ASSESSMENT OF TIME AND COST OVERRUN ON BUILDING PROJECTS: A CASE STUDY ON IFA BORU BOARDING SCHOOL PROJECTS

EBSE SILESHI GARUMA

A THESIS SUBMITTED TO DEPARTMENT OF CIVIL ENGINEERING

SCHOOL OF CIVIL ENGINEERING AND ARCHITECTURE

PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER'S IN CONSTRUCTION ENGINEERING AND MANAGEMENT

OFFICE OF GRADUATE STUDIES

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

DECEMBER, 2022

ADAMA, ETHIOPIA

ASSESSMENT OF TIME AND COST OVERRUN ON BUILDING PROJECTS: A CASE STUDY ON IFA BORU BOARDING SCHOOL PROJECTS

EBSE SILESHI GARUMA

BAHIRU BEWEKET (PHD)

ADVISOR

A THESIS SUBMITTED TO DEPARTMENT OF CIVIL ENGINEERING

SCHOOL OF CIVIL ENGINEERING AND ARCHITECTURE

PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER'S IN CONSTRUCTION ENGINEERING AND MANAGEMENT

OFFICE OF GRADUATE STUDIES

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

DECEMBER, 2022

ADAMA, ETHIOPIA

DECLARATION

I hereby declare that this Master Thesis entitled ‘‘**Assessment of Time and Cost Overrun on Building Projects: A Case Study on Ifa Boru Boarding School Projects**’’ 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

Name of the student	Signature	Date

RECOMMENDATION

I, the major advisor/ of this thesis, hereby certify that I have read the revised version of the thesis entitled ‘‘**Assessment of Time and Cost Overrun on Building Projects: A Case Study on Ifa Boru Boarding School Projects**’’ prepared under my guidance by **Ebse Sileshi Garuma** submitted in partial fulfilment of the requirements for the degree of masters of science in construction engineering and management. Therefore, I recommend the submission of revised version of thesis to the department following the applicable procedures.

Major Advisor	Signature	Date
Co-advisor	Signature	Date

APPROVAL OF BOARD OF REVIEWERS

We, the undersigned, members of the Board of Examiners of the thesis by Ebse Sileshi Garuma have read and evaluated the thesis entitled "Assessment of Time and Cost Overrun on Building Projects: A Case Study on Ifa Boru Boarding School Projects''and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfilment of the requirement of the degree of Master of Science in Civil Engineering (Specialized by Construction Engineering and Management).

_____ _____ _____

Chairperson Signature Date

_____ _____ _____

Internal Examiner Signature Date

_____ _____ _____

External Examiner Signature Date

Finally approval and acceptance of the thesis is contingent upon submission of its final copy to the office of postgraduate studies (OPGS) through the Department Graduate Council (DGC) and School Graduate Committee (SGC).

_____ _____ _____

Department Head Signature Date

_____ _____ _____

School Dean Signature Date

_____ _____ _____

Office of Postgraduate Studies, Dean Signature Date

ABSTRACT

The study presented here is about the identification of the major causes of construction time and cost overruns for the case of Ifa Boru Boarding School Projects. The relationship between time and cost overruns with their factors has also been formulated. Furthermore, the framework was established and mitigation mechanisms were studied to minimize the effects of time and cost overruns on the selected case study building projects. The quantitative investigation was conducted by collecting data through a questionnaire survey and interview. The study was conducted using both primary and secondary data. Clients, contractors, consultants, and regulatory authorities are among the construction sector stakeholders whose samples were chosen based on their direct exposure to school building construction operations. Both purposive and random sampling techniques were utilized to pick samples. The method of identification of main factors was based on their relative importance and mean score that was determined by the survey conducted on seven school projects. Multiple linear regression analysis has also been carried out to identify the most significant causes of time and cost overruns on the selected case study buildings. The analysis was done by Microsoft Excel and SPSS V26. The analysis results of the survey data indicate that the major causes of time overruns in the school building projects are improper planning and scheduling resulting in a poor judgment of time and resources (MS=4.05) and delay in mobilization (MS=3.94) from the contractor side, the degree of interference (MS=4.11) and additional work requirements (MS=4.07) of the client, absence of the consultants on sites (MS=4.17) and design mistakes and errors (MS=4.06) from the consultant side and delay in obtaining permits and payment approvals by the construction authorities from causes related to government and construction authorities are some of the main causes of these issues. Poor site management (MS=4.02) and shortage of materials on the site (MS=3.93) from the contractor-related side, Global financial crisis (MS=3.47) from the economic conditions category, delay in obtaining permits and payment approvals from the construction authorities (MS=3.81) from the government and construction authorities related delay, poor procurement program of material (MS=4.06) and change in material prices (MS=3.94) from material related category are the most frequently rated factors that cause construction cost overruns in the case studied school building projects. Planning and developing a project master program, managing and completing the design stage before construction, procurement management, and setting a clear scope are some of the resolution methods identified in this study.

ACKNOWLEDGMENTS

First and foremost, I would like to thank the Almighty God for being with me to complete this research. My deepest gratitude shall be extended to my advisor Dr. Bahiru Bewket for his unreserved guidance, support, and continual supervision throughout the study. His guidance, motivation, and advice have been a great asset in my progress in writing this thesis.

I am also very grateful to my family for their unwavering support, advice, and patience during my time as a student at Adama Science and Technology University (ASTU). I am also indebted to my friends and teachers who made these years at ASTU unforgettable. Last but not least I would like to thank my husband Engineer Urji Tsahay for his incredible support during the period of research work.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
BOQ	Bill of Quantity
COEM	Construction Engineering and Management
ECO	Engineering Corporation of Oromia
MS	Mean Score
MOWUD	Ministry of Water and Urban Development
PM	Project Management
PPA	Public Procurement and Property Authority
RII	Relative Importance Index
SPSS	Statistical Package for the Social Sciences

CHAPTER 1 INTRODUCTION

1.1 Introduction

Construction industry plays an important role in the economic growth of any country and is also considered the largest sector of job opportunities. A significant amount of money is spent on construction development projects around the world, which creates numerous employment opportunities and necessary infrastructure. The contribution of the construction sector to the growth of the national economy necessitates greater industrial efficiency through effective project completion. An indicator of effective project delivery is the timely completion of construction projects within budgeted costs and to the degree of quality standards established by the owner. Despite the significance of time and cost in building projects, the majority of projects in both developed and developing nations regularly encounter serious time and cost overruns (Romero, et al., 2018).

Despite its importance in a country's development, the construction industry faces numerous problems. A construction project is deemed successful in the construction sector if it fits both the budget and deadline standards (Olawale & Sun, 2010). Failure to achieve these criteria will result in cost and schedule losses for construction projects. To meet the project's budget and timetable, the quality of the final product is often compromised (Sharma & Gupta, 2020).

Construction is one of the biggest industries which is responsible for mobilizing a significant amount of capital and resources in Ethiopia. Private owners and government organizations are the two major clients in the construction industry. Private owners are more active in the construction of residential, commercial, and industrial structures than they are in infrastructure projects, which are mainly dominated by the public sector. However, public school districts are active in the construction and restoration of school buildings. Accordingly, the regional government of Oromia has launched the construction of seven boarding schools to create competitive students in the world (Nega, 2008)

The growth of school-building projects in Ethiopia, particularly in the Oromia region, is accelerating, in response to the community's basic requirements. Any building project is susceptible to a variety of factors causing time and cost overruns. The higher the project's level of complexity, the higher the risk that must be accepted. The risk will have an impact on

productivity, project quality, timeliness, and cost. Risk can result in delays and losses, and it is almost always an unexpected event. Construction project delays are a common occurrence in underdeveloped countries like Ethiopia (Toor & Ogunlana, 2008).

Project cost and time overruns are common challenges in almost all construction projects. Because of the risk and uncertainty involved in these undertakings, building projects tend to overshoot. This problem is even worse in developing countries like Ethiopia, where some projects' costs and time exceed double the amount expected (Long, et al., 2008).

The main cause of these overruns is a lack of understanding of the factors that influence cost and timeliness. The pre-construction phase and the construction phase are the two primary phases of a construction project. The risk management approach must be applied at both stages of the project. Both stages are critical to meeting the project's objectives.

The first stage is mostly concerned with planning, scheduling, and budgeting. Pre-construction is a critical stage that, if handled correctly, can result in higher earnings and fewer risks (Larsen, et al., 2015).

The second stage entails putting into action what was planned and scheduled in the first stage, as well as continual monitoring and control. Overruns can have a negative impact on the project's cost, schedule, quality, and productivity goals (Flyvbjerg, et al., 2002).

1.2 Background of the Study

1.2.1 Project time and cost overrun

Cost and time overruns in construction projects are caused by a number of factors. Cost overrun in a project has been defined in previous research as the difference between the total cost necessary to complete the project and the estimated/budgeting cost at the time of agreement or contract (Sharma & Gupta, 2021), (Doloi, 2013). Time overrun is defined in the literature as the discrepancy between the time required to complete a project and the time provided in an agreement or contract for delivering the completed project (Yang & Wei, 2010).

Previous studies have shown that cost and time overruns have a negative impact on both the project and the associated construction companies. These overruns have led to the bankruptcy

of numerous companies (Kazaz, et al., 2012). As a result, a systematic investigation of these overruns is required to provide clarity on the main overrun factors involved.

The identification of factors involved in construction projects is the first step indicated by the literature. This is a critical stage because we cannot move on without knowing what factors are involved (Doloi, 2013). The next step is to evaluate the overrun factors that have been identified. This stage will assist us in identifying crucial factors that have the greatest influence on overruns. The final step is to recommend mitigation measures and ongoing construction monitoring. Monitoring and control are critical for beneficial outcomes, as new overrun factors can arise at any time during the construction process.

Previous studies show that time and cost overruns are the most common challenges in construction projects during the past three decades (Majid & McCaffer, 1998). (Assaf & Al-Hejji, 2006) studied the causes of delays in large building projects in Saudi Arabia and identified materials-related delays as the main cause of project delays.

Cost and schedule overruns are commonly caused by variables that occur at various stages of the project life cycle. Increases in project scope, bad weather, design faults and revisions, unforeseen site circumstances, bidding outcome features, and other project-related changes are among these causes (Bhargava, et al., 2010).

If one of the critical paths of the project is delayed, it will create delays in the subsequent tasks. As a result of the delay, costs that were estimated during the planning stage tend to alter more. As a result, project delays play a significant role in project cost overruns. Socioeconomic and cultural factors are the most prominent risk factors for delays (Mpofu, et al., 2017).

Delays can be caused by a variety of factors, including those relating to materials, equipment, finances, the environment, labor, planning, and management. To reduce the likelihood of delays in succeeding projects, every factor should be carefully considered at the outset of work, so that time risks can be reduced together with the corresponding implementation costs.

The causes of schedule delays and their impact on the time concept were studied by (Aibinu, 2002), (Kazaz, et al., 2012), (Al- Kharashi & Skitmore, 2009)). (Iyer & Jha, 2005) and (Shane, et al., 2009) studied cost escalation issues in construction projects as they affect the

concept of cost-related factors. Finally, (Kaliba, et al., 2009), (Koushki, et al., 2005), and (Olawale & Sun, 2010) have studied how cost and time are interrelated.

One of the most significant issues facing many construction projects nowadays is completing projects on time and within budget. Overruns in construction projects are the most common. Some projects exhibit cost overruns of 200-400 percent when compared to their original projections or contract values (Simushi, 2017).

Previous research has focused on identifying the most significant causes of time and cost overruns on projects in general and addressed solutions to individual problems. Time, cost, and quality are three important components of planning a construction project (Rauzana & Dharma, 2022). A successful capital project is defined as a project completed in accordance with a given scope, within budget, and on time (Khayani, 2011).

Time and cost overruns are two major flaws in the construction sector. These failures can result in a variety of undesirable outcomes, including contractor-client disagreements, decreased work quality, and health and safety accidents. As a result, there is an urgent need for more research on variables such as time and cost overruns, as well as quality and health and safety, and recommendations on how to reduce these types of faults (Ahbab, 2012).

Even when operations have been meticulously planned, there is often a degree of uncertainty. Construction-related hazards cannot be removed, but they can be mitigated or shifted from one party to another (Kangari, 1995).

According to Alaghbari, et al. (2007), a construction project delay is a common risk that might result in losses throughout its implementation stage. Financial and economic challenges, contractors lacking experience and expertise, consultant delays in supervising work, delayed decision-making, using the wrong consultants when delivering orders, and a lack of materials are the main risk reasons for delays (Alaghbari, et al., 2007).

Construction projects are fast-paced and perilous if not properly handled. A project's productivity, performance level, quality, duration, and cost can all be affected by risk. A risk is an unexpected event that negatively affects a project as a result of uncertainty. Risk is associated with the possibility or probability of the occurrence of expected events. Even when an activity has been meticulously planned, uncertainty persists (Kangari, 1995).

1.2.2 Project Time and Cost Overrun in Ethiopia

The construction industry in Ethiopia also heavily incorporates issues including poor quality, high costs, and delays. According to a study by Nega (2008) on the main causes of cost overruns in building projects in Ethiopia, the following are the main causes of cost overruns. These include overproduction during construction, poor planning, and coordination, change orders brought on by client-requested improvements, and inflation or increases in the cost of construction supplies.

In Ethiopia, there are substantial public and private projects that address these issues, such as the construction of structures, roads, and bridges. In Ethiopia, it is uncommon for both private and public building projects to be finished on schedule, within budget, and with the desired degree of quality. In Ethiopia, there are many construction projects that are characterized by their poor performance. Research has also shown that developing countries' building industries squander a lot of resources, both human and material; up to 30% of construction expenses are attributable to poor performance.

In addition, research by Zinabu Tebeje and Getachew Teka (2015) revealed that Ethiopian construction projects frequently experience cost overruns due to problems with the design and specification, reworks, material and equipment, schedule delays, delayed payments, poor supervision, construction errors, poor coordination and communication, and construction mistakes.

Comprehensive research concentrating on the interrelationships of time, cost, and quality is critical for proving major disparities between the three aspects of the "iron triangle" and expanding the body of knowledge. The construction industry has a significant multiplier effect on the economy as a whole (MOWUD, 2006). According to this the interrelationship between the construction industry and the broader economy largely emanates from three of the industry’s characteristics.

The present research is therefore intended to study the main causes of construction time and cost overruns and to develop a relationship between these overruns with their causes.

1.3 Statement of the Problem

Construction delays, cost overruns, and poor quality have long been issues in the construction industry (Larsen, et al., 2015). Time and cost overrun in large public construction projects, in particular, appear to be a global phenomenon, with no reduction in time or cost in the last 70 years and an average cost overrun of 28% (Flyvbjerg, et al., 2002). To minimize these overruns, the existing set of understanding tends to focus on essential success factors such as time and cost as individual concepts of different project types and geographic regions, with little context.

