392	0.314	0.552	0.818	0.52	0.61	0.617	-0.2
Risk-Id7	0.191	0.293	0.358	0.344	0.262	0.329	0.401	0.337	0.359	0.54	0.766	0.56	0.544	0.523	-0.1
Risk-an2	0.07	0.233	0.158	0.209	0.288	0.077	0.211	0.265	0.081	0.285	0.492	0.704	0.515	0.537	-0.1

Risk-an3	0.074	0.31	0.244	0.323	0.291	0.165	0.286	0.352	0.273	0.335	0.513	0.711	0.422	0.477	-0.0
Risk-an4	0.338	0.434	0.321	0.359	0.376	0.151	0.545	0.527	0.271	0.536	0.677	0.896	0.623	0.62	-0.1
Risk-an5	0.284	0.335	0.242	0.298	0.392	0.214	0.478	0.405	0.278	0.518	0.536	0.83	0.626	0.562	-0.0
Risk-me1	0.068	0.373	0.278	0.297	0.363	0.059	0.241	0.255	0.256	0.232	0.429	0.479	0.622	0.607	-0.0
Risk-me2	0.265	0.462	0.410	0.331	0.512	0.153	0.442	0.467	0.331	0.376	0.498	0.463	0.715	0.486	-0.1
Risk-me3	0.385	0.269	0.330	0.333	0.339	0.144	0.358	0.38	0.28	0.327	0.44	0.382	0.706	0.463	-0.1
Risk-me4	0.406	0.494	0.297	0.284	0.444	0.131	0.542	0.548	0.349	0.46	0.494	0.605	0.787	0.586	-0.1
Risk-me5	0.457	0.405	0.271	0.34	0.372	0.393	0.596	0.466	0.317	0.526	0.55	0.611	0.79	0.534	-0.1
Risk-me6	0.295	0.296	0.246	0.253	0.341	0.255	0.484	0.305	0.339	0.527	0.464	0.502	0.754	0.544	-0.1
Risk-res1	0.07	0.479	0.293	0.415	0.307	0.1	0.282	0.398	0.26	0.372	0.62	0.665	0.657	0.853	-0.1
Risk-res2	0.269	0.526	0.406	0.472	0.4	0.114	0.35	0.537	0.365	0.398	0.587	0.574	0.62	0.907	-0.1
Risk-res3	0.177	0.503	0.391	0.451	0.265	0.059	0.369	0.409	0.326	0.387	0.619	0.555	0.608	0.871	-0.1
Risk-res4	0.048	0.215	0.08	0.185	0.329	0.124	0.32	0.317	0.245	0.188	0.366	0.503	0.498	0.614	0.0
Soci-rs1	-0.09	-0.24	-0.21	-0.26	-0.08	-0.07	-0.09	-0.18	-0.11	-0.24	-0.19	-0.12	-0.21	-0.20	0.9
Soci-rs2	-0.11	-0.06	0.008	-0.07	-0.08	-0.22	-0.15	-0.08	-0.02	-0.24	-0.12	-0.01	-0.06	0.007	0.8

Heterotrait Monotrait Ratio

The heterotrait monotrait (HTMT) ratio the cutoff value is placed at < 0.85. But because of commonalities among the indicators on the constructs, a more liberal cut-off value of < 0.90 can be used. On this note, the values of the study were found to be under the cut of value 0.9. But to achieve this indicator of risk management, risk identification indicator 4 which states Identifying entities affected by risks influences risk identification process, and risk analysis indicator 6 which states performing quantitative risk analysis influences the risk analysis process were found to have values above 0.9 and were removed from the model. Thus, discriminant validity through heterotrait monotrait ratio is established. The results are presented in Table 3.5 below.

Table 3. 5: Heterotrait monotrait ratio

	Const -rs	Desig -rs	Econ -rs	Envir -rs	Fina-rs	Legal -rs	Logis -rs	Mana -rs	Politi -rs	Pp	Risk-Id	Risk-an	Risk-me	Risk-res	Soci-rs
Const-rs															
Desig-rs	0.582														
Econ-rs	0.405	0.852													
Envir-rs	0.342	0.583	0.696												
Fina-rs	0.386	0.464	0.374	0.464											
Legal-rs	0.366	0.259	0.238	0.287	0.443										
Logis-rs	0.635	0.446	0.399	0.291	0.683	0.382									
Mana-rs	0.679	0.738	0.664	0.675	0.67	0.324	0.77								
Politi-rs	0.363	0.646	0.805	0.704	0.556	0.485	0.483	0.681							
Pp	0.625	0.478	0.385	0.407	0.472	0.279	0.767	0.637	0.492						
Risk-Id	0.515	0.529	0.475	0.599	0.441	0.372	0.566	0.623	0.494	0.738					
Risk-an	0.326	0.506	0.389	0.469	0.531	0.254	0.566	0.601	0.36	0.664	0.864				
Risk-me	0.551	0.629	0.523	0.518	0.659	0.333	0.709	0.658	0.536	0.69	0.786	0.847			
Risk-res	0.256	0.635	0.453	0.578	0.488	0.139	0.464	0.61	0.464	0.506	0.797	0.868	0.893		
Soci-rs	0.189	0.237	0.201	0.266	0.199	0.24	0.193	0.195	0.14	0.342	0.216	0.126	0.232	0.164	

3.7. Ethical Consideration

There are usually certain ethical considerations to be made when performing research. There are some general norms or guidelines that researchers must adhere to, such as not altering data or results in any way to further personal objectives. The ethical considerations in this research were to responsibly cite and acknowledge the professionals whose works were used and reviewed in the literature to avoid plagiarizing. And properly obtain and analyze data without manipulation and fabrication to avoid an incorrect presentation of the result. In addition, we made sure that the survey participants understood that their participation was optional and that the information they provided was kept private. The data obtained would be used for academic purposes only.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Introduction

This chapter deals with the statistical procedures used to analyze the data, results, discussion, and interpretation. First, the data preparation process was performed with the aid of SPSS version 27 to be able to analyze the data in PLS-SEM. The results of this analysis, demographic characteristics of respondents are provided in the first section. Then PLS-SEM analysis which was conducted using SmartPLS 4 software is explained. The results from the model that deals with the impact of constructs is used to test the first and second objectives of the stud. The second section is the structural model analysis which measures the significance of the path relationship which was used to test the third objective of the study. A summary of the results is also provided.

To achieve the results and attain the objective of the study questionnaire part two which determined risk factors was used for the first objective and questionnaire part three which determines risk management process indicators was used for objective two, and to achieve objective three both parts of the questionnaire was used. In addition, the data was collected specifically from large construction projects in Addis Ababa.

4.2. Demographic Characteristics of the Sample

Response Rate

The study questionnaire included demographic questions to determine the general profile of the participants. On this note, the primary element analyzed was the response rate in which for this particular study 120 questionnaires were distributed to respondents on construction sites and contractors' offices, and out of those 94 questionnaires were returned and 81 of the questionnaire items were dimmed to be valid. According to Fincham, (2008), A response rate of 70% or more can help draw a very good analysis. The current study response rate is 84%, which means that the response rate is sufficient to draw a very good analysis. The response rate of the questionnaire is shown in Table 4.1 below.

Table 4. 1: Response rate

Number of Questionnaires Distributed	120
Number of Questionnaires Returned	94
Number of accepted questionnaires	81
Number of rejected questionnaires	13
Percentage of Survey Response Rate	84 %

General Profile of Respondent

This section provides the general information of participants which includes the respondent's job position, educational status, field of specialization, and years of experience. The educational level of the participants of the study, expressed in percentage, indicated that (30.9%) were second-degree holders (MSc) and (69.1%) were found to have a first-degree (BSc). the educational level of the participants indicates that the study's participants are literate and they have a better understanding of the topic and grasp the research's subject matter, making them excellent participants for this study to achieve the established objective. Figure 4.1 below illustrates the educational level of the participants of the study.