One of the most important indicators of the success of a project is its cost. This is particularly true for public projects in developing nations like Ethiopia, where public construction projects are undertaken with limited financial resources. Cost overrun is a crucial problem in the construction sector that may cause lower productivity, project delays, and disputes between parties. Nowadays, this problem has become a frequent occurrence in Ethiopia (Nega, 2008)

Delays in construction projects are common in the Ethiopian construction industry. Construction delays are sometimes responsible for changing profitable projects into losing undertakings. These delays can be avoided or reduced if the major reasons for the delays are identified and addressed as soon as possible (Nega, 2008).

The majority of the construction projects undertaken have been delayed beyond the planned completion date and have also required additional funding above what was contracted at the start of the project. This challenge is causing issues with project funding, timely facility utilization by the private and public sectors, and relationships among stakeholders (client, contractor, financier, etc.) involved in the construction process. This necessitates further studies on projects susceptible to these issues (Gebre, 2021).

The cost of the boarding school projects being constructed in the Oromia region is extremely exorbitant and considerably in excess of the main contract agreement. It is well known that project cost variations can vary from 47.4% to 113.90% of the original contract value. This results in the contract being administered outside of the contract document. The revised completion date of the project was fourteen months which was expected to be completed in seven months. This leads to time delays and cost overruns on certain projects, which differs from previous findings.

The lack of justifiable approaches in assessing and analyzing delays appears to be a great challenge in the construction industry of our country where completion time deviations frequently occur. Additionally, it is well known that it is a very tough effort to justify and quantify the impacts of each delay event needed for the demonstration of causation and quantum (Robel Asefa, 2015).

In his investigation, Endale Mamuye (2016) came to the conclusion that the 40/60 Saving Houses Project in Addis Abeba had a schedule overrun. Additionally, Weyessa Ewnety (2014) evaluated the Addis Abeba Light Rail Transit Construction Project's cost overrun. In light of this, the researcher gathered data comparing estimated project costs and schedules to the actual. As a result, data gathered by CRMs of CBE on 50 private project cases funded from 2011–12 to 2015–16 shows that practically all of them experience either cost overrun or schedule overrun.

I got the chance to take part in a discussion with consultants about the performance of boarding school projects, and I discovered that some projects had problems with a cost overrun and schedule overrun. There are many references to the reasons why school projects run over budget and on schedule, but there is little information on how to fix the issue. This led me to think that more study was necessary.

Although numerous researchers in Ethiopia have done studies on cost and schedule overruns, practically all of the studies were conducted on public projects including condominium buildings, the AA city light rail project, and road constructions none of them have conducted research on the time and cost overruns for boarding school projects.

This research is therefore intended to study the major causes of time and cost overruns, formulate the relationships between these overruns with their factors, and establish the framework to minimize the effects of overruns on the Ifa Boru boarding school projects.

1.4 Objectives

1.4.1 General Objective

The general objective of this research is the assessment of time and cost overruns for Ifa Boru Boarding school Projects.

1.4.2 Specific Objectives

The specific objectives of the research are

- To analyze the major causes and effects of time and cost overrun of the boarding school construction projects
- To formulate the relationship between time and cost overruns with their factors of the boarding school construction projects
- To establish a framework for minimizing time and cost overrun and developing mitigation measures to minimize these effects

1.5 Research Questions

- What are the major causes of the time and cost overrun of the boarding school projects?
- How the relationship between time and cost overrun with factors is formulated?
- How to minimize the time and cost overrun by establishing a framework?

1.6 Significance of the Study

From a policy implementation perspective: The significance of this research from a policy implementation perspective is by identifying and analyzing the major causes and effects of overruns and adopting the possible recommendations of the researcher. The regional government of Oromia, Ethiopia invests much of its annual budget in the implementation of boarding school projects. As a result, boarding school project stakeholders must understand how the school-building projects are progressing in terms of costs and timelines. A significant amount of budget can be saved and spent in the most-needed construction phase and can be completed on time if the stakeholders' planning and construction division can plan and monitor the construction progress in these types of projects, allowing the government and client to benefit from these investments.

From the academic point of view: One benefit of this study might be the identification of major causes of overruns that have a significant effect on the timely and economical completion of school building projects. The findings of this study add value to this area of research by providing possible recommendations for these types of building projects. One of the main reasons for this study is that by determining the effect of overruns for these types of

projects, design engineers might be able to use an effective planning and management process to control these overruns.

1.7 Scope of the Study

1.7.1 Thematic Scope

Many reasons are responsible for the time and cost overrun of building construction projects which occur at varying rates, and their impact on the final cost of the construction project varies as well. It would be difficult to address all of the issues that cause overruns. The selected causes and consequences of time and cost overruns on the boarding school projects were addressed.

1.7.2 Spatial Scope

The study area was focused on Ifa Boru's seven Boarding schools constructed at Yabelo, Negele, Haramaya, Ambo, Bedele, Nedjo, and Dodola Town, in the Oromia region. The main reason for the selected study area is based on the fact that those projects are affected by a a significant amount of time and cost overruns.

1.7.3 Temporal Scope

The study was carried out from April 2022 to September 2022. The data collection process was carried out from April to June 2022 while the data analysis process was undertaken from June to August.

1.8 Limitations of the Study

The research activity was not without its difficulties and constraints, which were experienced during the research preparation. Time and financial constraints were the major limitations of the research. In addition to this, some stakeholders were reluctant to provide the relevant information.

The research is limited to Ifa Boru boarding school projects which are constructed at seven project sites. Data collection was challenging and time-consuming due to the unavailability of the project representatives. However, the researcher attempted to collect the information patiently by encouraging the respondents within the given time.

1.9 Organization of the Research

This thesis is divided into five chapters, as follows:

The first chapter of this thesis is an introduction that was intended to give an overview of the importance of time and cost overruns in construction projects. It mainly covers the background of the study, scope, and limitations, objectives, the problem statement and the significance of the thesis. Chapter 2 discusses the general descriptions of cost and time overruns, the major causes and effects of overruns, as well as a review of related literature that has been done previously. The methodology of research such as the information of the project, data collection methods, sample size, and how the survey data was analyzed, are all covered in Chapter 3.

Chapter 4 explains the discussion and interpretation of the results of the questionnaire, and the reliability analysis of the questionnaire is also covered in this chapter. The design and content of the questionnaire and basic information of the respondents are described in this chapter. Chapter 5 covers the conclusions and recommendations to various stakeholders, as well as opportunities for future research and recommendations. It concludes the research with a summary of the findings and the areas for further research and recommendations.

1.10 Definitions of Important Terms

Construction Industry: is an industry that is involved in the planning, execution and evaluation of all types of civil works.

Construction Project: is an investment of scarce resources with a definite objective, time horizon and geographical boundary.

Construction Management: A disciple developed from Project Management as a result of the growing challenge to complete projects within the allocated budget, time and assumed quality standard.

Time overruns: Time overrun is defined as the discrepancy between the time required to complete a project and the time provided in an agreement or contract for delivering the completed project (Yang & Wei, 2010).

Cost overruns: Cost overrun in a project has been defined as the difference between the total cost necessary to complete the project and the estimated/budgeting cost at the time of agreement or contract (Sharma & Gupta, 2021), (Doloi, 2013).

CHAPTER 2 LITERATURE REVIEW

2.1 Overview

This chapter covers previous studies devoted to time and cost overruns of construction projects and provides a brief discussion of past findings. Also, the chapter reviews the reasons for time and cost overruns, their effects on construction projects, and possible resolution methods as found in previous studies are discussed.

The construction sector in Ethiopia is influenced by several small-scale business visionaries the majority of whom work in the country's casual economy. Numerous scholars have raised concerns regarding project time and cost overruns. A few written works unambiguously appear as follows to clarify and keep a strategic distance from vagueness. Successful project management is defined as meeting the project's expectations and goals within the time and budget constraints (Murali & Kumar, 2019).

2.2 Theoretical Review

2.2.1 Overview of Project Cost and Schedule Overrun

A construction project can be considered as successful when it satisfies the goals and objectives outlined in the project plan. That means it has met its technical goals, kept to its timetable, and spent less than it had planned. The proper management of a project depends on the use of project management tools and procedures. As a result, effective project management is dependent on the management tools and practices employed. Managing resources includes controlling the people, equipment, funds, supplies, and techniques that are utilized. While some projects are managed effectively and efficiently, others are poorly managed, resulting in significant delays and cost overruns (Frimpong, Y.2003).

The failure to finish projects on time and under budget is a persistent issue that is getting worse across the globe. Ahmed et al. (2002) stated that construction project overruns are a common occurrence. According to Azhar (2008), cost overruns are a widespread trend that is especially severe in developing nations.

Cost and time overruns occur on different kinds of projects for a variety of different causes. Client satisfaction could be compromised if project costs or schedules go over budget. There could be significant schedule slippage if the funding profile no longer matches the budgetary cap.

The consequences are negative, particularly for developing nations whose wealth is largely determined by how well they perform in building infrastructure through the construction sector. Delays and cost overruns cripple clients, contractors, and consultants by leading to the development of antagonistic relationships, mistrust, litigation, arbitration, cash flow issues, and an overall atmosphere of apprehension toward one another (Ahmed et al., 2002). Despite increases in construction expenditures, less and less work is completed as a result of delays and cost overruns.

2.2.1.1 Definition of an Overrun

An overrun is defined by many scholars as a change in cost or schedule from the final estimate given when the decision to approve or proceed was made until the construction is completed and functioning. According to this definition, a project is not automatically regarded as being on time and within budget only because it was completed within the agreed-upon price and timeline. Instead, a project is only regarded as on time and a budget if it is completed according to the final estimate made when the project was approved, which is normally prior to the signing of a construction contract (Matti Siemiatycki, 2015).

In the construction industry, a delay is the amount of time that passes beyond the agreed-upon delivery date for a project or the completion date indicated in a contract. It is a project that is running behind schedule and is seen as a typical issue with building projects. For the owner, a delay results in lost revenue because there aren't enough manufacturing facilities and rental space, or they have to rely on their current facilities. Delays can often result in increased overhead expenses for the contractor due to lengthier work periods, higher material costs due to inflation, and higher labor costs.

Cost overrun is the difference between actual costs and permitted costs. It is described as the amount that is greater than the sum agreed upon by the client and the contractor when the contract was signed and represents the final, actual cost of a construction project (Abubeker Jemal Mustefa, 2015).

2.2.2 Managing Time, Cost Quality: Three-Dimensional Approach

Time, cost, and quality are three constraints that must be met for the contract to be completed. To compensate for changes in one constraint, changes in another may be required. The contract manager should be aware of how any change in one restriction affects the others and the contract risks.

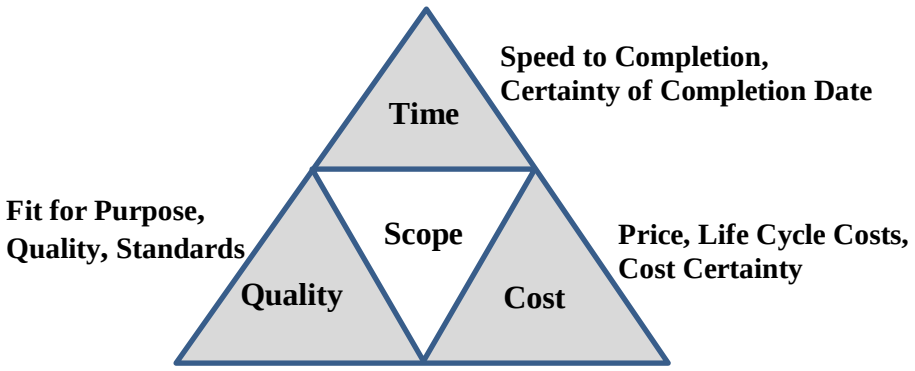


Figure 2-1 Time Cost Quality Interdependencies (Bank, 2018)

2.2.3 Time Control

Identifying the critical path is an important component of contract management. The critical path is a sequence of activities that add up to the quickest contract completion time achievable. The initial steps in developing a robust and realistic contract implementation plan are identifying the activities, their sequencing and other dependencies, and predicting completion times.

Key factors in time control include:

- Developing a comprehensive, practical, and realistic schedule of key activities (this may include key deliverables and milestones and projected contract completion date);
- Undertaking a quality assurance check of the schedule including identifying any flaws in logic or faulty assumptions;
- Ensuring that the Borrower/Contract Manager and the contractor are working on the same schedule;
- Implementing an effective tool or system to track and monitor progress against the schedule;
- Ensuring early intervention when a potential or actual delay is identified

- Implementing appropriate action to mitigate or manage a delay and recording the decision/s.

2.2.3.1 Cost Control

Cost management is critical to ensure whether the contract is delivered within the contract price. The method to cost management will be influenced by the nature of the contract. The Contract Manager should put in place proper financial systems and reporting mechanisms that track actual costs, record planned expenses, and issue warnings when costs exceed the budget. In an ideal world, the contract management system would be integrated with the government's or project's financial management system.

2.3 Time and Cost Overrun

An overrun is a situation where a planned event actually takes longer or costs more than it was planned (Simushi, 2017). (Assaf & Al-Hejji, 2006) referred to a delay in construction as the time overrun either beyond the completion date specified in the contract or beyond the date the parties agreed upon for delivery of a project. (Kaliba, et al., 2009) used the terms schedule delay and cost escalation to refer to time and cost overruns respectively. Time overrun or schedule delay is defined by (Kaliba, et al., 2009) as a situation where a construction project does not come to completion within the planned period. They defined cost escalation as the increase in the amount of money required to construct a project over and above the original budgeted amount. While the time overrun is attributed to scope changes, delay in finalization of tender documents and short bid submission time, lack of commitment of project participants, poor coordination, etc., cost overrun is attributed to more variations between quantities estimated and actually executed.

2.3.1 Time Overrun

Projects or construction activities that are not delivered to the client on time are referred to as projects with schedule delays. As a result, (Assaf & Al-Hejji, 2006) defined time schedule delays as time overruns, or going beyond the agreed-upon delivery date for a project. It is essentially a project that runs behind schedule and is a common problem in building projects all around the world. In general, it should be understood that any change or adjustment to one of the two variables will impact the other. As a result, a project with a delayed schedule will necessitate additional funds and resources to complete.

Construction delays are defined as time overruns that occur after the contract deadline or after the parties' agreed-upon delivery date (Assaf & Al-Hejji, 2006). One of the most common challenges in the construction sector is construction delays. A variety of circumstances might cause construction projects to be delayed. (Frimpong, et al., 2003) highlighted the key delay issues in Ghana as monthly payment challenges from agencies, poor contractor management, material procurement, poor technical performances, escalation of material prices, contractor competency, poor designs and estimating, and unresolved management issues relating to the site and procedural approaches have all been cited as important sources of delay in Vietnam by the Vietnamese government (Long, et al., 2008).

2.3.2 Cost Overrun

A budget increase, cost rise, or cost growth are all terms used to describe a cost overrun. However, a cost overrun should be contrasted with cost escalation, which refers to the anticipated increase in a planned cost owing to factors such as inflation (Love, et al., 2013).

The lack of a common definition, combined with the use of ineffective distribution models, has resulted in erroneous cost overrun likelihood projections. A cost overrun is described by (Flyvbjerg, et al., 2002) and (Odeck, 2004) as the difference between predicted and actual construction costs. In this case, the budget at the time of the decision to build is used as a guide for estimating the potential overrun. Actual construction costs (Acv) are those that have been accounted for at the time of project completion.

(Rowland, 1981; Hinze, et al., 1992), (Hinze, et al., 1992) proposed an alternate definition and reference point for determining a cost overrun, claiming that it is the difference between the expected and actual costs.

Different countries have different cost overruns. This means that in different countries, the same building projects result in different cost overruns. Cost overruns are caused by a variety of factors, including technical, economic, managerial, political, environmental, and project resource issues (Abdel-Hafeez, et al., 2016). Furthermore, these factors may be supplemented by specific event-related factors (Preuß, et al., 2019).

(Bordat, et al., 2004) defined cost overruns in construction contracts as it involves change orders and claims. Defining a “claim” as the proposed changes to the contract that are being negotiated or litigated, (Jahren & Ashe, 1990) identified two kinds of rates:

• The cost overrun rate, which is the percent difference in cost, (positive or negative) between the final contract cost and the contract award amount,

• The change order rate, which is the ratio between the dollar amount of change orders and the award amount.

The "final amount" was defined as the cost of the contract including change orders, and outstanding claims and the dollar award amount is the dollar value at which the contract was awarded. Change orders are "an indication that something on a construction project has not gone as planned" (Rowland, 1981) and are associated with contract alterations such as additions, deletions, or modifications to the contract.

In project management, the point of undertaking control is to guarantee the activities to complete on schedule, inside the financial plan, and accomplish other task targets.

Various studies have explored the causes of project cost overrun on a construction project. (Kaming, et al., 1997) who contemplated 31 construction projects in Indonesia, found that from a contractor's perspective, cost overruns were mainly brought about by error of material take-off, increment in material expenses, and cost increment because of environmental restrictions or limitations. (Long, et al., 2008) ranked the three top causes for cost overruns in Vietnam as a material cost increment because of inflation, inaccurate quantity takeoff, and work cost increment because of natural limitations. (Kaliba, et al., 2009) conclude that cost heightening (escalation) of construction projects in Zambia is brought about by components, for example, increase climate, scope changes, environmental security and mitigation costs, schedule delays, strikes, technical challenges, and inflation.

2.4 Empirical Review

2.4.1 Causes of Time and Cost overrun

The delays in building construction projects in Ghana were investigated by Fugar et al. in 2010. According to the study, 32 delays were found using literature reviews and semi-structured interviews. The most significant delays were determined by ranking these delays' causes using a questionnaire survey. 130 people filled out the questionnaire, including 39 contractors, 37 clients, and 54 consultants.

By using a relative relevance measure, the most significant delay factors and cause groups were ranked. Nine primary categories, including material, labor, equipment, financing, environmental changes, government actions, contractual relationships, and scheduling and controlling techniques, were used to classify the delay factors. The most significant delay factor was the financial group, followed by the material group and, in that order, the scheduling and controlling groups.

The findings of his study revealed that the top ten factors that contributed to delays included: a delay in honoring certificates, underestimating project costs and complexity, difficulty obtaining bank credit, poor supervision, underestimating the time required for contractors to complete projects, a shortage of materials, poor professional management, fluctuating prices, and rising material costs, and poor site management.

Abdo (2006) studied 52 public building projects built by local contractors between 1995 and 2005 to learn more about the delays and their effects in Ethiopia. Data on delays were gathered by a questionnaire survey, and the mean score technique was utilized to examine 62 replies from contractors, consultants, public owners, and construction professionals.

He divided the 80 potential reasons for delays into six categories, including design-, management, construction, finance, code, and force-majeure-related reasons for delays. Design-related delays were the most frequent among these kinds of delays, followed by management-related delays. He ultimately pinpointed ten major reasons for delays in Ethiopian public building construction projects, including a lack of materials on the market, late material deliveries, delayed contractor payments, unrealistic performance schedules, changes in subsurface conditions, client financial constraints, unfavorable weather conditions, a lack of emphasis on planning, and variations in material and labor prices.

Endale Mamuye (2016) analyzed the reasons for the delay in the Addis 40/60 saving housing project. According to him, the following factors contribute to project time overruns: inadequate site management, poor planning and scheduling of the project, late design review, and approval, slowness in the decision-making process, late material supply, financial difficulties faced by the contractor, electric supply, water supply issues, equipment shortages, and delayed payments to contractors.

Robel Assefa (2015) claims that the primary reasons for the Addis Ababa light rail transit construction project's delay are financial issues, managerial issues, and contractor capability.

He added that the main reasons cited by the participants included right-of-way issues, incomplete designs, integration with the city master plan, problems with demolishing or relocating public utility crossings, and delays in material delivery on site, site handover, decision-making, and external work due to public agencies.

According to Manavazhia and Adhikarib's study from 2002, cost overruns in building projects in poor nations frequently result from delays in the supply of materials and equipment to construction sites. It was discovered that these delays only had an average effect on project costs of 0.5% of the total estimated cost of the projects (Abubeker Jemal Mustefa,2015).

According to Endale Mamuy (2015), the effects of principal reasons for the delay in the 40/60 housing project were time overrun and cost overrun to the client and the contractor. The Addis Ababa light rail delay has resulted in time overruns, cost overruns, a loss of political and economic value for the project, and multiple arbitrations between the contracting parties.

Motaleb & Kishk (2010) have investigated the causes and effects of construction project delays in the UAE. They conducted a questionnaire survey that investigated 42 potential delay factors. The results of their studies revealed that change orders, and financial and other client-related factors are the most significant causes of delay. It requires the training of clients and their representatives and also project teams to reduce the effects of time and cost overruns (Motaleb & Kishk, 2010).

Construction delays are inevitable in almost all projects due to a lack of communication between contractors, subcontractors, landowners, or other factors. According to (Abdalla & Hussien, 2002), the reasons for schedule delays and cost overruns can be divided into eight categories.

Daniel W M Chan and Kumaraswamy (1997) surveyed to establish and rank the relative significance of the major factors driving building delays in Hong Kong. They studied and ranked the causes of construction delays based on the roles of the parties involved in the construction and the types of construction projects. According to their findings, the following factors contribute to construction delays: "poor site management and supervision," "unforeseen ground conditions," "low speed of decision making including all project teams,"

"client-initiated variants," and "required variations of works" (Daniel W M Chan and Kumaraswamy, 1997).

Sunday J. Odediran (2012) investigated the factors that contribute to time and cost overruns of construction projects and as well as their impact on project performance in Nigeria. Major cost overrun factors are the rise in the cost of construction materials, improper estimation of materials and project cost underestimation, while the most significant factors of time overrun include unexpected site conditions, increase in project scope, lack of timely progress payment and inadequate planning (Sunday J. Odediran, 2012). The time and cost overruns do not only affect diverse industries but also affect both public and private projects. They also affect small and large projects, but large projects are reportedly the worst affected.

Based on the review of previous works of literature a total of 140 causes of time and cost overruns were identified and grouped into 12 categories as shown in Table 2-1.

Table 2-1 List of Factors Contributing to Time and Cost Overruns

Category	ID	Causes
A Causes Related to Contractors	A1	Poor performance and inadequate experience of contractors
	A2	Improper planning and scheduling result in a poor judgment of time and resources
	A3	Delay in mobilization
	A4	Inappropriate construction methods
	A5	Poor site management
	A6	Shortage of materials on the site
	A7	Unethical behaviors used to achieve a high level of profit
	A8	Wastage of materials on site
	A9	Improper method of competition in procurement
	A10	Inadequate tender pricing
	A11	Frequent change of sub-contractors
	A12	Depend on the site engineers to bear the whole responsibility on-site
	A13	Poor project management skill
	A14	Lack of contractor's experience
	A15	Financial difficulties faced by contractors
	A16	Bad relation between management and labor
	A17	Errors during constructions
	A18	Contractual claims such as an extension of time
	A19	Incompetent subcontractors
	A20	Unsuitable construction equipment

	A21	Improper construction methods
	A22	Inaccurate quantity take-off and quantity underestimation
	A23	Poor financial control on site
	A24	Unqualified work
	A25	Shortage of site workers
B Causes Related to Clients	B1	Lack of experience of the client in the construction
	B2	Contract modifications
	B3	Degree of interference of the client
	B4	Delayed disbursing of payments
	B5	Additional works required by the client
	B6	High quality of work required by the client
	B7	Poor contract management
	B8	Poor communication & coordination with contractors
	B9	Lack of financial control and payment arrangement skills
	B10	Owner has no priority/ urgency to complete the project
	B11	Unrealistic contract duration imposed by the owner
	B12	Delays caused by the owner and his/her agent
	B13	Financial problems faced by clients
	B14	The practice of assigning the contract to the lowest bidder
	B15	Lack of communication with the consultant
	B16	Changes in client requirements
	B17	Re-measurement of provisional sum
	B18	Improper and poor project feasibility study
	B19	Poor procurement method for contractor selection
	B20	Slow decision making
C Causes Related to Consultants	C1	Lack of consulting experience
	C2	Dispute between contractor and consultant
	C3	Lack of technical skill (staff)
	C4	Delay in payment and material approval
	C5	Delay in instructing labor
	C6	Absence of consultant on site
	C7	Delay in approval of tests and poor inspection
	C8	Delay in instructing site engineers in case of lack of understanding in construction drawings
	C9	Poor contract management
	C10	Mistakes and errors in design
	C11	Underestimate project duration
	C12	Slowdown in design preparation
	C13	Delay in approval of design changes
	C14	Lack of cost plan monitoring and control
	C15	Inadequate project preparations

	C16	Incomplete design at tendering stage
	C17	Poor design and delays in design
	C18	Lack of coordination in the design phase
	C19	Frequent design change
	C20	Slow response (late instruction, inspection, delay in approval)
D Causes Related to Economic Condition	D1	Global financial crisis
	D2	Design change due to market demand
	D3	Material market rate (escalation, inflation, or fluctuation)
E Causes Related to Environmental Condition	E1	Unknown geological condition
	E2	Bad weather condition
	E3	Accidents during construction
	E4	Changes in laws and regulations
F Causes Related to the Project	F1	Complexity of the project
	F2	Change in the scope of the project
	F3	Project location
	F4	The original contract duration is too short
	F5	Corruption
	F6	Ineffective penalties for delay
	F7	Unavailability of bonus for early completion
	F8	Type of construction contract
	F9	Type of project bidding and award
	F10	Lack of experience in a similar project
	F11	Lack of communication between project members
	F12	Poor site safety
G Causes Related to Design and Documentation	G1	Mistakes, inconsistencies and ambiguities in specifications and drawings
	G2	Inadequate design team experience
	G3	Unclear specification
	G4	Incomplete drawing and detailed design
	G5	Project design complexities
	G6	Inadequate investigations by the designer during the design phase
	G7	Poor design and delay in the design
	G8	Slow revision of drawing in case of change in design
	G9	Poor documentation and no detailed written procedure
H Causes related to Government and Construction Authority	H1	Lack of supervision by authorities regarding whether the project is run properly.
	H2	Interference and improper comments by some authorities without conducting a technical investigation or supervision.
	H3	Bureaucracy in government agencies

	H4	Delay in obtaining permits and payment approvals from the construction authorities
	H5	Delay in Approval of Additional and Supplementary Works (Design and BOQ)
I Causes Related to Administrative & Management Condition	I1	Inaccurate construction planning
	I2	Delays in decisions making
	I3	Delay in resolving disputes
	I4	Poor managerial skill
	I5	Slow inspection and testing procedure used in a project
	I6	Lack of high technology
	I7	Lack of personnel training and management support
	I8	Inadequate review
	I9	Delay in payment
J Causes Related to Materials	J1	Poor procurement program of material
	J2	Delay of material delivery and late ordering to site
	J3	Improper handling of materials on site
	J4	Inappropriate material quality
	J5	Change in material prices
	J6	Shortage of construction materials required
	J7	Changes in specifications and material types during construction
K Causes Related to Labor and Equipment	K1	Shortage of manpower (skilled and unskilled labor)
	K2	Poor productivity of labor
	K3	Shortages of contactor's administrative staff
	K4	The low-level skill of manpower
	K5	Lack of technical professionals in the contractor's organization
	K6	Lack of experience of staff on the contractor side
	K7	Labor strikes by the contractor workforce
	K8	Lack of maintenance for equipment
	K9	Equipment availability and failure
	K10	Low efficiency of the machinery
	K11	Late delivery of equipment to sites
L Causes Related to External Factors	L1	High cost of machineries
	L2	Fluctuation in the price of raw materials
	L3	Unforeseen site condition
	L4	Shortage of site workers
	L5	Delay in material procurement
	L6	Unpredictable weather condition
	L7	Poor labor productivity
	L8	Unskilled labor
	L9	Equipment failure
	L10	Labour absenteeism
	L11	High cost of labour

	L12	Fluctuation of prices of materials
	L13	Acceleration
	L14	Price escalation
	L15	Slow information flow between parties

2.4.2 Causes Related to Contractors

2.4.2.1 Poor Performance and Inadequate Experience of Contractors

(Majid & McCaffer, 1998) Considered the factors of a lack of contractual worker experience as a promoter of delays. Insufficient contractor labor experience is one of the factors that contribute to construction project delays (Long, et al., 2008). A part of the delayed projects in the construction sector is encountering a challenge during the construction stage. Despite this, the contractual worker was unable to resolve the problem promptly due to a lack of knowledge. Because of the difficulty, a piece of the work is completely halted during the contractor's procedure of identifying a solution. After the problem was understood, the work continued, but the timeline expired. Finally, the entire project will be delayed.

2.4.2.2 Improper planning and scheduling result in a poor judgment of time and resources

The stakeholders involved in the construction sector plan and prepare a schedule of each activity to control whether they are progressing as per the schedule or not. Planning and scheduling of works should be done before the construction phase of any project.

2.4.2.3 Inaccurate Time Estimate

According to (Long, et al., 2008), the variables of erroneous time estimating contribute to the reasons for construction project delays. Time gauges are important because they contribute to other methods of project management and organization. A wrong time estimation method might lead to project delays. The contractor does not allow time for various common issues that arise frequently during the construction stage, such as equipment breakdowns, missed conveyances due to supplies, disasters and crises, and so on. As a result of this issue, the real-time will run out before the estimated time, and the entire project may be delayed.

2.4.2.4 Inaccurate Cost Estimate

According to (Long, et al., 2008), there are parts of off-base expense assessment that contribute to building project delays. Construction estimating errors can be extremely costly and humiliating. Wrong estimations from contract drawings, using incorrect units of

measurement, material improperly valued, and the most well-known number juggling mix-ups are all examples of off-base cost gauges. Contractor in view of inaccurate cost estimation for that specific work at some point. Finally, re-estimation time will cause a piece of the work to be delayed, and it will also cause the complete assignment to be delayed.