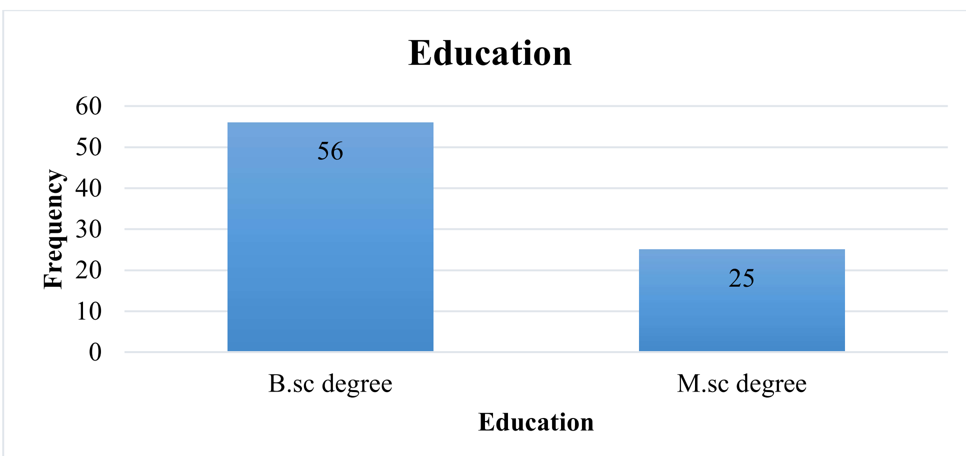

Figure 4. 1: Educational level of respondents

The total grouping of respondent's fields of specialization which is important to determine their association with the subject matter of the questionnaire has been estimated. Through this, 69.1 % were found to be engineers, 25.1 % from construction management, 2.5 % from architecture, and 2.5 % from project management which are all in great association with the subject matter of the study, construction risk, risk management, and project performance. The results of respondents' fields of specialization are presented in Figure 4.2 below.

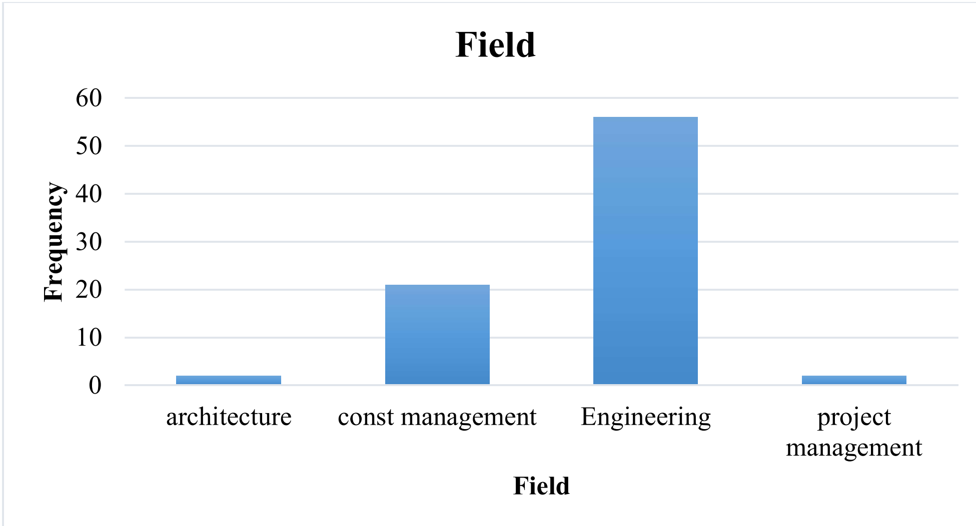

Figure 4. 2: Field of specialization of the respondents

The working experience of the participants of the study, expressed in percentage, is 1-5 years of experience (19.8%), 6-10 years of experience (55.6%), 11-15 years of experience (16%), 16-20 years of experience (3.7%) and more than 20 years (4.5%). the majority of the participants have a good experience rate and it is believed by the study that respondents had sufficient knowledge and understanding of the topic, this makes them dependable and credible sources of information. The work experience of the respondents is presented in Figure 4.3 below.

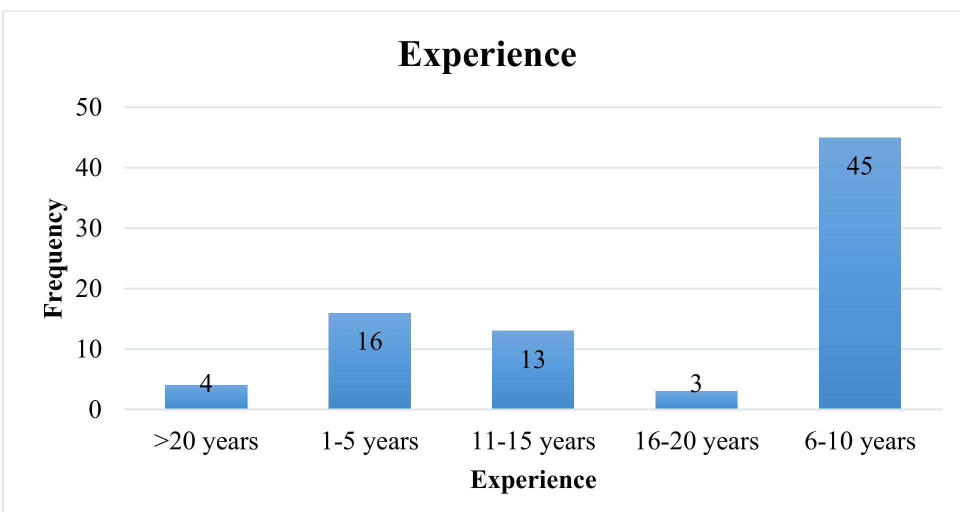

Figure 4. 3: Experience of the respondents

The overall groupings of respondents working positions in percentile resulted, site engineers at 35.8% and office engineers at 18.5%, which comprised the majority of the position, and others like technical managers, project managers, deputy general managers, operational managers, etc., cover the rest of the percentile. This shows that the respondents are selected from a wide range of professions which is beneficial to get information on variant positions. The results of the respondent's position are presented in Figure 4.4 below.

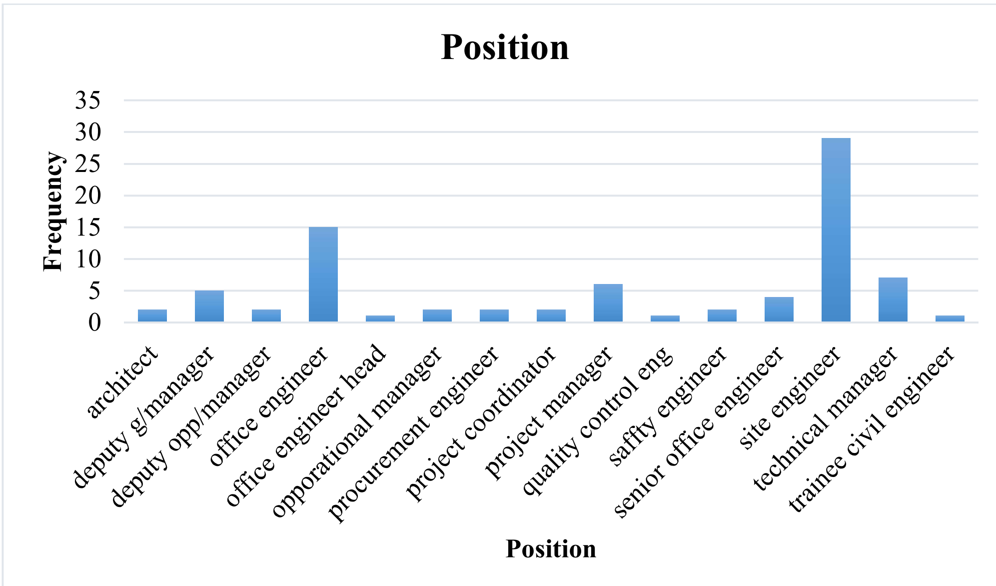

Figure 4. 4: position of the respondents

4.3. Significance and Relevance of Indicator Weights

In this stage, the significance and relevance of indicators weight has been established. Indicator weights are normally considered statistically significant at a $P < 0.05$ and $T > 1.99$. it should be noted that the larger the weights the greater the relevance of the indicator to the construct. The study found all the values of the constructs to be significant at $P < 0.002$ except an indicator of external risk, social risk construct which had a collective value of $P = 0.153$ which is greater than, $p < 0.05$, and an outer weight of 1.026 which is also lower than $T > 1.99$, which indicates that the construct has an insignificant value which does not meet the criteria. the outer loading for social risk construct is - 0.797 so the individual item was not removed from the model since it has some kind of relevance to the model. Additionally, path coefficient β which determines the impact of the independent variable on dependent variables was met since all the values are > 0.1. Except for the values of social risk construct. The results are presented in Table 4.2 below.