2.4.2.5 Poor Site Management and Supervision

(Odeh & Battaineh, 2002) considered factors such as poor site administration and monitoring as contributors to delays. (Daniel W M Chan and Kumaraswamy, 1997) identified poor project members/staff and oversight as contributing factors to delays. In the construction sector, a component of the project team lacks management and supervision due to colleagues that lack experience and aptitude, such as recent graduates. When they are confronted with a problem, they have no notion of how to solve it. A portion of the supervisors did not participate with their colleagues due to a lack of communication. Finally, because the problem cannot be resolved fast, the entire task will be delayed.

2.4.3 Causes Related to Clients

2.4.3.1 Degree of Interference of the Client

(Long, et al., 2008) investigated the aspects of client impedance that contribute to construction project delays. A portion of the client instructs contractual workers to perform extra work, while another portion of the task is unable to progress and will be delayed immediately.

2.4.3.2 Lack of Experience of Client in Construction

According to (Koushki, et al., 2005), the absence of customer contacts in construction projects has a significant impact on the reasons for delays. A portion of the project's delay was caused by the client's lack of experience, particularly among new developers. Customers are frequently confronted with an issue and have no idea how to understand it quickly owing to a lack of understanding. A portion of the work couldn't progress while the customer was figuring out the best way to solve the problem. Finally, due to a specific job delay, the entire project is delayed.

2.4.4 Additional work required by the client

The variables of progress arrange that contribute to delays, according to (Odeh & Battaineh, 2002). During the construction time frame, the customer frequently changes the plan, which has an impact on the overall project delay. It is based on the fact that the contractor will not

be able to complete the work until the engineer issues the most recent drawing. As a result, completing the contract within the agreed-upon time range is impossible.

2.4.4.1 Causes Related to Consultants

2.4.4.2 Inadequate Consultant Experience

According to (Long, et al., 2008), insufficient consultant expertise is one of the reasons that contributes to delays. Many specialists in the building project work without any prior experience. Aside from that, there are a variety of reasons for an inexperienced expert, including different site conditions, mismanagement and maladministration, site access limits, and a defective design and specification.

2.4.4.3 Poor Design and Delay in Design

As mentioned by (Ogunlana, et al., 1996), poor design and structural delays are factors that contribute to building project delays. It is because in a project if a poor design is encountered, the project will be destroyed and redone.

2.4.4.4 Incomplete Drawing and Detail Design

The factors of fragmented drawing and detailed plan were identified by (Long, et al., 2008) as supporters of delays. (Ogunlana, et al., 1996) considered the factors that contribute to building project delays, such as inadequate drawings and detailed plans. During construction, the contractor is working, but the drawings are jumbled, and none of the details are visible. He couldn't continue working because of the problem, thus the project had to be put on hold until an expert could provide additional information on that specific drawing. Because work cannot advance without detailed drawings, it will affect that specific work's delay and deferment, as well as the overall project's delay.

2.4.4.5 Causes Related to the Project

The original contract term was too short. Legal disagreements between parties, a faulty definition of significant completion, ineffective delay fines, the type of construction contract (turnkey or construction only), and the type of project offered and awarded (negotiation, lowest bidder).

2.4.4.6 Causes Related to Design and Documentation

Mistakes and inconsistencies in plan documents, ambiguous and insufficient details in drawings, project plan complexity, insufficient data collection and analysis before design,

configuration engineer's misunderstanding of client's requirements, mistakes, inconsistency, and ambiguities in specification, and lack of use of advanced engineering design software.

2.4.4.7 Causes Related to Materials

Lack of construction materials in the market, changes in material types and standards during construction, material conveyance delays, and harm to arranged materials when they are critically necessary. Due to the availability of numerous materials, there was a delay in the selection of appropriate building components and in organizing the corresponding finishing materials.

2.4.4.8 Causes Related to Labor and Equipment

Labor shortages, unqualified workers, labor nationality, low labor productivity, and personal conflicts among workers are some of the labor-related delays.

2.5 Effect of Time and Cost Overruns

2.5.1 Effects of Time Overruns

In terms of construction in ill-disposed connections, schedule delays in construction projects have a detrimental impact on clients, contractors, and consultants. The consequences of time overruns are the results that occur when the causes of the overruns are not identified and effectively addressed. The study (Pourrostam & Ismail, 2011) recognizes and positions the following effects of construction delays: cost overruns, disputes, mis-intervention, litigation, arbitration, cash-flow concerns, and outright abandonment of tasks.

These revelations are being made together with various investigations, as done by (Aibinu, 2002) and (Motaleb & Kishk, 2010). According to (Manavazhi & Adhikari, 2002), delays in the delivery of materials and equipment to building sites are frequently a contributing factor in cost overruns in developing-country construction projects.

2.5.2 Effects of Cost Overruns

When a construction project's cost overrun occurs, the consequences are known as impacts. According to (Nega, 2008), cost overruns have significant consequences for key partners and the construction industry as a whole. To the client, cost overruns imply additional expenses beyond those initially agreed upon, resulting in lower levels of profitability. The additional charges are passed on to the end client as higher rental or rent fees or costs.

According to experts, cost overrun implies a lack of ability to communicate a cash incentive, which could tarnish their reputations and cause clients to lose faith in them. If the contractor is to blame, it implies a loss of benefit and slander that could jeopardize their chances of receiving future jobs. Cost overruns could result in project abandonment and a decline in construction activities, as well as a bad reputation and a failure to ensure it at higher costs due to increased risks. To the business as a whole, cost overruns could result in project abandonment and a decline in construction activity, poor standing, and an inability to ensure it at higher costs due to increased risks.

The investigation of (Nega, 2008) also identified the following as significant cost overrun impacts: delays during construction, supplementary agreements, and discouraging investment; public clients will invest less in project construction, resulting in fewer projects in the future; additional cost/expense, Budget deficit creates an adversarial relationship between project participants. The consultant's reputation is damaged. The contractor will lose money due to non-completion; project owners will consider the consultant incompetent. Significant experience with consultant oversight and agreement with the organization Installments to contractors are being delayed. The contractor will be harmed by the client's budget shortfall; loss of user benefits that would have been received if the project had been completed on time. Budget constraints will affect the contractor. Table 2-2 presents 28 identified effects of overrun

Table 2-2 Effects of time and cost overruns

ID	Effects for Overrun
EF1	Disputes among the parties
EF2	Arbitration
EF3	Litigation
EF4	Abandonment
EF5	Increase in project costs
EF6	Increases market risk
EF7	Overall efficiency decreases
EF8	Decreasing customer's faith and trust
EF9	Increases stress on the overall team
EF10	Negative social impact
EF11	Poor quality of work
EF12	Require Additional Agreement
EF13	Dissatisfaction of the client and/or end-users
EF14	Negative attitude toward the construction industry by the society

EF15	Reduce the contribution of the construction industry to the national economic growth
EF16	Prevent the planned property and service production growth rate
EF17	Erode the mutual trust and respect among the stakeholders and weakens the construction industry
EF18	Distorts fair and equitable resource distribution
EF19	Discourages the investment in school projects
EF20	Creates frustration for stakeholders
EF21	Creates a skeptical outlook on an appraisal of other new construction projects
EF22	Pours money unnecessarily into the project at hand at the expense of other new projects
EF23	High cost of supervision and contract administration for consultants
EF24	Delayed payments to contractors
EF25	Additional cost/expense on the user rental/lease/costs
EF26	Budget shortfall adversarial relationship between participants of the project
EF27	Loss of profit for non-completion to the contractor
EF28	The contractor will suffer from a budget shortfall of the client

2.6 Resolution (Mitigation) Methods for Minimizing Time and Cost Overrun

The researchers discovered a few techniques for controlling building costs or overcoming cost overrun difficulties in their investigation. Proper Project Costing and Financing: (Kaliba, et al., 2009) indicated that delays in payments may occur due to complex financial cycles in client organizations, and the researchers have their own opinion on how to effectively address the difficulties. Contractors would face financial difficulties if payment was delayed, delaying the completion of surrounding works.

According to (Ashworth, 2004), one of the client's requirements for a building project is an appraisal of the expected cost. Proper cost control is important because it reflects the overall trend toward greater cost-effectiveness and ensures building costs not only in terms of initial prices but also in terms of life cycle costs and total cost evaluation. Contractors, consultants, and clients should ensure that they have the right people with the right qualifications to manage their projects effectively, according to (Kaliba, et al., 2009). It is preferable if the construction manager has experience and skills in project or construction management, and the first cost estimates should be as accurate as feasible. Clients can examine and choose the

necessary finances for completing the project, and they can be made available as needed, thanks to the accuracy of the cost estimate.

According to (Nega, 2008), the sole concern about the work was to complete the project successfully. To maintain a strategic distance from consecutive changes, guard against fragmented scope identification. Also, avoid joining works that are out of scope to avoid unnecessary work. (Peeters & Madauss, 2008) devised a method for avoiding cost overruns. Any improvement project must include a risk assessment. As a result, the project manager should have performed a risk management function to identify and mitigate the project's hazards. The goal of risk management is to reduce any risk that could result in the project's requirements not being met, and they also stated that once the cost target has been determined, it is followed by selecting an appropriate contract model with procedures to link the initial estimate to the final price.

According to Nega, the study's weakness is that it only looks at cost overruns in public building construction projects, although cost overruns increase project time overruns.

Another previous study has limitations in that it is limited to construction projects carried out by one side of the contractor and there are empirical data available.

(Khoiry, et al., 2018) have critically reviewed 47 journals that studied the issues of delays in construction projects. According to the study conducted by (Khoiry, et al., 2018), the main criteria for minimizing delays can be classified into four, which are; management of time and resources, interpersonal, technical, and technology.

Parties in the construction industry should give due consideration to the factors contributing to construction costs and time overruns to minimize their consequences on the efficiency and performance of construction projects. Improving cost determination methods, the Existence of full design and detail at every construction stage, carry out an adequate site visit and investigation before cost estimation are some of the recommendations to reduce cost and time overruns in construction projects (Sunday J. Odediran, 2012).

(Peeters & Madauss, 2008) have developed different techniques called the 5C approach to avoid cost overruns. Based on their studies (Peeters & Madauss, 2008) A five-step approach to help construction managers reduce cost overruns is as follows:

- Step 1: Realistic Cost Estimation.
- Step 2: Consideration of the Life Cycle Cost (LCC).
- Step 3: An Appropriate Contractual Framework.
- Step 4: Cost Control and Risk Management During the Project Phase.
- Step 5: A Communication-Managed Insurance Approach.

The first three steps need to be considered carefully before signing the contract, but also risk management and reporting (essential for proper insurance management) have to be built into the contractual conditions well in advance (Peeters & Madauss, 2008). A review of previous works indicates that 15 methods are identified as the mitigation measures to overcome the challenges of time and cost overruns in school building construction projects.

Table 2-3 Resolution Methods of Overrun

ID	Resolution Methods of Overrun
RE1	Planning and developing a project master program
RE3	Managing and completing the design stage before construction
RE4	Procurement management
RE7	Setting a clear scope
RE8	Developing a risk management plan
RE16	Monitoring the progress and deliverables
RE2	Implementing clear project processes and procedures
RE5	Using appropriate software
RE6	Setting a realistic project cost and time
RE9	Briefing the project to the concerned body
RE10	Making a construction plan and developing a methodology
RE11	Value engineering and cost-cutting
RE12	Up-scaling marketplace
RE13	Allotting time for the tender stage
RE14	Having a team responsibility matrix
RE15	Train clients, consultants, and contractors

2.7 Research Gaps

As is pointed out in the previous section of this paper, very few studies have been conducted to determine the effect that the cost and time overruns of school building projects have on the

overall construction industry. One of the main reasons for this study is that by determining the causes and effects of overruns for these types of projects, stakeholders might be able to use an effective planning and management process to control these overruns. Causes related to government and construction authority are not addressed by previous researchers, this research however incorporates government and construction authorities as to the main causes of the time and cost overruns.

Methodological gap: Most research conducted earlier have not taken into account the relationship between time and cost overruns and the factors that influence them. Therefore, a regression analysis was used in this study to formulate the relationship between time and cost overruns and their influencing factors.

Knowledge gap: The majority of earlier research did not sufficiently examine the factors causing cost overruns of building projects in Ethiopia, leaving a gap in our understanding of these issues. The paper therefore holistically assessed and grouped those factors impacting overruns and examined the impact of those factors on construction projects in Ifa Boru boarding school projects.

2.8 Conceptual Framework/Road Map of the Study

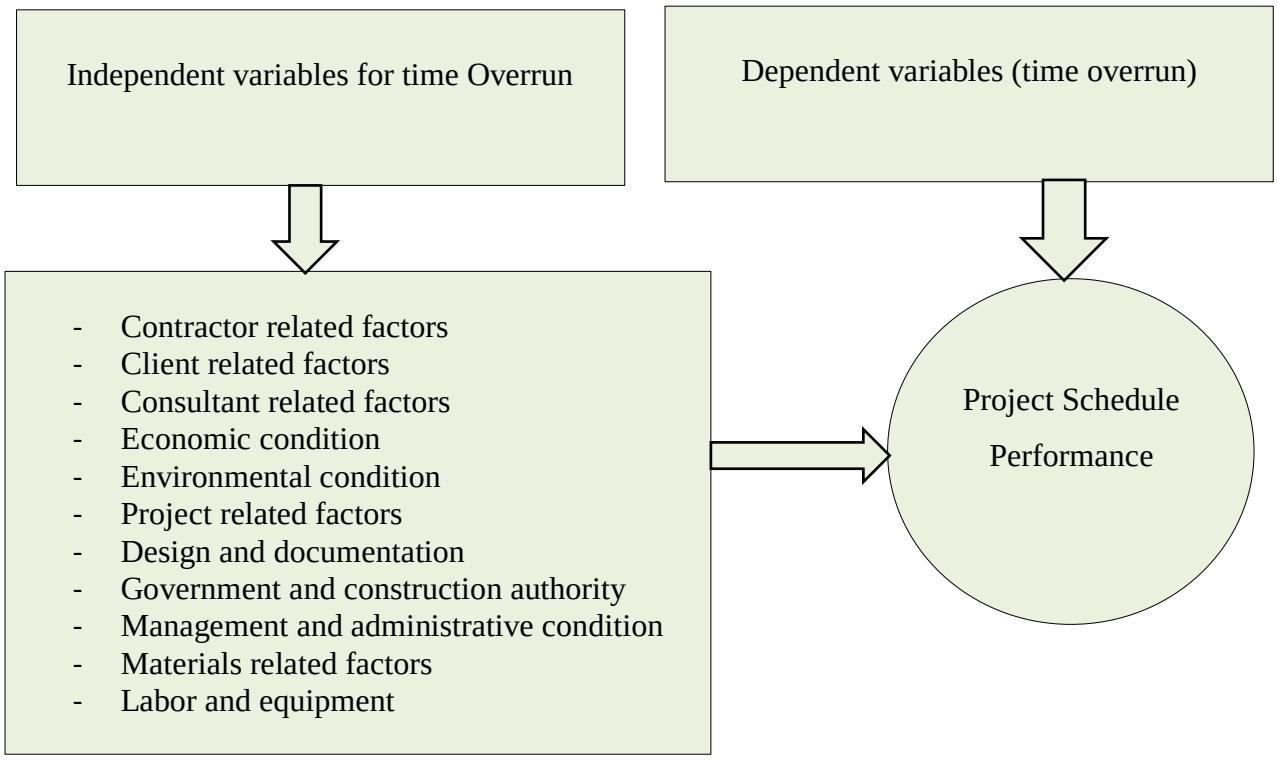


Figure 2-2 Conceptual model of determinants of the project time Overrun

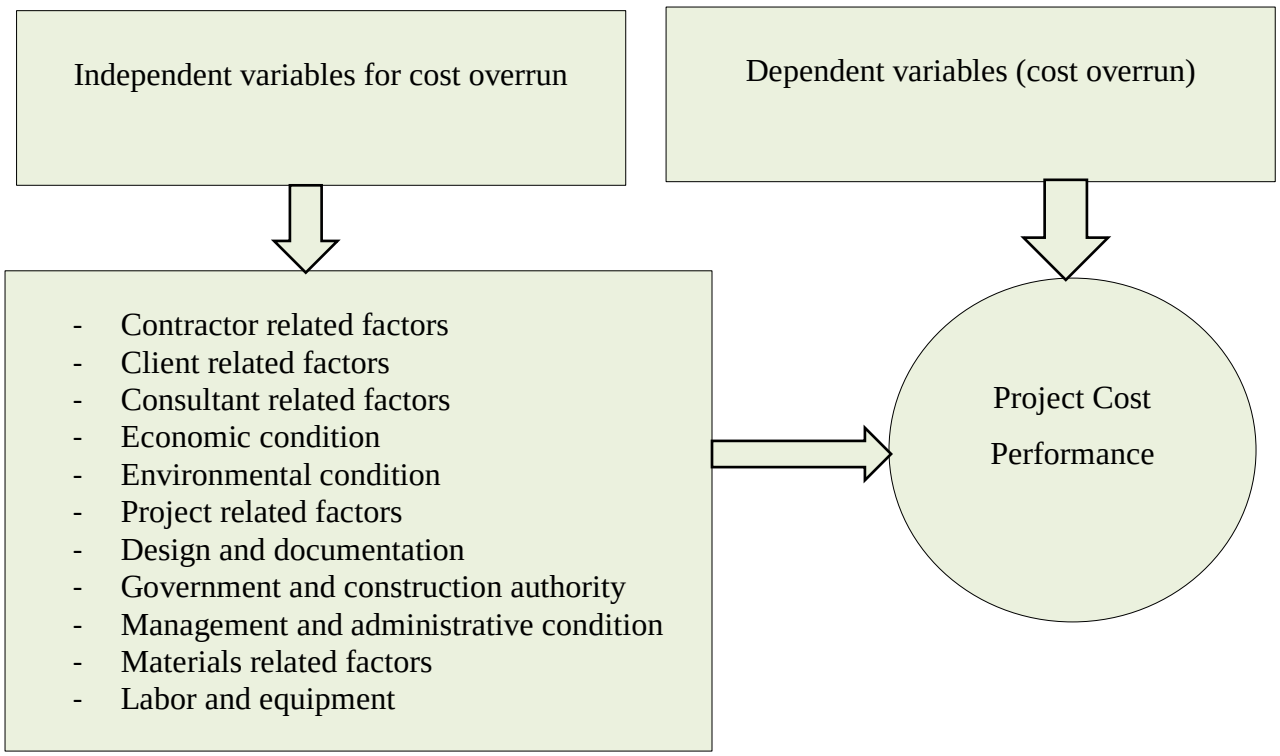


Figure 2-3 Conceptual model of determinants of the project cost overrun

CHAPTER 3 RESEARCH METHODS

3.1 Introduction

This chapter discusses the research methodologies adopted to identify various issues associated with time and cost overruns in a construction project. With the selection of participants for a questionnaire survey and the discussion of case study selection, the rationale for the adoption of various research methodologies is offered. This section outlines each step that was taken to accomplish the goals that were specified for this study. The methods used, as well as how and where pertinent data for the study was acquired, are addressed. Additionally, the research tools used and the data collection and analysis methods are presented.

3.2 The Study Area

The study area was focused on Ifa Boru's seven Boarding schools constructed at Yabelo, Negele, Haramaya, Ambo, Bedele, Nedjo, and Dodola Town, in the Oromia region. The main reason for the selected study area is based on the fact that those projects are affected by a significant amount of time and cost overruns. The project variation ranges from (47.4% for the Yabello BS project to 113.90% for the Haromaya boarding school project) of the original contract value and the revised completion date of the project was fourteen months which was expected to be completed in seven months.

3.3 Research Design

The term "research design" refers to the organization or plan of a scientific investigation; designing a research study entails creating a strategy or plan that will direct data gathering and analysis (Poilt and Hungler, 1985).

This research consists of six phases; the first one is the literature review, problem identification, and categorization of overrun factors, and effects to meet the objectives of the study. The second phase of the research includes identifying the population and sample size determination. The third phase of the research is the design of the questionnaire and piloting. The fourth phase of the research includes data analysis by different software, and the fifth

phase of the study encompasses the discussion and presentation of results. In this phase, the result of the desk study and questionnaires is discussed. The last phase of the research includes the conclusions and recommendations. The research design process carried out in this study is summarized as shown in

Figure 3-1.

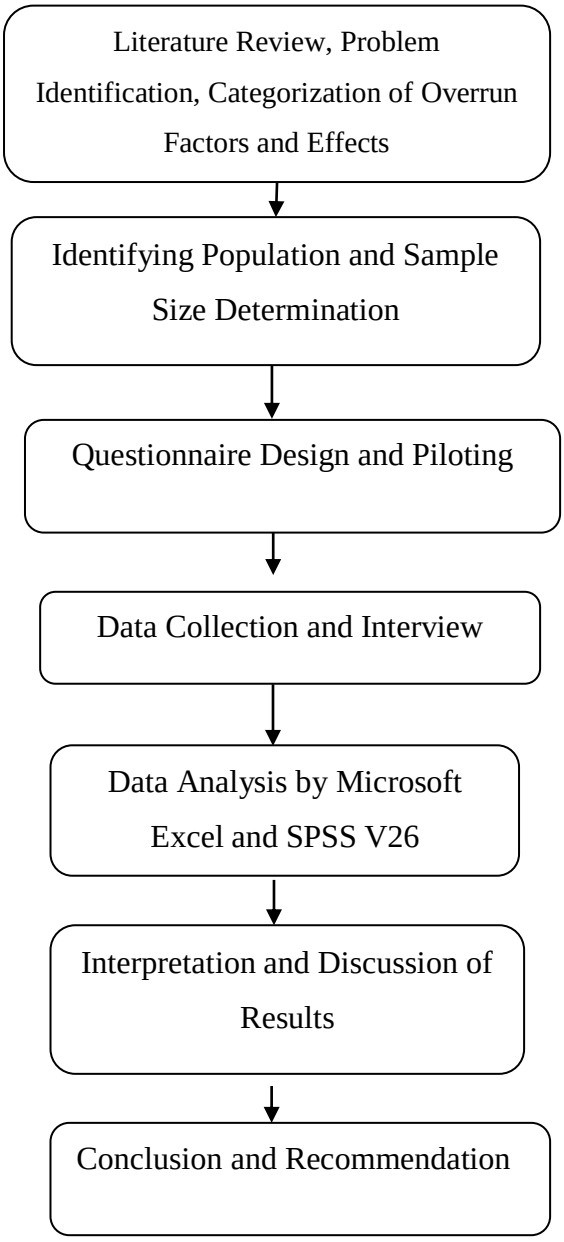


Figure 3-1 Research Design

3.4 Research Approach

The procedure chosen by the researcher to collect, evaluate, and interpret data is known as a research approach. There are three types of research approaches: quantitative qualitative and mixed.

Researchers believed that biases inherent in any one method could cancel out or neutralize the biases of other methods (Creswell, 2003), despite the fact that all methods have their limitations. This suggests that a mixed methods design is useful to capture the best aspects of both quantitative and qualitative approaches. Consequently, a mixed research approach was adopted to carry out this study.

3.4.1 Quantitative Research Approach

This method was used to respond to inquiries regarding the key elements that most significantly affected cost and schedule overruns. Its method of inquiry was census design, which uses data from the entire population to produce a quantitative or numerical depiction of trends, attitudes, or opinions in a population.

Project cost and time overrun were utilized as dependent variables and other determinants were employed as independent variables in a census design using a structured questionnaire with both closed- and open-ended questions to better understand the effects of one variable on the other. By reducing subjectivity, this quantitative research strategy produces more objective results. The quantitative approach, however, is restricted to solely in the questionnaire-specified outcomes. As a result, it has a poor knowledge of the context.

3.4.2 Qualitative Research Approach

A less organized and more flexible qualitative method was also employed to gather extra information beyond what was provided in the questionnaire and to reduce the limitations noted in the quantitative approach. This method was used to interview a limited group of respondents who had more expertise working on building projects. Additionally, a study of the contract documents for a few building projects was conducted. However, because only a small number of participants were included in this methodology, it is difficult to generalize findings to a broad group.

3.5 The Research Type

Both exploratory and descriptive research types were applied to this study. The study is exploratory because it determines whether or not there are time and cost overruns. Additionally, since it attempts to describe the variables of time and cost overrun as well as the actual rate of time and cost overrun the study is considered to be descriptive.

3.6 Population and Sample

3.6.1 Study Population

Ifa Boru boarding school projects implemented by the regional government of Oromia, Ethiopia at different sites were considered as the study population. These school projects implemented at seven project sites at Yabelo, Negele, Haramaya, Ambo, Bedele, Nedjo, and Dodola towns of the Oromia regional state are available during data collection time. All boarding school projects have been considered using both the purposive and random sampling techniques.

3.6.2 Sample Size and Sampling Techniques

This study mainly focuses on the Ifa Boru boarding school projects constructed at seven project sites. Clients (project owners), contractors, consultants, and regulatory authorities are among the construction sector stakeholders whose samples were chosen based on their direct exposure to school building construction operations. Within the group of owners, contractors, consultants, and regulatory authorities, purposeful (non-probability, deliberate) sampling was utilized to pick samples. The sample size formula helps in the calculation or determination of the minimum sample size required to determine the appropriate or sufficient proportion of the population, as well as the confidence level and margin of error.

The sample size is applied to the simplified formula provided by (Yamane, 1967) to determine the required sample size at a 95% confidence level, degree of variability=0.05. The total population of the study is the major stakeholders who are involved with the projects like clients, contractors, consultants, and regulatory bodies.

Based on the purposive sampling technique, the following numbers were allocated to the respondents in each category of stakeholders. However, to achieve the required numbers within each category of stakeholders, a random sampling technique was adopted.

The total number of people directly participating in seven projects was assumed to be 120 for the contractor, 20 for the client, 40 for consultants, and 20 for regulatory authorities. The total population for this study then becomes 200.

$$n = \frac{N}{1 + N \cdot e^2} \qquad (3\text{-}1)$$

Where:

n = Desired sample size (Yamane Sample Size)

N =Total population size (200 in this case)

e is determined by the confidence we are seeking from our study. This means that if 95% confidence is required about the results of the study then the value of e=0.05.
the sample size for this particular research is therefore computed as,

$$n = \frac{N}{1 + N \cdot e^2} = \frac{200}{1 + 200 \cdot 0.05^2} = 133$$

The desired sample size n is 133 which a total of 150 questionnaires were distributed to the respondents.
To determine the number of participants in the questionnaire, divide the sample size by the expected response rate, and multiply it by 100. In this case, 133 customers are required to respond to the survey and the expected response rate was assumed to be 90%.

$$\text{Invited respondents} = \frac{\text{Sample Size}}{\text{Expected response rate}} \times 100 = \frac{133}{90} \times 100 = 148$$

This implies that about 150 questionnaires should be distributed among the respondents of the study.

3.7 Data Collection Methods

3.7.1 Source of Data

The study was conducted using both primary and secondary data. The primary documents were collected using a questionnaire from owners, contractors, consultants, and regulatory bodies. The secondary data such as project cost overrun and construction time overrun were obtained from consultants, from different previously identified research, the internet, journals, books, and different articles in published documents.

3.7.2 Design of the Questionnaire

The process of collecting data was conducted for boarding school projects, which include a large number of engineers with a wide range of disciplines and expertise. The respondents in this study were experts with various positions that were involved in the construction industry such as engineers working in the field of construction projects in various companies (consultants, owners, contractors, and regulatory bodies). The respondents were asked to identify the most significant causes of time and cost overruns in school construction projects based on their education, working experience, and position in the company.

The first stage of this study was the collection of data through reviews of the previous studies on the causes and effects of cost and time overruns in construction projects. In the second stage of this study, the previously collected data were used in designing the Preliminary questionnaire. A pilot study was used to check the validity of the initial questionnaire.

A questionnaire designed from the previously identified overrun factors consists of four parts. The first part was about the background of respondents and the second part was explaining the causes of time and cost overruns while the third part was stating the effects of cost and time overruns and the fourth part was about the resolution methods of these overruns using a Likert scale. A five-point Likert scale (1 = Strongly Disagree and 5 = Strongly Agree) was used for assessing the impact of overrun factors. A total of 150 survey forms were distributed, out of which 140 filled survey forms were collected and used in this research. Data obtained from the Likert scale was evaluated in SPSS v26 and Microsoft Excel. This survey was filled out by respondents involved in dealing with cost and time overruns.

3.8 Case Study Projects

The case study was conducted at Ifa Boru Boarding School Projects implemented in Haramaya, Dodola, Ambo, Nedjo, Negelle, Bedelle, and Yabello construction sites. Some valuable information such as the original and actual contract periods, and the original and revised contract amounts are obtained from the provisional acceptance of the engineering corporation of Oromia. The seven project offices officially launched the projects on October 19, 2020. Each of the seven projects was expected to be completed on May 17, 2021; however, the actual completion times for all seven projects are longer than anticipated, indicating a time overrun (Table 3-1). Furthermore, the original contract value for the seven projects is different from what was implemented in the actual construction phase indicating

there is a cost overrun (Table 3-2). The corresponding time and cost overruns are then computed.