Table 4. 2: Significance and Relevance of Indicator Weights

	Path	Path β	Mean	Error	T = (β/error)	P value
internal risk - constriction	1st - 2nd	0.171	0.165	0.025	6.944	0.000
internal risk - design	1st - 2nd	0.255	0.254	0.040	6.321	0.000
external risk - risk	2nd - 3rd	0.344	0.344	0.039	8.833	0.000
external risk - legal	1st - 2nd	0.171	0.171	0.058	2.918	0.002
external risk - environmental	1st - 2nd	0.291	0.284	0.039	7.551	0.000
internal risk - financial	1st - 2nd	0.183	0.182	0.030	6.114	0.000
internal risk - risk	2nd - 3rd	0.734	0.727	0.038	19.517	0.000
external risk – economic	1st - 2nd	0.446	0.439	0.039	11.379	0.000
internal risk - logistic	1st - 2nd	0.338	0.332	0.040	8.386	0.000
internal risk - management	1st - 2nd	0.329	0.328	0.033	10.046	0.000
external risk - political	1st - 2nd	0.350	0.342	0.036	9.759	0.000
risk management-identification	1st - 2nd	0.293	0.293	0.023	12.479	0.000
risk management - analysis	1st - 2nd	0.245	0.245	0.021	11.688	0.000
risk management - m and e	1st - 2nd	0.347	0.347	0.029	11.982	0.000
risk management - response	1st - 2nd	0.252	0.251	0.018	14.109	0.000
risk management - social risk	1st - 2nd	0.080 -	0.043	0.078	1.026	0.153

4.3.1. Construction Risk Factors Affecting Project Performance

The first objective of the study aspires to determine the main construction risk factors affecting the success of construction project performance. The results of the study indicated that economic risk factors from external risk construct are the primary factors affecting project performance with an impact value of $\beta = 0.446$. The outcomes of the study were in alignment with previous research which reported similar values (Ishaq, 2021a) and found economic risk factors to be the primary risk categories affecting project cost in Nigeria. (Teferi, 2020) also confirmed the significant impact of economic risks specifically inflation on the performance of Ethiopian construction projects. Ejeta et al (2021), also supported this claim in which the top three risk factors out of five were found to be economic risk factors in his study. As can be seen from the results of this study economic risk factors such as inflation, exchange rate and economic instability and market condition have the highest impact on project performance cost, time, quality, and safety out of all the other factors. This impact is not one to be seen lightly, because economic risks such as inflation which is brought on by an increase in the dollar worth of imported building supplies can hinder the progress of a country's construction projects and some are even abandoned. This problem is even more concerning in the context of Ethiopia in which the rate of inflation increases highly from month to month. Due to this, specific attention should be given to such risks as the negative impact on a project is significantly high.

Political risk factors were found to have the second highest impact on project performance from external risk factors at $\beta = 0.350$. (Ali & Ahmed, 2020) also reported similar findings in which political risk factors in terms of political security and stability were rated among the top influencing factors. Several other researches such as (Ibrahim & Abubakar, 2019) and (Bahamid et al., 2020) also confirmed the grave impact of political risks. Even though this research supported this claim other studies were also found that have placed this category of risk among the lower factors. (Tadayon et al., 2012) ranked political risk factors among the low impact and Yadeta (2019) also stated management and construction risks were found to have the highest impact preceding political risk. this slight deviation in result might be due to the current situation of the country which has boosted the impact of political risk factors over the others. On the other hand, the values of political risk are only slightly over management and logistic risk which can be justified to have more or less a similar impact. As reported by the study political risks such as corruption and political instability are among the major factors that many nations believe will have a significant impact on the success of construction projects. this is because the amount of money spent on constructions by the government will be more expensive because of the action of corruption, particularly in developing countries such as Ethiopia.

Logistic risk factors were found to have the first highest impact from internal risk factors with $\beta = 0.338$ and their overall impact has been rated third. logistic risk factors in terms of defective risk materials and competent & qualified professionals have been reported among the highest impacting factors by several studies, (Mesfin, 2018), (Ahmed, 2014), and (Ali & Ahmed, 2020). This claim was also supported by Yadeta (2019), which suggested that these risk factors are among the highest impacting factors in the construction industry, even though the indicator have been categorized into different categories in the study. Furthermore, the findings of this study show that the indicator of logistic risk factors such as lack of skilled labor, shortage in material, and equipment availability in addition to the ones indicated above all represent or measure the category significantly well as compared to other categories in which several indicators had to be removed. And as indicated by the participants of the study, logistic risk factors are the major issues that larger construction projects face every day.

Management risk factors were found the second most impacting factors of the internal risk category at $\beta = 0.329$ and fourth overall. Management risks were indicated to be one of the most critical categories of internal risk factors in Ethiopia (Endris Yadeta, 2020). This is in alignment with the findings of the study by Cheng & Darsa (2021), and (Ali & Ahmed, 2020) which also indicated management risks in terms of poor resource management and poor communication between involved parties are among the highest impactful factors. This indicates that larger construction projects in Ethiopia face a higher problem from logistic and management issues, the main concern of these projects is managing the overall project, allocating available resources efficiently, and covering sufficient logistics such as material and equipment delivery rather than issues with the financing and design of the project in comparison.

On the other hand, the impact of environmental risk at $\beta = 0.291$, design risk at $\beta = 0.271$, and financial risk factor at $\beta = 0.183$ have also been reported to have a significant impact by the study, and several researches support the finding. (Ahmed, 2014), (Teferi, 2020) and (Yadeta, 2019). The study also found construction risk factors from internal risk and legal risk factors from the external risk category to have the least value at $\beta = 0.171$ for both. the value of construction risk factors was found to deviate from previous studies in which most studies categorized it as a higher impact value of construction risks (Ishaq, 2021a), (Tessema et al., 2022). (Endris Yadeta, 2020) even refers to construction risks as one of the highest impacting issues in Ethiopia alongside management and logistic risk categories. This deviation in result might be because of the removal of construction indicators 1 and 2, Accidents/safety during construction, and low labor and equipment productivity because of lower loading values as indicated above in the factor loadings section. And these measures of construction risk were the ones that were indicated as having the highest impact of the category in previous research. The same goes for legal risk factors which have been indicated as somehow impactful specially when it comes to difficulty to get permits and ordinances as reported by Tadayon et al (2012) and (Tessema et al., 2022). But the results of the study states a lower impact of legal risk factors and this might be because of the type of construction projects selected for the study. Larger construction projects as indicated by participants do not suffer from getting permits and conflicts between involved parties this is because such projects are mostly government funded and if not has the attention of the government since they contribute highly to the economic growth of the country. finally, social risk was found to have the least impact, in fact, the contribution was found to be insignificant with $\beta = 0.08$. Thus, it can be noted that the impact of social risks such as religious differences and cultural differences is negligible. This is also confirmed by Yadeta (2019), in which social risk factors were ranked among the least factors.

Even though the comparative results of the study that have been discussed above indicated economic and political risk factors from external risk and logistics and management risk factors from internal risk as the major problems that large construction projects face. The overall results of the study indicate that all of the indicators of internal construction risk (financial risk, construction risk, management risk, logistic risk, and design risk) and external construction risk (economic risk, political risk, environmental risk, and legal risk) have a significant impact on project performance cost, time, quality and safety. This is justified with an impact value of $\beta > 0.1$ for all. On the other hand, social risk from external risk factors which hold religious and cultural issues was found to have an insignificant impact on the performance of a project. These risk factors are not that much of a problem to be concerned with in large construction projects. on top of this it should be noted that emphasis should be given to the risk factor with the highest impact on construction projects so that they can be prioritized and dealt with to reduce their impact on the performance of projects. The results can be seen in Figure 4.5 below.