3.9 Time and Cost Overruns for Studied Projects

The time overrun for a construction project can be estimated using the following formula. The time overrun for the studied seven school building projects is presented as shown in Table 3-1.

$$\boldsymbol{Time\ overrun} = \frac{\boldsymbol{actual\ contract\ period - contract\ period}}{\boldsymbol{contract\ period}} \times \mathbf{100}(\%) \qquad (3\text{-}2)$$

Table 3-1 Time Overruns for the Case Studied Projects

Project Site	Starting Date	Original Contract Period(days)	Original Contract date	Actual Completion Date	Actual Contract Period (days)	Time Overrun (%)
Haromaya	19-Oct-20	210	17-May-21	12-Feb-22	481	129.05
Dodola	19-Oct-20	210	17-May-21	28-Jan-22	466	121.90
Ambo B S	19-Oct-20	210	17-May-21	27-Jan-22	465	121.43
Nedjo	19-Oct-20	210	17-May-21	2-Mar-22	499	137.62
Negelle	19-Oct-20	210	17-May-21	3-Apr-22	531	152.86
Bedelle	19-Oct-20	210	17-May-21	10-Mar-22	507	141.43
Yabello B S	19-Oct-20	210	17-May-21	26-Nov-21	403	91.90

(Source: provisional acceptance of ECO,2022)

Cost overrun is an unexpected change in the project budget that ends up increasing the total project cost. The cost overrun for a construction project can be estimated using the following formula.

$$cost\ overrun = \frac{actual\ contract\ price - original\ contract\ price}{original\ contract\ price} \times 100(\%) \qquad (3\text{-}3)$$

The cost overrun for the studied seven school building projects is presented as shown in Table 3-2.

Table 3-2 Cost Overruns for the Case Studied Projects

Project Site	Original Amount	Revised Amount	Cost Overrun (%)
Haromaya	161,054,339.65	344,493,436.38	113.90
Dodola	156,070,376.17	267,984,149.56	71.71
Ambo B S	155,439,710.87	275,366,815.47	77.15
Nedjo	160,930,120.14	275,302,995.33	71.07
Negelle	171,253,847.44	270,159,479.90	57.75

Bedelle	167,430,074.93	261,744,992.61	56.33
Yabello B S	171,253,847.44	252,538,087.05	47.46

(Source: provisional acceptance of ECO,2022)

3.10 Methods of Data Analysis and Presentation

3.10.1 Identification of Overrun Factors and Effets

The first objective of this research relies with the identification of cost and time overruns in building construction projects. During a thorough assessment of the literature on cost and time overruns, a total of 140 overrun factors, 28 effects, and 16 resolution methods were discovered. Then, these factors were clustered into twelve major categories, namely, contractor-related, client-related, consultant-related, causes related to economic conditions, design, and documentation related, government and construction authority related, materials-related, projects related, labor and equipment related, and causes related to external factors.

Furthermore, a framework of resolution mechanisms was established to minimize the effects of time and cost overruns to meet the third objective of this research.

The collected data through a questionnaire survey was analyzed using the software called Statistical Package for the Social Sciences (SPSS V26) and Microsoft Excel. SPSS was used to generate the frequency *(ni)* of the response category index for the cause-and-effect factors. The relative importance index (RII) for each factor was calculated using the frequency data for each response category generated from Excel.

As the first objective of this research work is the identification of overrun factors, the relative importance index (RII) technique was used for the analysis of different overrun factors. This method was found appropriate for ranking critical overrun factors as compared to other methods (Sambasivan, et al., 2017), (Iyer & Jha, 2005), (Akintoye, 2000)). RII was calculated by using Eq. (3-4 and 3-5)

$$R_{II} = \frac{\sum a_i \cdot n_i}{N \cdot A} \quad (3\text{-}4)$$

$$R_{II} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{N \cdot 5} \quad (3\text{-}5)$$

n_1 to n_5 is the number of respondents from **Strongly Disagree** to **Strongly Agree**

N is the total number of respondents

where ai = assigned weight to ith response, ni = frequency of ith response, N = total number of respondents, and A = highest weight. The value of RII indicates the impact of the factor on cost and time overrun in a building project. Higher the value of RII more critical the factor. RII for different categories was found using Eq. (3-4) and considering factors present in that category only.

3.10.2 Mean Score Analysis

The following formula can be used to calculate the mean score for each overrun factor.

$$MS = \frac{\sum a_i \cdot n_i}{N} \qquad (3\text{-}6)$$

Where ai is 1 to 5 from 5 points Likert scale, ni is the number of respondents who rate a particular factor, and N is the total number of respondents which is 140 in this case

The data analysis methods include the following

- Literature review from the previous chapter.
- The questionnaire survey targeted contractors, consultants, clients, and regulatory bodies.
- Relative importance Index analysis
- Ranking the causes and effects from high to low and identifying the highest 36 causes and 20 effects.
- Development of conceptual frameworks to minimize the effects of overruns

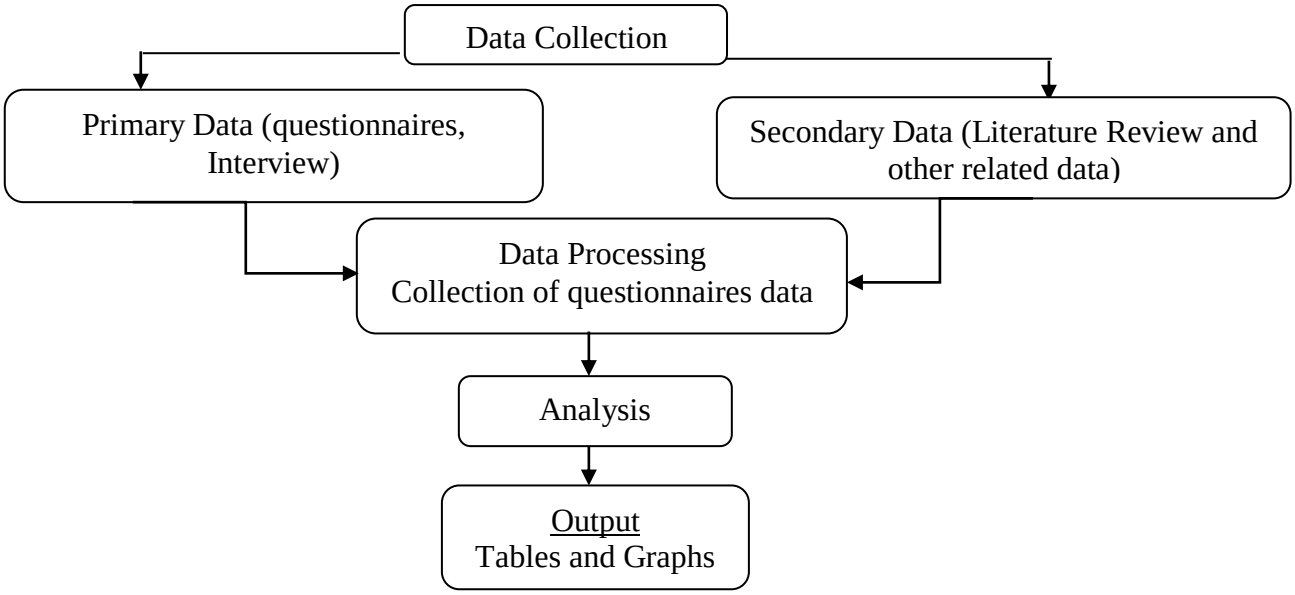


Figure 3-2 Data Analysis Procedures

3.10.3 Analysis of Correlation Matrix

A correlation matrix analysis of the data was carried out using SPSS 26, to identify any possible linear correlations between the independent variables that influence time and cost overruns. The equation to compute the correlation coefficient, r, is shown:

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{\left[n\sum x^2 - (\sum x)^2\right] \cdot \left[n\sum y^2 - (\sum y)^2\right]}} \qquad (3\text{-}7)$$

Where:

x and y are any pair of variables whose level of correlation is being sought.

n is the total number of observations. The correlation coefficient lies between -1 and +1. If the coefficient is close to -1 or +1, the two variables are close to a perfect linear relationship, and when the coefficient is close to 0, there is little or no correlation.

3.10.4 Analysis of Variance (ANOVA)

The analysis of variance is conducted to show the overall significance of the independent variables. The ANOVA table was generated by SPSS V26 and Microsoft Excel.

3.10.5 Regression Analysis

Multiple regression analysis is a helpful tool to develop relationships between overruns with their factors as the second objective of this research. In multiple regression models, there is only one dependent variable and several independent factors; in simple regression models, however, there is only one dependent variable and one independent variable.

To evaluate the statistical relationship between a response (i.e., time and cost overruns in the case study school building projects) and their significant factors, multiple linear regression models were utilized. Multiple regression models are often better at describing data than a simple linear model with only one explanatory variable. However, the researcher's goal is usually to reduce the model to its most efficient version (Williams, 2005).

The form of multiple linear regression models is described below:

$$\boldsymbol{Yi = K + \beta 1 X 1 + \beta 2\, X\, 2 + \beta 3\, X\, 3 + \beta 4\, X\, 4 + \beta 5\, X 5 + \ldots\ldots\ldots Bk\, Xk + \varepsilon} \quad (3\text{-}8)$$

Where Yi is the observed time or cost overruns corresponding to the independent/explanatory variables *X1* to *Xk*.

N is the number of explanatory variables β1 to βk

3.11 Reliability and Validity of the Study

To check the questionnaire's validity, selected experts were invited to comment on the questionnaire as a pre-assessment means. To check the questionnaire item's internal consistency, its reliability was checked by Cronbach's alpha test coefficient. According to the formal definition, Cronbach's alpha is a coefficient of reliability or correctness rather than a statistical test. Cronbach's alpha values ranged from 0 to 1 in accordance with the correlations between the objects. Values above 0.70 are regarded as "rational" or appropriate in the majority of social science study environments. In this study, the statistical package SPSS version 26 was used to determine Cronbach's alpha. Both the time and cost overruns variables, as well as the complete set of data, have Cronbach's coefficient alpha values larger than 0.70. A greater score, therefore, denotes a better degree of internal consistency. Cronbach's alpha can be estimated using the following equation (Boermans & Kattenberg, 2011).

$$\alpha = \frac{I}{I-1}\left(1-\frac{\sum \sigma_i^{\,2}}{\sigma_x^{\,2}}\right) \quad (3\text{-}9)$$

Where I = the number of items on the scale. $\sigma_i^{\,2}$ = the variance of item i , and $\sigma_X^{\,2}$= the variance of the observed total test scores.

3.12 Ethical Consideration

While conducting research, ethical factors must be taken into account. The first thing a researcher should do is to ensure that participants are aware of the objective of the research and are properly informed about the evaluation being undertaken and that the researcher does not exert undue influence over the respondents' decisions. Furthermore, the acquired data from participants should not be linked to their names or other personal information, and the documents must be used for research purposes only. Finally, the researcher should present a

complete and accurate questionnaire so that the participants can easily understand and give factual information accordingly.

Table 3-3 Operationalization of Variables

Objective/RQ	Variable	Indicator	Data Source	Method of Data	Method of Data Analysis
Identification of major causes and effects of time and cost overruns	Causes of Time and cost overrun	Causes of overruns	Literature and (own survey,2022)	Questionnaire	RII and MS
Formulation of the relationship between time and cost overruns with	Time and Cost Overruns with their causes	Overruns with their Causes	Literature and (own survey,2022)	Questionnaire	Regression Analysis
Establishment of a framework for minimizing time and cost	Effects of Overruns	Effects of overruns	Literature and (own survey,2022)	Questionnaire	RII and MS

(Source: Researcher, 2022)

CHAPTER 4 ANALYSIS AND DISCUSSION OF RESULTS

4.1 Response Rate of the Questionnaire

A total of 150 questionnaires were distributed to participants involved in different sections of the companies. 140 out of 150 questionnaire papers were filled and returned. Table 4-1 presents the respondent response rate by reporting the number of questionnaires distributed and returned. As can be shown in the table, 93.3% of the total respondents have filled out and returned the questionnaire.

Table 4-1 Respondents' Response Rate

Distributed Questionnaire	Returned	Unreturned	Response Rate (%)
150	140	10	93.33

4.2 Analysis of Reliability of the Questionnaire

Before performing any statistical analysis, reliability analysis was performed. Internal consistency of overrun factors and questionnaire survey reliability are important aspects to judge whether the survey results are appropriate or not (Ahsan & Gunawan, 2010), (Sharma & Gupta, 2020). This was done by using statistical software named SPSS to check Cronbach alpha. Generally, Cronbach's alpha has a value between 0 and 1. The higher the value higher is the reliability and internal consistency (El-Karim, et al., 2017). Overall, Cronbach alpha for the questionnaire of the causes related to the contractors was found to be 0.827, which ensures high reliability and internal consistency of data collected.

Table 4-2 Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.827	0.822	25

4.3 Ranking of Overrun Factors

As the first objective of this research work is the identification of overrun factors, the relative importance index (RII) and the mean score (MS) techniques were used for the analysis of different overrun factors.

RII for the causes related to contractors category was found to be 0.810, RII for the causes related to clients category was found to be 0.823, RII for the causes related to consultants category was found to be 0.834, and RII for the causes related economic condition was found to be 0.694, RII for the causes related to the project was found to be 0.811, RII for the causes related to design and documentation was found to be 0.771, RII for the causes related to government and authority was found to be 0.761, RII for the causes related to materials was found to be 0.751, RII for the causes related to labor and equipment was found to be 0.780.

4.3.1 Ranking of Causes in Studied Projects

Table 4-3 shows the first 36-time overrun factors and the first 50-cost overrun factors ranked by the frequency of occurrence of each time overrun factor in studied projects. It means that these factors have more probability of occurrence among 140-time overrun factors in building projects. Also, these factors are the most critical factors which impacted the studied projects with time overrun.

Table 4-3 Ranking of the Top 36 Causes of Time Overruns

Category	ID	Name of the Causes	RII	MS	Rank
Causes Related to Contractors	A2	Improper planning and scheduling result in a poor judgment of time and resources	0.810	4.05	1
	A3	Delay in mobilization	0.787	3.94	2
	A4	Inappropriate construction methods	0.776	3.88	3
	A5	Poor site management	0.770	3.85	4
	A6	Shortage of materials on the site	0.769	3.84	5
	A12	Depend on the site engineers to bear the whole responsibility on-site	0.721	3.61	6
	A13	Poor project management skill	0.699	3.49	7
	A15	Financial difficulties faced by contractors	0.660	3.30	8
Causes Related to Clients	B3	Degree of interference of the client	0.823	4.11	1
	B5	Additional works required by the client	0.814	4.07	2
	B16	Changes in client requirements	0.797	3.99	3

	B2	Contract modifications	0.736	3.68	4
	B6	High quality of work required by the client	0.720	3.60	5
	B20	Slow decision making	0.713	3.56	6
Causes Related to Consultants	C6	Absence of consultant on site	0.834	4.17	1
	C10	Mistakes and errors in design	0.811	4.06	2
	C3	Lack of technical skill (staff)	0.760	3.80	3
Causes Related to Economic Condition	D1	Global financial crisis	0.694	3.47	1
	D3	Material market rate (escalation, inflation, or fluctuation)	0.669	3.34	2
Causes Related to the Project	F2	Change in the scope of the project	0.811	4.06	1
	F3	Project location	0.797	3.99	2
	F4	The original contract duration is too short	0.774	3.87	3
	F7	Unavailability of bonus for early completion	0.749	3.74	4
Causes Related to Design and Documentation	G1	Mistakes, inconsistencies, and ambiguities in specifications and drawings	0.771	3.86	5
	G3	Unclear specification	0.766	3.83	6
Causes related to Government and Construction Authority	H4	Delay in obtaining permits and payment approvals from the construction authorities	0.761	3.81	1
	H5	Delay in Approval of Additional and Supplementary Works (Design and BOQ)	0.751	3.76	2
	H1	Lack of supervision by authorities regarding whether the project is run properly.	0.691	3.46	3
	H2	Interference and improper comments by some authorities without conducting a technical investigation or supervision.	0.677	3.39	4
Causes Related to Materials	J1	Poor procurement program of material	0.780	3.90	1
	J2	Delay of material delivery and late ordering to site	0.776	3.88	2
	J3	Improper handling of materials on site	0.773	3.86	3
	J4	Inappropriate material quality	0.766	3.83	4
	J5	Change in material prices	0.750	3.75	5
	J6	Shortage of construction materials required	0.744	3.72	6
Causes Related to Labor and Equipment	K11	Late delivery of equipment to sites	0.710	3.55	1

Table 4-4 Ranking of the Top 50 Cost Overrun Factors

Remark	ID	A Causes Related to Contractors	RII	MS	Rank
Causes Related to Contractors	A2	Improper planning and scheduling result in a poor judgment of time and resources	0.807	4.036	1
	A5	Poor site management	0.804	4.021	2
	A6	Shortage of materials on the site	0.786	3.929	3
	A12	Depend on the site engineers to bear the whole responsibility on-site	0.781	3.907	4
	A13	Poor project management skill	0.776	3.879	5
	A18	Contractual claims such as an extension of time	0.760	3.800	6
	A22	Inaccurate quantity take-off and quantity underestimation	0.753	3.764	7
Causes Related to Clients	B2	Contract modifications	0.823	4.114	1
	B3	Degree of interference of the client	0.814	4.071	2
	B5	Additional works required by the client	0.810	4.050	3
	B16	Changes in client requirements	0.797	3.986	4
	B1	Lack of experience of the client in the construction	0.790	3.950	5
	B6	High quality of work required by the client	0.720	3.600	6
	B17	Re-measurement of provisional sum	0.713	3.564	7
	B18	Improper and poor project feasibility study	0.693	3.464	8
Causes related to consultants	C3	Lack of technical skill (staff)	0.790	3.950	1
	C14	Lack of cost plan monitoring and control	0.784	3.921	2
	C17	Poor design and delays in design	0.759	3.793	3
Causes Related to Economic Condition	D1	Global financial crisis	0.694	3.471	1
	D3	Material market rate (escalation, inflation, or fluctuation)	0.669	3.343	2
Causes Related to the Project	F2	Change in the scope of the project	0.811	4.057	1
	F6	Ineffective penalties for delay	0.794	3.971	2
	F7	Unavailability of bonus for early completion	0.787	3.936	3
	F12	Poor site safety	0.776	3.879	4
	F3	Project location	0.757	3.786	5
	F8	Type of construction contract	0.686	3.429	6

	F9	Type of project bidding and award	0.673	3.364	7
	F10	Lack of experience in a similar project	0.641	3.207	8
Causes Related to Design and Documentation	G1	Mistakes, inconsistencies and ambiguities in specifications and drawings	0.771	3.857	1
	G2	Inadequate design team experience	0.766	3.829	2
	G3	Unclear specification	0.764	3.821	3
	G4	Incomplete drawing and detailed design	0.703	3.514	4
Causes related to Government and Construction Authority	H4	Delay in obtaining permits and payment approvals from the construction authorities	0.761	3.807	1
	H5	Delay in Approval of Additional and Supplementary Works (Design and BOQ)	0.751	3.114	2
	H2	Interference and improper comments by some authorities without conducting a technical investigation or supervision.	0.691	3.386	3
Causes Related to Materials	J1	Poor procurement program of material	0.811	4.057	1
	J5	Change in material prices	0.787	3.936	2
	J2	Delay of material delivery and late ordering to site	0.776	3.879	3
	J3	Improper handling of materials on site	0.773	3.864	4
	J6	Shortage of construction materials required	0.744	2.564	5
	J7	Changes in specifications and material types during construction	0.596	2.979	6
Causes Related to Labor and Equipment	K11	Late delivery of equipment to sites	0.770	3.850	1
Causes Related to External Factors	L1	High cost of machineries	0.804	4.021	1
	L2	Fluctuation in the price of raw materials	0.744	3.721	2
	L12	Fluctuation of prices of materials	0.714	3.571	3
	L14	Price escalation	0.683	3.414	4
	L4	Shortage of site workers	0.677	3.386	5
	L5	Delay in material procurement	0.674	3.371	6
	L7	Poor labor productivity	0.671	3.357	7
	L8	Unskilled labor	0.654	3.271	8

Table 4-4 presents the first 50-cost overrun factors ranked by the frequency of occurrence of each factor in studied projects. It means that these costs overrun factors have more

probability of occurrence among 140 factors in building projects. Also, these factors are the most critical factors which impacted the studied projects with cost overrun.

Table 4-5 Ranking of the top 20 Effects of Time and Cost Overruns

ID	Name of the effects of overruns	RII	MS	Rank
EF1	Disputes among the parties	0.810	4.05	1
EF6	Increases market risk	0.801	4.01	2
EF8	Decreasing customer's faith and trust	0.791	3.96	3
EF9	Increases stress on the overall team	0.789	3.94	4
EF10	Negative social impact	0.779	3.89	5
EF13	Dissatisfaction of the client and/or end-users	0.776	3.88	6
EF14	Negative attitude toward the construction industry by the society	0.767	3.84	7
EF15	Reduce the contribution of the construction industry to the national economic growth	0.757	3.79	8
EF16	Prevent the planned property and service production growth rate	0.756	3.78	9
EF17	Erode the mutual trust and respect among the stakeholders and weakens the construction industry	0.753	3.76	10
EF19	Discourages the investment in school projects	0.751	3.76	11
EF20	Creates frustration for stakeholders	0.750	3.75	12
EF23	High cost of supervision and contract administration for consultants	0.748	3.74	13
EF27	Loss of profit for non-completion to the contractor	0.747	3.74	14
EF28	The contractor will suffer from a budget shortfall of the client	0.716	3.58	15
EF7	Overall efficiency decreases	0.714	3.57	16
EF18	Distorts fair and equitable resource distribution	0.713	3.56	17
EF21	Creates a skeptical outlook on an appraisal of other new construction projects	0.700	3.50	18
EF22	Pours money unnecessarily into the project at hand at the expense of other new projects	0.699	3.49	19
EF26	Budget shortfall adversarial relationship between participants of the project	0.697	3.49	20

Table 4-6 Ranking of Resolution Methods to Overcome the Above Overruns

ID	Name of the Resolution Methods of Overruns	RII	MS	Rank
RE1	Planning and developing a project master program	0.787	3.94	1
RE3	Managing and completing the design stage before construction	0.784	3.92	2
RE4	Procurement management	0.771	3.86	3
RE7	Setting a clear scope	0.767	3.84	4
RE8	Developing a risk management plan	0.761	3.81	5
RE16	Monitoring the progress and deliverables	0.750	3.75	6

RE2	Implementing clear project processes and procedures	0.737	3.69	7
RE5	Using appropriate software	0.736	3.68	8
RE6	Setting a realistic project cost and time	0.733	3.66	9
RE9	Briefing the project to the concerned body	0.730	3.65	10
RE10	Making a construction plan and developing a methodology	0.710	3.55	11
RE11	Value engineering and cost-cutting	0.643	3.21	12
RE12	Up-scaling marketplace	0.570	2.85	13
RE13	Allotting time for the tender stage	0.531	2.66	14
RE14	Having a team responsibility matrix	0.526	2.63	15
RE15	Train clients, consultants, and contractors	0.507	2.54	16

4.3.2 Main Factors Contributing to Time and Cost Overruns

The most critical problems causing time overrun are improper planning and scheduling resulting in a poor judgment of time and resources, delay in mobilization, inappropriate construction methods, poor site management, shortage of materials on the site, and depending on the site engineers to bear the whole responsibility on-site, poor project management skill, and financial difficulties faced by contractors which belong to contractor related factors. The next important factors are the degree of interference of the client, additional work required by the client, changes in client requirements, contract modifications, high quality of work required by the client, and the slow decision-making belonging to client-related factors.

The absence of a consultant onsite, mistakes and errors in design, and lack of technical skill (staff) are the most critical causes of time overrun under the category of consultants.

The changes in the scope of the project, project location, short contract duration, and unavailability of bonuses for early completion are some of the factors contributing to overruns categorized under causes related to the project.

The mistakes, inconsistencies, ambiguities in specifications and drawings and unclear specifications relate to the design and documentation also play an important role in the cause of time overruns in construction projects.

Delay in obtaining permits and payment approvals from the construction authorities, delay in the approval of additional and supplementary works (design and BOQ), lack of supervision by authorities regarding whether the project is run properly, interference and improper comments by some authorities without conducting a technical investigation or supervision are some of the major causes of time overrun under government and construction authorities.

Factors that have less influence than the first thirty-six factors are "improper construction methods", "unsuitable construction equipment" and "inaccurate quantity take-off and quantity underestimation" adopted by the contractor, "Lack of communication with the consultant", "Owner has no priority/ urgency to complete the project" and "poor project management" of the client. Lack of consulting experience and inadequate project preparations are the factors caused by consultants that have less impact to lengthen the time and put the cost of it up.

4.3.2.1 Major Causes of Time Overrun

Improper planning and scheduling result in a poor judgment of time and resources, a contractor-related time overrun factor is ranked 1st, with a weighted average mean score of (MS=4.05). Without proper planning and scheduling, it is difficult to measure and control the progress of the project during construction.

Delay in mobilization (MS=3.94) This is also a client-related time overrun factor, which is ranked 2nd according to the survey result. According to respondents' responses, there is a delay in the mobilization of resources (materials and equipment) for all seven projects. This shows that the mobilization time can significantly affect the overall time delay of the project.

Inappropriate construction methods (MS=3.88) ranked 3rd among time overrun causes related to contractors. This indicates that the use of proper construction methods will minimize the overall construction time overrun according to the survey results.

Poor site management with (MS=3.85) ranked 4th in from the contractor-related time overrun factors. Based on the results of the survey taken from the respondents the site should be managed properly to control the timely progress of activities. This is the major factor in increasing the time and cost of a project, as poor project management may lead to inefficient resource usage and project cost increase.

Shortage of materials on the site with (MS=3.84) ranked 5th among the time overrun causes related to contractors. The shortage of materials on the site will cause a delay in construction until the materials are delivered to the site. The contractor or his staff members should therefore check the availability of construction materials on the site and should order early before it is scarce.

The degree of interference of the client (MS=4.11) Ranked 1st among the causes related to clients. Some of the clients need to interfere in every single activity of the contractors which will lead to disputes among the parties and the construction might be interrupted that causing a time overrun.

Additional works required by the client (MS=4.07) Clients sometimes ask for additional work beyond the agreement this can in turn cause time overruns.

Changes in client requirements (MS=3.99) According to the survey results clients involved in school building projects may change their minds after the construction is started this will lead to redesign and modification that will cause additional time overruns.

Contract modifications (MS=3.68) The original contracts are modified due to unforeseen geological conditions and unpredicted problems encountered on the site. This modification will also cause additional time and cost overruns from what was agreed upon before.

High quality of work required by the client (MS=3.60) Even though every construction is progressed based on the client's requirements and satisfaction, some clients require a high quality of work which will lead to time overruns.

Slow decision-making (MS=3.564) The lack of quick decision-making skills will cause the time to overrun.

4.3.2.2 Major Causes of Cost Overrun

Improper planning and scheduling result in a poor judgment of time and resources, a contractor-related cost overrun factor is ranked 1st, with a weighted average mean score of **(MS=4.04).** Without proper planning and scheduling, it is difficult to measure and control the progress of the project cost during construction.

Poor site management with (MS=4.02) ranked 2nd among the contractor-related cost overrun factors. Based on the results of the survey taken from the respondents the site should be managed properly to control the cost of any progress of activities. This is the major factor for increasing the cost of a project, as poor project management may lead to inefficient utilization of resources and project cost increase.

Shortage of materials on the site with (MS=3.93) ranked 3rd among the cost overrun causes related to contractors. The shortage of materials on the site will cause a delay in construction

until the materials are delivered to the site this will result in additional project costs such as low productivity of equipment and labor.

The degree of interference of the client (MS=4.07) Ranked 2nd among the cost overrun causes related to clients. The higher degree of interference of the clients will sometimes lead to disputes among the parties and the construction might be interrupted that causing a cost overrun to the whole project.

Additional works required by the client (MS=4.05) Clients sometimes ask for additional work beyond the original agreement this can in turn cause cost overruns.