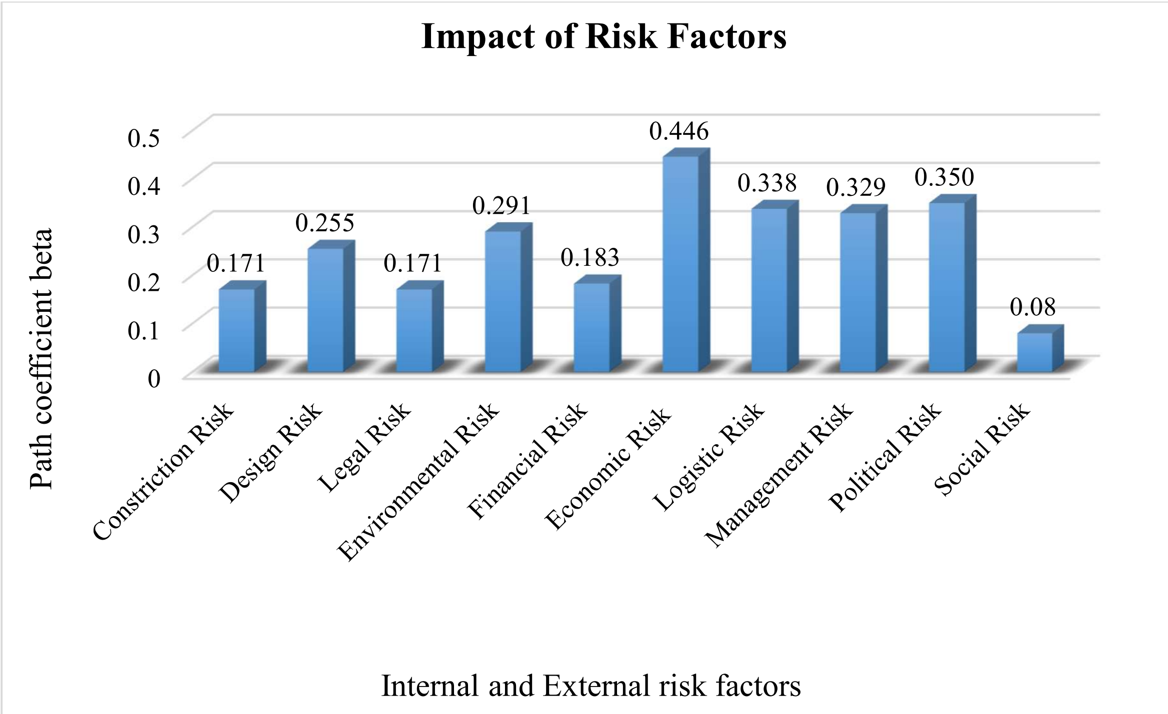

Figure 4. 5: Impact of risk factors on project performance

4.5.2 Impact of Internal and External Risk Factories

The results of the study indicated a higher outer weight value of internal risk at 19.517 and that of external risk at 8.833. This indicates that internal risks have the highest impact on project performance which is confirmed by an impact value $\beta = 0.734$ as compared to external risks at $\beta = 0.344$ which is the lower value in comparison. But, it should be noted that the overall result dictates that both internal and external risk has a significant impact on project performance cost, time quality, and safety since the path coefficient $\beta > 0.1$ for both. Several researchers displayed similar findings (Endris Yadeta., 2020), (MESFIN, 2018) and (Bahamid et al., 2020), in which the results of these studies show economic and some political risk factors such as inflation, exchange rate, economic market instability, war, and political market instability and corruption as the primary risk factors affecting project performance. However, collectively it is the risk factors from logistics, management, construction, and financial categories such as poor resource management and poor communication between involved parties, poor cash flow management, delayed payments, defective risk of materials, competent & qualified professionals, improper planning and scheduling and unforeseen site ground conditions, that has the overall impact. This claim has been clearly and specifically stated by Yadeta (2019). Thus, collectively it is the low contribution of legal and social risk factor that reduces the overall impact of the external risk category, Therefore, it is the internal risk factors such as management and supply of logistics that are important in large constructions and the ones causing the most impact on project performance. the results of internal and external risk factors are presented in Figure 4.6 below.

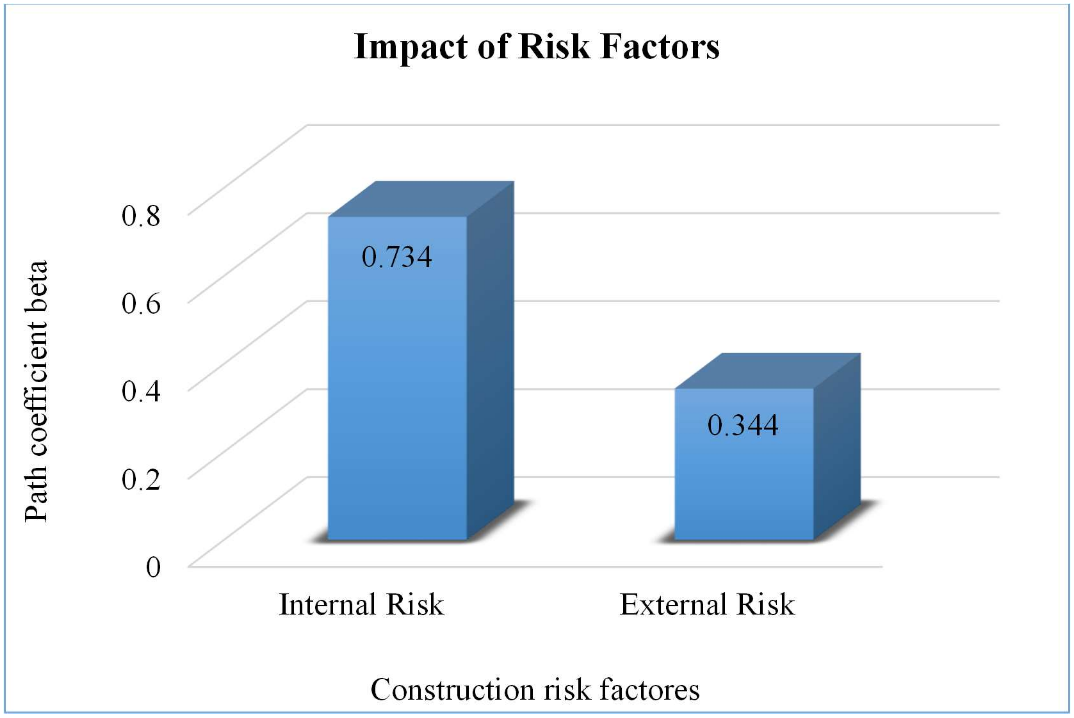

Figure 4. 6: Impact of internal and external risks on project performance

The general results of the measurement model reliability and validity and significance and relevance of indicator weights are presented in figure 4.7 below.

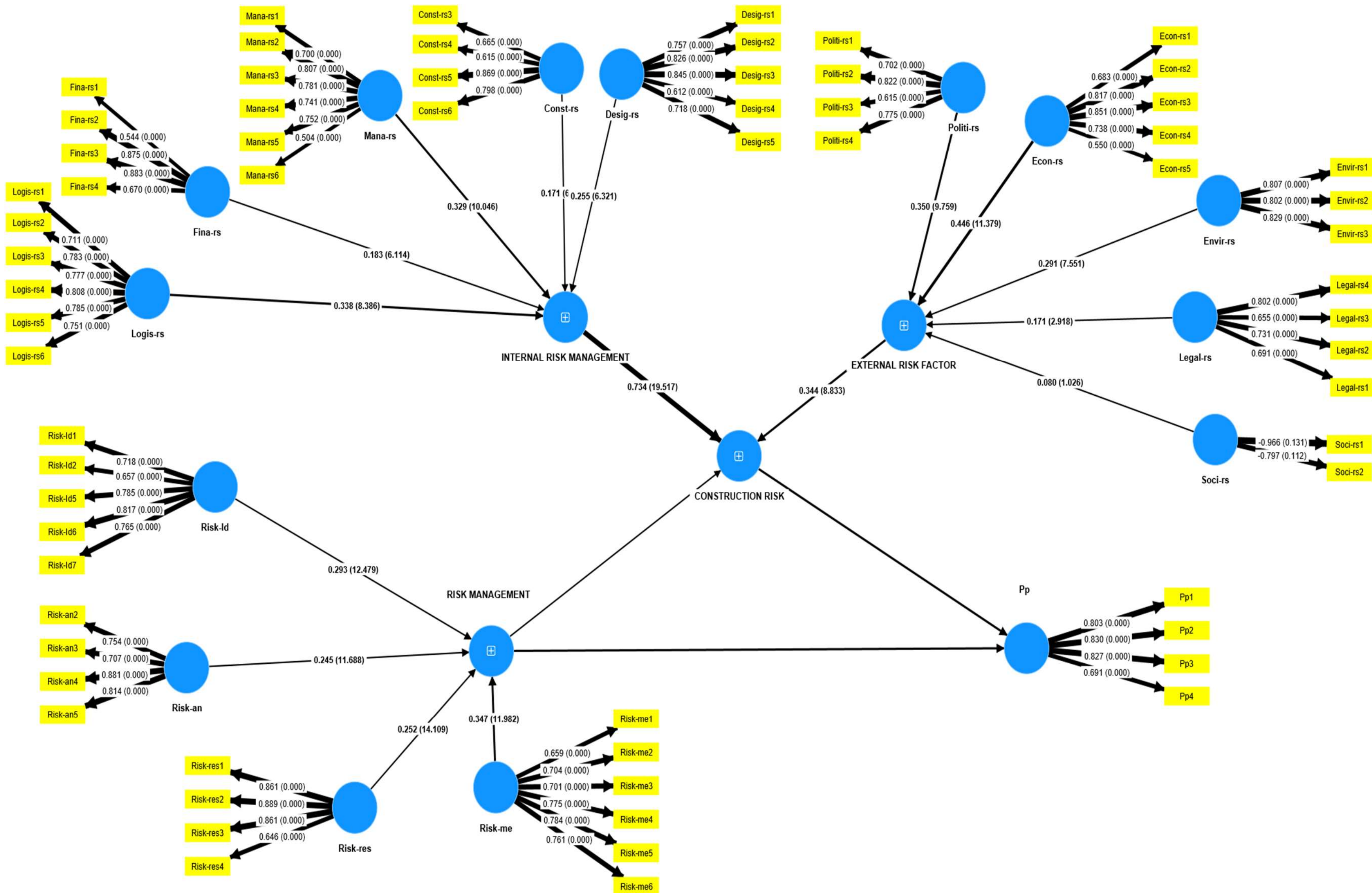

Figure 4. 7: Measurement model

4.4. Significance and Relevance of Path Relationships

By dividing path coefficient β by the standard error, the T-test reveals if certain parameter estimations are statistically distinct from zero. T-test results show whether or not the null hypothesis is rejected. A t-statistic value greater than 1.99 is considered a significant value. Further, the analysis also resulted in the path coefficient β which represents the impact of independent variables on dependent variables. The results of the study indicate a significant value of T-statistic and p-value. It also shows the impact value beta for the three hypotheses H1, H2, and H3 which are all supported for this study. The results are presented in Table 4.3 below.

Table 4. 3: Significance of the structural model relationship

Hypothesis	Path	Path β	Error	T-statistics	P values
H1	Construction Risk > Project performance	0.319	0.117	2.740	0.006
H2	Risk Management > Construction Risk	0.697	0.065	10.758	0.000
H3	Risk Management > Project performance	0.436	0.100	4.355	0.000

Coefficient of Determination (R2)

The coefficient of determination (R2) indicates how much change in the dependent variable can be accounted for by one or more independent variables (Henseler & Sarstedt, 2013). And according to (Cohen, 1988), R2 value of 0.26 is considered high, 0.13 is moderate and 0.02 are stated to be weak. For the dependent endogenous variables construction risk and project performance, the R2 value of both was found to be 0.486. which indicates that 48.6% of change in construction risk is being explained by risk management and the R2 value of the dependent variable project performance states 48.6% change in project performance cost, time quality, and safety are being explained by construction risk and risk management.

Predictive Relevance Q2

The value of predictive relevance Q2 0.02 is deemed to be a weak, 0.15 moderate, and 0.35 strong degree of predictive relevance. the results of the study for Q2 were substantial in that the Q2 value for the endogenous variable construction risk is 0.431 and that of project performance is 0.391 which are both greater than the maximum value hence, the model has high predictive relevance. The results are presented in Table 4.4 below.

Table 4. 4: Explanatory power and prediction relevance

Predictors (independent variable)	Outcome (dependent variable)	R^2	Q^2
Risk management	Construction risk	0.486	0.431
Risk management	Project performance	0.486	0.391
Construction risk			

Mediation Analysis

Mediation analysis shows a change in the exogenous (independent) construct causing a change in the mediator variable, which then affects the endogenous (dependent) construct. recommended determining the existence and kind of mediation. The first step is to establish if the mediator is or is not mediating the indirect relationship between the two variables. This is justified by the significance of the indirect relationship. The second step will be to determine whether the mediator construct can completely (full mediation) or partially (partial mediation) explain the relationship between the two constructs and this is justified by VAF calculations. Mediation analysis has been performed to test the mediating effect of construction risk between risk management and project performance and hypothesis H4 states exactly that. The result of the study reviled a positive and significant indirect relationship. In which the indirect effect (Risk Management > Construction Risk > Project performance) was found to be ($\beta = 0.223$, $T = 2.680$, $P < 0.007$), the total effect values were also positive and significant at ($\beta = 0.658$, $T = 10.093$, $P = 0.000$) and the direct effect ($\beta = 0.436$, $T = 4.355$, $P = 0.000$) which was also positive and significant. Since all the values are positive this shows a complimentary mediation. The results are presented in Table 4.5 below.

Table 4. 5: Mediation effect

Indirect effect	Path β	Error	T Statistics	P Values
Risk Management > Construction Risk > Pp	0.223	0.083	2.680	0.007
Total effect				
Risk Management > Pp	0.658	0.065	10.093	0.000
Direct relationship				
Risk Management > Pp	0.436	0.100	4.355	0.000

In order to determine whether the mediation is partial or full VAF calculation which is the ratio of the indirect effect to the direct effect has been performed. VAF value between 20% and 80% indicates partial mediation. Table 4.6 shows the VAF calculation results, which show a VAF value of 53%, supporting construction risks and complimentary partial mediation between risk management and project performance.

Table 4. 6: VAF calculations

Hypothesis	Direct Effect	Indirect Effect	Total Effect	VAF (indirect effect)
Risk Management > Construction Risk > Pp	0.436	0.223	0.658	0.53

4.5.2. Risk Management Process Affecting Project Performance

The second objective of the study aims to determine the main indicators of the risk management process affecting the success of project performance which are risk identification, risk analysis, risk response, and risk monitoring and evaluation. and the results presented the highest impact value of risk monitoring and evaluation at $\beta = 0.347$, as compared to the other construct. previous findings stated the same, (Kissi et al., 2019) also identified a significant relationship of risk monitoring and evaluation with project performance. M&E such as tracking and monitoring identified risks, risk response plan implementation, and evaluating risk process effectiveness has been discovered to be one of the key managerial roles for ensuring that the goals specified for projects are successfully accomplished and that projects meet stakeholder expectations. Projects that have not been appropriately examined and supervised fail to complete effectively.

The second highest value was risk identification at $\beta = 0.293$. It was estimated as one of the most important activities that should be carried out in construction projects, and this was supported by several studies (Butt et al., 2021), and (Mesfin, 2014),

(Dilnesa, 2020), also reported identifying the occurrence of risk and, categorizing them are the best measures and current practice of risk identification in Ethiopia over activities such documentation of risk which is not practiced very well. The study also affirms risk identification process is primarily and effectively practiced in Ethiopia. Risk identification is the primary and crucial factor to be undertaken and construction personnel's frequently miss the fact that the projects are too complex to be completed under the current set of conditions and circumstances and that project plans are improbable and the identification process can be really helpful to save projects from failure by exercising identification of occurring risks, identification of risk owns, identification of entities affected by risk and documenting them to practice lesson learned for similar projects.

Finally, risk response and risk analysis were found to have somewhat a similar effect with values of $\beta = 0.252$ and $\beta = 0.245$ respectively. Alsaadi & Norhayatizakuan (2021) investigated the effects that risk management on project performance and found risk analysis to be among the most impacting factors alongside risk identification. This deviation in result might be because of the risk management practice in Africa. As reported (Amoah & Pretorius, 2020), projects do not practice risk assessment during construction and because of this, the impact of risk assessment might not be preserved well by the responsible party. Similarly, (Dilnesa, 2020), indicated that even though the practice of identifying sources of risk together with its impact on construction projects is integrated as an essential practice in construction projects in Ethiopia. The risk analysis process prioritization of risk and their ranking is not understood well which might be an explanation for the deviation of the findings. This claim can further be backed up by Mesfin (2014), who reported that basically risk assessment practice is overlooked in most projects in Ethiopia as it is considered mostly a time consuming practice, the current practice of risk management process in Ethiopia covers two simple steps identifying risk factors and responding to them. The significant impact of risk response process was also supported by

(Dilnesa, 2020), there is a well-developed response strategy for risk factors in Ethiopian construction projects. (Mishra & Mallik, 2017) also found a significant impact of risk identification, analysis and response on their investigation. The process of identifying risks, assigning them to their owners, analyzing them qualitatively or quantitatively, developing a response strategy, implementing the strategy and tracking and monitoring the identified risks is the silver lining between the success and failure of projects. It should be noted that, the overall result of this study indicates a significant impact and contribution of all the indicators of risk management (risk identification, risk analysis, risk response, and risk monitoring and evaluation), on project performance since all the values of outer weight are way over the threshold value of 0.1. the results can be seen in graph 4.8 below.

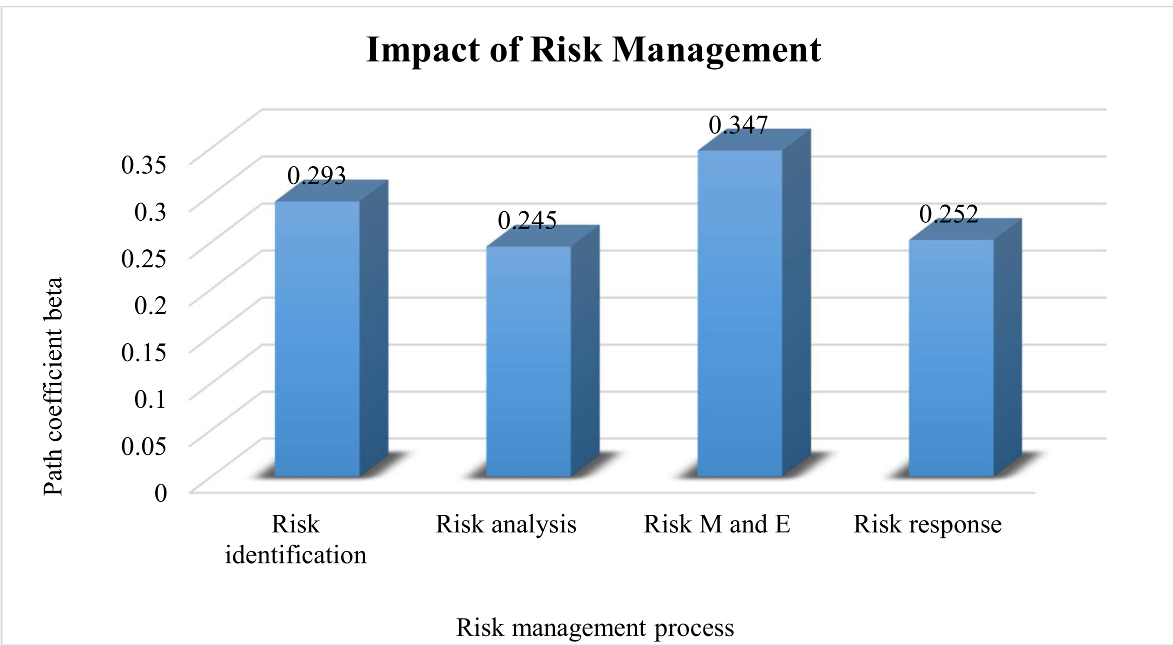

Figure 4. 8: Impact of risk management process on project performance

4.5.3. Relationship between Risk Management and Project Performance

The third objective of the study aims to analyze the relationships between risk management and project performance with construction risk as an intermediate factor between the two. And to achieve this four hypothesis has been drawn. The first hypothesis of the study H1 evaluates whether there is a significant relationship between risk management and project performance. The results indicate that the hypothesis was supported at ($T = 4.355$, $P = 0.000$) which means that the null hypothesis at $T = 0$ was rejected. On the other hand, path coefficient $\beta = 0.436$

indicates the impact that risk management has on project performance is significant. This result has been supported by the findings of several studies (Chin et al., 2020), and (Alsaadi & Norhayatizakuan, 2021) reported a significant relationship between the risk management process and project performance. They provide solid evidence that the process of risk management is crucial in mitigating the negative impact on the performance of a project. The findings of this study are in line with the existing literature, in which all the values indicate that there lies a significant relationship between risk management and project performance through the practice of risk identification, risk analysis, risk response, and risk monitoring and evaluation impacting the success of construction project cost, time, quality and safety.

The second hypothesis of the study H2, evaluates whether there is a significant relationship between risk management and construction risk. This hypothesis was supported at ($T = 10.758$, $P = 0.000$). On the other hand, the path coefficient which is in fact the highest value in the model indicates the highest impact at $\beta = 0.697$. The results have been supported by previous studies, (Nketekete et al., 2017) which showed the impact of the management process by assessing the failure rate of unmanaged construction risks, the study identified the importance of risk management practice in mitigating the negative effects of construction risks. (Nagarajan & Ganapathi, 2023) also took a similar approach to establishing the relationship in Nigeria.

H3, evaluate whether there is a significant relationship between construction risk and project performance. And the hypothesis was supported with ($T = 2.740$, $P = 0.000$). On the other hand, path coefficient $\beta = 0.319$ indicates the impact that construction risk has on project performance. Several studies have confirmed this relationship. (Tadayon et al., 2012), (Teferi, 2020), and (Yadeta, 2019) all properly identified the impact of construction risk on project performance. Adedokun & Egbelakin, (2022) also established the relationship by showing the impact of internal and external risk on project performance and the findings indicate a significant relationship which is in line with the finding of this study. And all the values of this study indicate that there lies a significant cause-and-effect relationship between construction risk and project performance in terms of cost, time, quality, and safety.

Finally, the result of mediation analysis which shows the mediating effect of construction risk between risk management and project performance. And hypothesis H4, which was supported states exactly that. The first analysis was the indirect effect which is the effect that risk management has on project performance indirectly which resulted (T = 2.620, P = 0.009) and path coefficient β value = 0.223 which indicated a significant impact. The second evaluation was the total effect which is the effect of risk management on project performance through construction risk which was also significant with (T = 9.961, P = 0.000) and the path coefficient β = 9.961. Finally, the direct effect which is the impact of risk management on project performance directly. Which showed (T = 9.961, P = 0.000) and a beta value of 4.355 which is a significant impact.

The mediation effect of construction risk was supported by (Zailani et al., 2016) who showed the impact the management process has on the performance of projects through construction risk by determining the effect of risk. the same can be said for the findings of (Ejeta et al., 2021) established the relationship between risk management and project performance through the unmanaged risk factors by showing the effects of management at several stages and its impact on construction risks that affect project performance. Generally, these values indicate that there exists a significant mediation effect of construction risk between risk management and project performance in which both the direct effect from risk management to project performance and the indirect effect between risk management and project performance through construction risk is significant and the impact is in both directions. This indicates that there is a definite mediation effect of construction risk, which can be expressed as the impact of risk management on project cost, time, quality, and safety through the risks that need to be managed. The results can be seen in Figure 4.9 below.

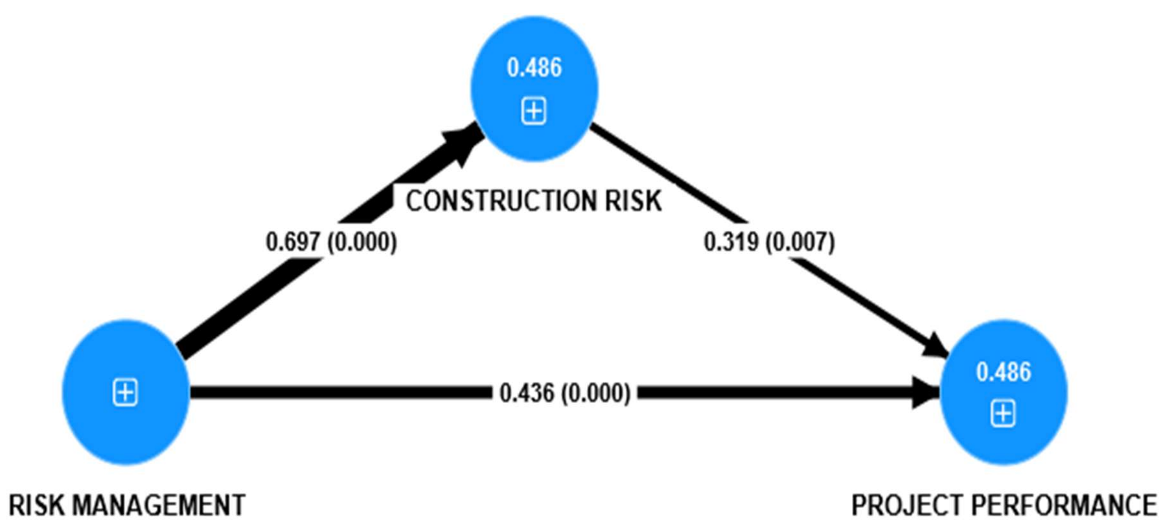

Figure 4. 9: Structural model

The findings of this study indicate that there exists a significant relationship between risk management and project performance. The mediating effect of construction risk was also supported by the results of the study. Generally, as can be seen from the model the impact of risk management on construction risks is significant as compared to the other relationships. This indicates that it is because of the risk factors that are not properly managed and dealt with that construction project delay, cost overrun, defective quality and safety issues are encountered by projects. The lack of proper management of these risks through the process of identifying occurring risks, their timing, and the entities affected by risk, analyzing them qualitatively/ quantitatively, developing proper risk response plans and appropriate implementation, and conducting continuous monitoring and evaluation is impacting construction projects in Ethiopia significantly and emphasis should be given to such practice in order to improve project success. The final output model of the study which includes both the measurement model and structural model can be seen in Figure 4.10 below.

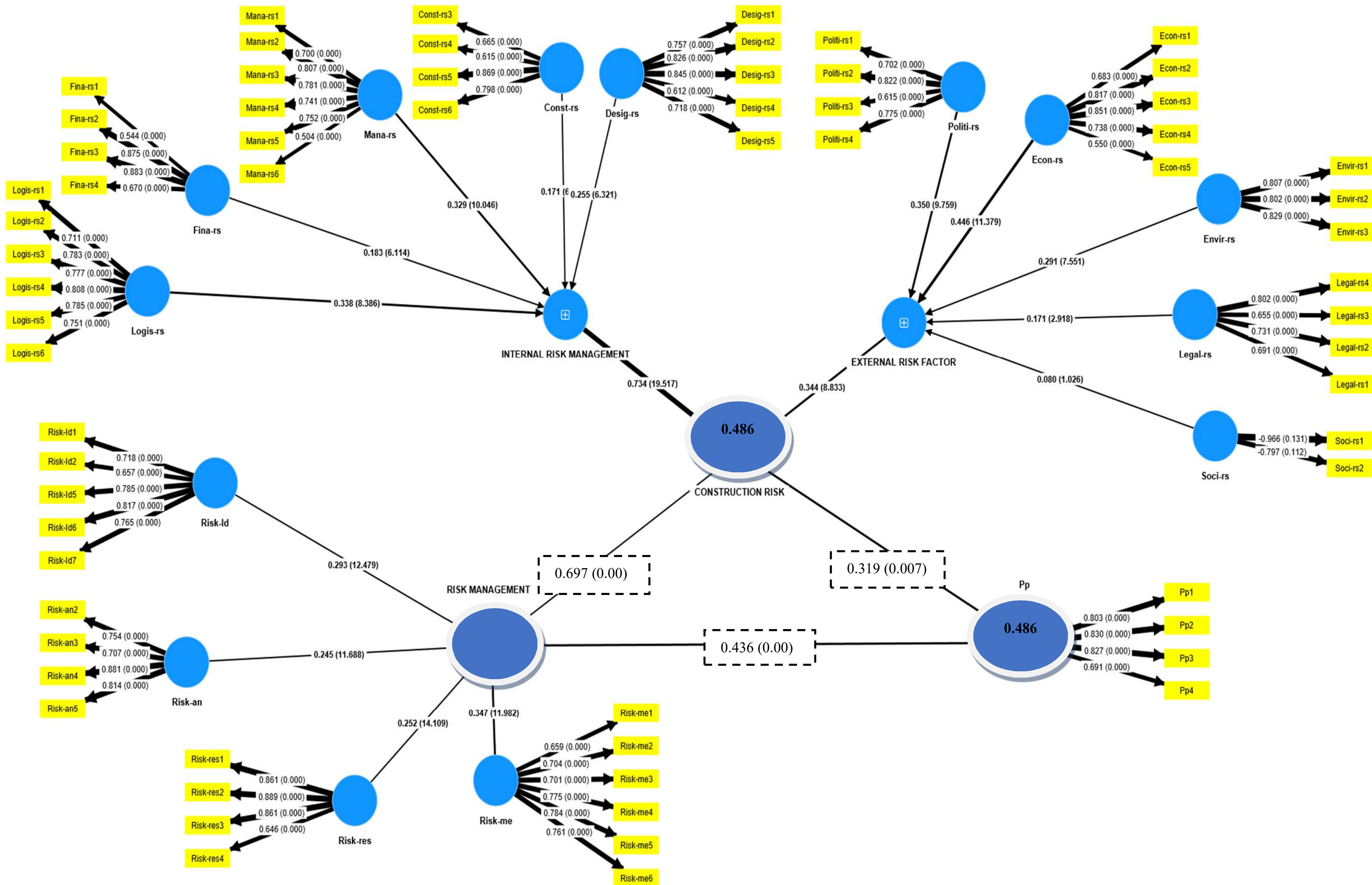

Figure 4. 10: PLS-SEM structural and measurement model

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The objective of this study was to examine how the process of risk management affects construction project performance and justify the mediating role of construction risk between the two. To achieve this primarily 76 indicators were identified to develop the model, and several hypotheses were proposed and then tested in which all of the hypotheses were supported. Hence, the study answered the research problem by confirming the significant relationship between risk management and project performance as well as the mediation effect of construction risk.

The findings of the study showed that economic and political risk factors from external risk and logistic and management risk factors from internal risk had the highest impact on project performance comparatively. In addition, the collective results of the study indicate that internal risk factors had the highest impact on the success of a project as compared to external risk factors. due to this specific attention should be given to such risks to avoid their negative impact on the performance of construction projects and construction personnel should understand that prioritizing such risks is the key for the realization of project objective.

The findings of the study in terms of the risk management process showed that risk identification, risk analysis, risk response, and risk monitoring and evaluation have a significant impact on project performance. Although, the impact and contribution of risk identification and risk monitoring and evaluation were found to be relatively higher which indicates that these activities are the most mandatory in the entire process and should be prioritized and practiced effectively to enhance project success.

Finally, the hypothesis showed that there is a significant relationship between risk management and project performance was supported by the results of the study. which indicates that construction project delay, cost overrun, quality, and safety issues are caused because of unmanaged construction risks and also because of lack of proper management of these risks. Implementing the process of identifying occurring risks, their timing, and the entities affected by risk, analyzing them qualitatively/ quantitatively, developing proper risk response plan and appropriate implementation and conducting continuous monitoring and evaluation is the silver lining between project success and failure.

Most of the findings of the study were found to be in line with the findings of previous studies also some deviations were found when it comes to the impact value of the construction risk category which was found to be lower in this particular study when literature says otherwise.

By modeling the relationship between risk management, construction project risk, and project performance the study contributes to and extends the knowledge on the topic. The developed model clearly showed the impact of each risk category both internal and external and the general effect of the management process which helps larger construction in Ethiopia in identifying the critical risks with the most effect and prioritizing them during construction. This information can also be used for the planning process and to prepare mitigation plans to deal with the negative impact of these risks.

5.2. Recommendation

Based on the research findings, the following recommendations are made to improve project performance and the overall process of risk management in Ethiopia.

- Contractors should priorities the main risk management practices that has the highest influence in achieving projects performance success and prepare an implementation plan to maximize success.
- As it can be seen from the findings the main problems caused regarding the risk management process is due to lack of sufficient knowledge, Companies should facilitate ongoing development, education, and exchange practices for managing risks for their employees and it should also be among the main focus of the education curriculum.
- The other factor is lack of assembling responsible parties for the problem caused by insufficient risk management, Companies should understand the necessity of developing and organizing distinct teams that are certified, experienced, and capable to encourage the culture of risk management.
- The study also shows that the problems caused due to lack of risk management are detrimental to construction projects, Contractors should have a strategy at hand to evaluate, track, and respond to the risks for which they are accountable.

- Involved parties should engage the existence of risks since accepting risks as a crucial component of project management helps create, evaluate, and distribute response plans.
- Contractors should priorities the risk factors that has the highest impact on the performance of a projects and prepare a mitigation plan to reduce their negative impact on a project.
- Contractors should emphasize the risk management process, in order to manage the risk of delay, cost overrun, quality, and safety and accomplish project objectives by creating a risk management strategy in the early stages of the lifecycle.

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APPENDICES

Appendix A- Questionnaire

Dear Sir/Madam,

My name is Feven Araya student at Adama Science and Technology University (ASTU) School of Civil Engineering and Architecture Department of Construction Engineering and Management. I am currently working on a research entitled “Effects of Risk Management Practice on the Performance of Building Construction Projects”. I believe your experience and educational background will greatly contribute to the success of my research. So it is with great respect that I ask you for some of your time to fill out this questionnaire. The questionnaire is prepared to gather information from selected Projects and the outcome of the research will serve as partial fulfillment of a Master’s Degree in Construction Engineering and Management. The purpose of the research is to determine the relationship between risk management and project performance with construction risk as an intermediating factor. The questionnaire which is comprised of three sections will take about 40 minutes to complete. Please take the time to carefully read each statement or question before answering it, and do your best to provide accurate information. Please note that your responses will be kept confidential and anonymous and will be used only for academic purposes. I greatly appreciate your cooperation and contribution to the realization of this research. If you have any questions about the survey, please contact me Email: fevenaraya751@gmail.com, Phone No: +251906432549, or my Telegram account @Feveennnn.

Thank you, Best regards

Feven Araya

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Questionnaire Part 1) General Profile of Respondents

1. Please, choose & circle the multiple-choice questions					
Job position?	1) G/Manager	2) Deputy G/Manager	3) Project Manager	4) Technical Manager	5) Site engineer
For others, please specify					
Educational level?	1) Diploma	2) B.Sc. degree	3) M.Sc. degree	4) PhD	
For others; please specify					
Field of specialization?	1) Engineering	2) Architecture	3) Project Management	4) Construction Management	
Other; please specify					
Years of experience?	1) 1– 5 years	2) 6 – 10 years	3) 11 – 15 years	4) 16-20 years	5) More than 20 years

Questionnaire Part 2), Examine and rate the extent to which the listed indicators construct/express the risk management Process (Risk identification, Risk analysis, Risk response, and Risk Monitoring and Evaluation) in relation to their Effect on Construction Risks that influence project performance using on a five-point rating Likert Scale.? Mark (/) for 1) Very Low (VL), 2) Low (L), 3) Neutral (N), 4) High (H), 5) Very High (VH).

ID	**Risk Identification Indicators**	1	2	3	4	5
1	Determination of occurring risk enhances risk identification?					
2	Identification of risk owner influences risk identification?					
3	Risk discussion enhances risk identification?					
4	Identifying entities affected by risks influences risk identification?					
5	Categorization of risk enhances risk identification?					
6	Documentation of risk characteristics enhances risk identification?					
7	Availability of primary project documentation influences risk identification?					

ID	**Risk Analysis Indicators**	1	2	3	4	5
1	Describing risk situations and events completely and precisely enhances risk identification?					
2	Determining the probability of risk occurrence enhances risk analysis?					
3	Determination of degree of risk impact influences risk analysis?					
4	Determination of Timing of identified risk influences risk analysis?					
5	Performing qualitative risk analysis (risk prioritization) influences risk analysis?					
6	Performing quantitative risk analysis influences risk analysis?					
ID	**Risk Response Indicators**	1	2	3	4	5
1	Planning risk response enhances risk response?					
2	Identifying/developing risk response strategies influences risk response?					
3	Identifying possible alternative risk response strategies influences risk response?					
4	Developing options and actions for treating risks enhances risk response?					
5	Analyzing cost of different risk response strategies influences risk response?					
ID	**Risk Monitoring And Evaluation Indicators**	1	2	3	4	5
1	Risk response plan implementation enhances risk M & E?					
2	Evaluating risk process effectiveness influences risk M & E?					
3	Identify new risks that emerge enhances risk M & E?					
4	Mid-term and end-term risk evaluation influences risk M & E?					
5	Tracking identified risk influences risk M & E?					

6	Monitoring risks regularly enhances risk M & E?					
ID	**Project Performance Indicators**	1	2	3	4	5
1	On-time project delivery influences project performance?					
2	On-budget project delivery influences project performance?					
3	Quality performance influences project performance?					
4	Construction safety influences project performance?					

Questionnaire Part 3), Examine and rate the extent to which the listed construction risk factors Influences Project Performance using a five-point rating Likert Scale. Mark (/) for: 1) Very Low (VL), 2) Low (L), 3) Neutral (N), 4) High (H), 5) Very High (VH)

ID		1	2	3	4	5
1	**Financial risk influences project performance**					
1a	High inflation rate					
1b	Delayed payments					
1c	Financial failure of contractor					
1d	Inappropriate type of project bidding and award					
1e	Poor cash flow management					
2	**Logistic risk influences project performance**					
2a	Equipment availability					
2b	Lack of skilled Labour					
2c	Shortage in material					
2d	Lack of competent & qualified professionals					
2e	Risk of defective material from supplier					
2f	Late delivery of materials					
3	**Management risk influences project performance**					
3a	Improper scope of work definition					
3b	Poor communication between involved parties					
3c	Poor resource management					
3d	Unclear project planning due to project complexity					

3e	Lack of essential information					
3f	Quality and performance control					
ID		1	2	3	4	5
4	**Construction risk influences project performance**					
4a	Accidents/safety during construction					
4b	low labor and equipment productivity					
4c	Improper planning and scheduling					
4d	Unforeseen site ground conditions					
4e	Construction mistakes and rework					
4f	Risk of insufficient technology					
5	**Design risk influences project performance**					
5a	Design changes					
5b	Defective design					
5c	Gaps between implementation and specifications					
5d	Inaccurate estimation of quantities of work					
5f	Lack of Coordination between designs					
6	**Legal risk influences project performance**					
6a	Difficulty to get permits and ordinances					
6b	Delays in resolving disputes					
6c	Legal disputes among the parties of the contract					
6d	Ambiguity of work legislations					
6e	Authorities and regulations requirements					
7	**Political risk influences project performance**					
7a	Changes in governments laws and regulations					
7b	Political insecurity and instability					
7c	Theft/robbery of material at site					
7d	Bribe and corruption					
7e	Risk of labor disputes and strikes					
8	**Environmental risk influences project performance**					
8a	Adverse weather conditions					

8b	Difficulty to access the site (Remote sites)					
8c	Natural disasters					
9	**Economic risk influences project performance**					
9a	Exchange rate/ Instability of currency exchange					
9b	Increase in prices of materials					
9c	Increase in interest rates					
9d	Inadequacy of insurance					
9e	Economic instability and Market condition					
10	**Social risk influences project performance**					
10a	Religious differences					
10b	Culture differences					
10c	Holidays and celebrations					
10d	Language barrier					