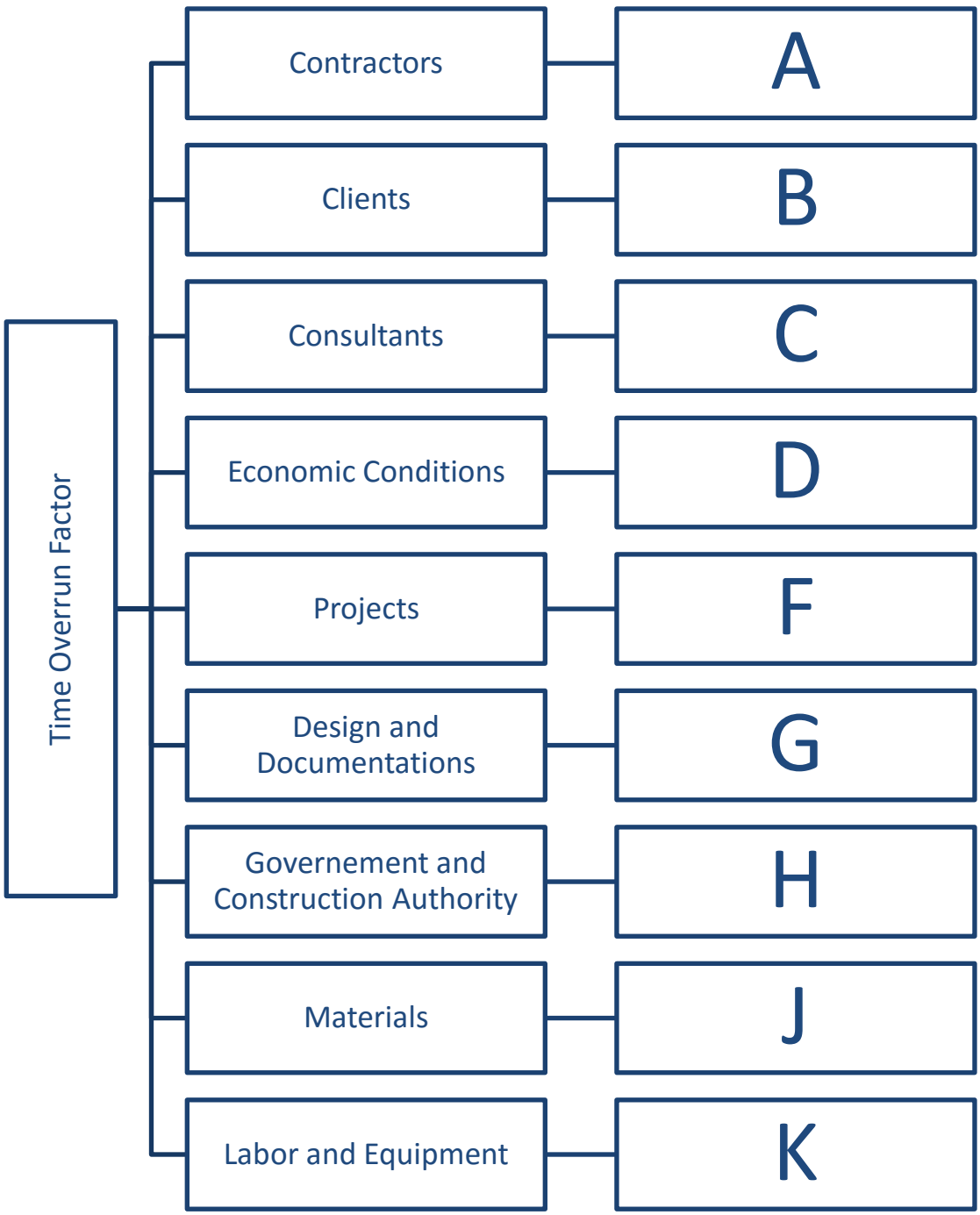
Contract modifications (MS=4.11) The modification of original contracts for many reasons will cause an increase in cost overruns from what was agreed upon before.

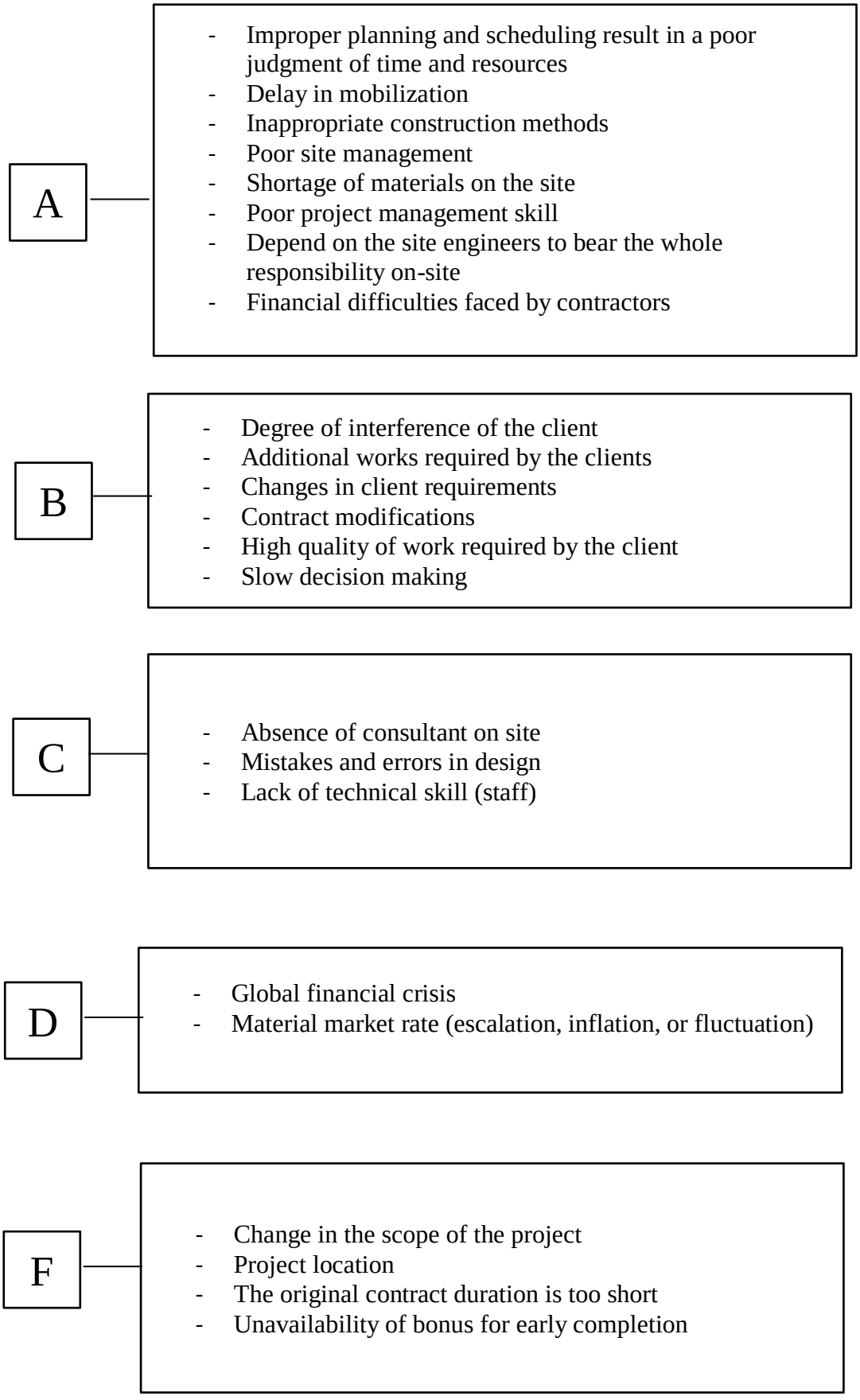
Global Financial Crisis (MS=3.47) According to the survey results the global market crisis is ranked 1st in the cost overrun causes related to economic conditions.

Changes in the Scope of the Project (MS=4.06) This is ranked 1st in the cost overrun causes under the project-related category. The change in the scope of the project will incur additional costs from what was agreed before

4.3.3 The Framework of Causes of Cost and Time Overrun

After ranking the most significant factors based on their mean score and relative importance index values, the framework of the top 36-time overrun factors and the top 50 cost overrun factors were prepared as it is presented in Figure 4-1 and Figure 4-2.


Time Overrun Factor
Contractors
A
Clients
B
Consultants
C
Economic Conditions
D
Projects
F
Design and Documentations
G
Governement and Construction Authority
H
Materials
J
Labor and Equipment
K


A
- Improper planning and scheduling result in a poor judgment of time and resources
- Delay in mobilization
- Inappropriate construction methods
- Poor site management
- Shortage of materials on the site
- Poor project management skill
- Depend on the site engineers to bear the whole responsibility on-site
- Financial difficulties faced by contractors
B
- Degree of interference of the client
- Additional works required by the clients
- Changes in client requirements
- Contract modifications
- High quality of work required by the client
- Slow decision making
C
- Absence of consultant on site
- Mistakes and errors in design
- Lack of technical skill (staff)
D
- Global financial crisis
- Material market rate (escalation, inflation, or fluctuation)
F
- Change in the scope of the project
- Project location
- The original contract duration is too short
- Unavailability of bonus for early completion

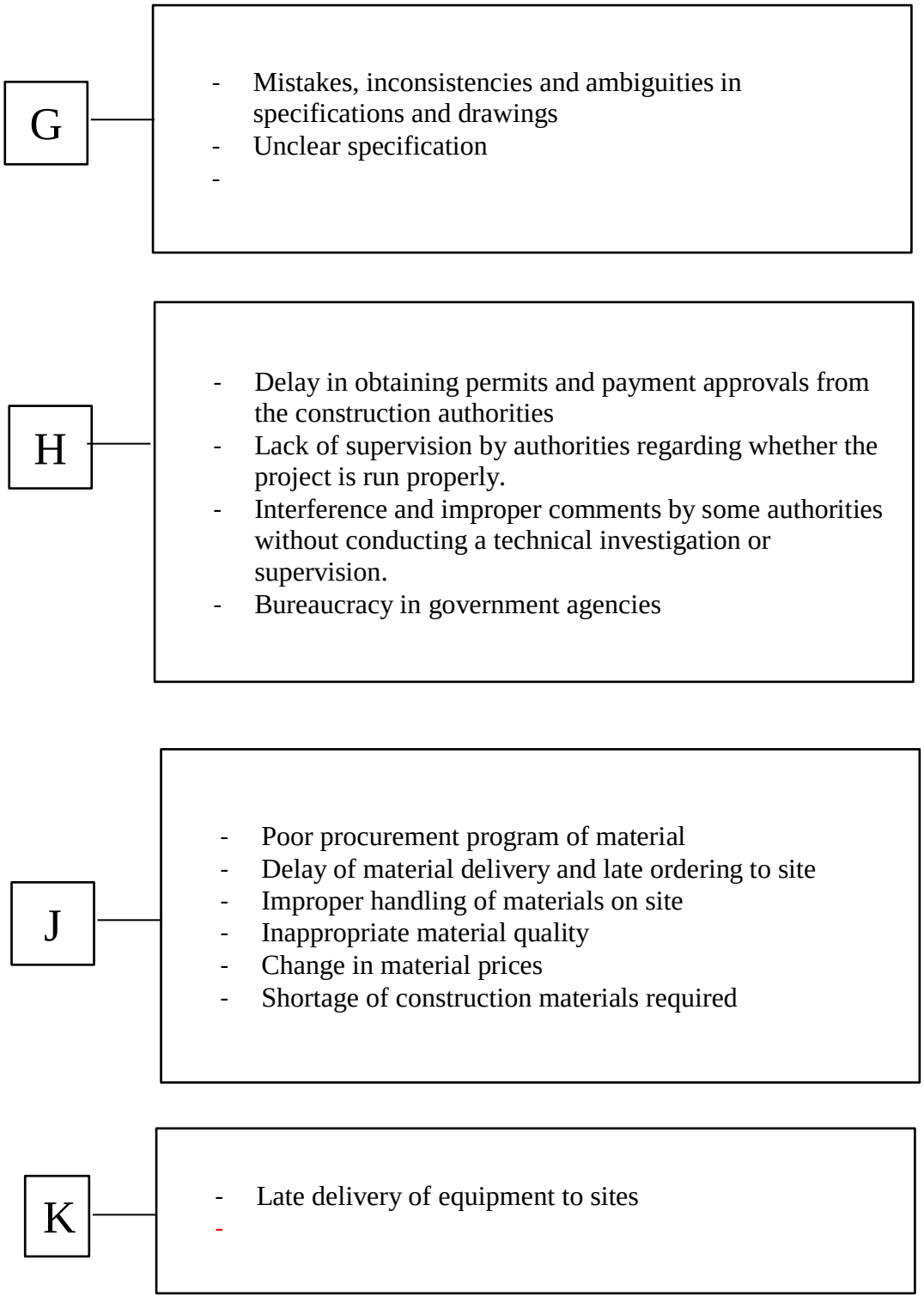
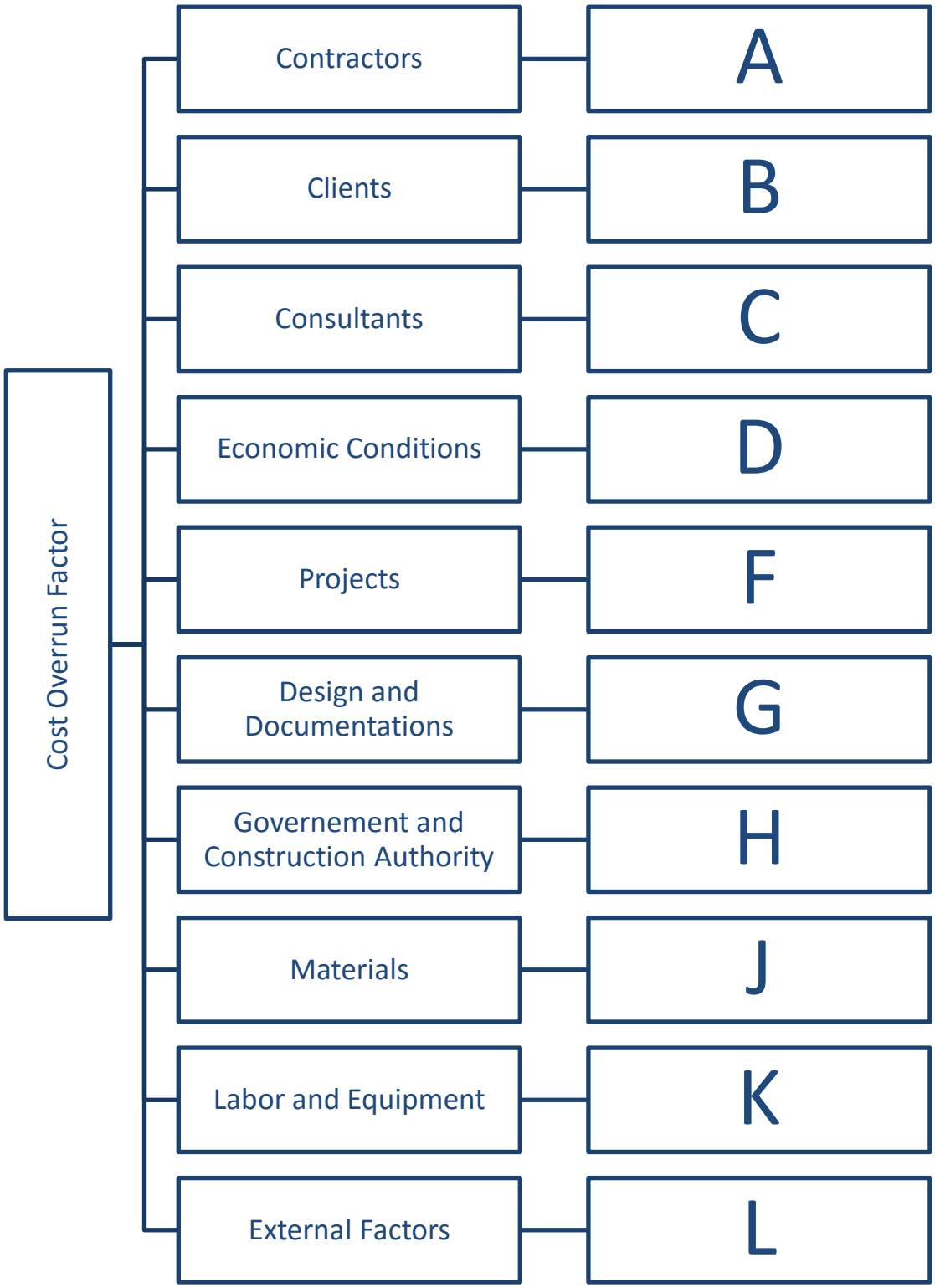
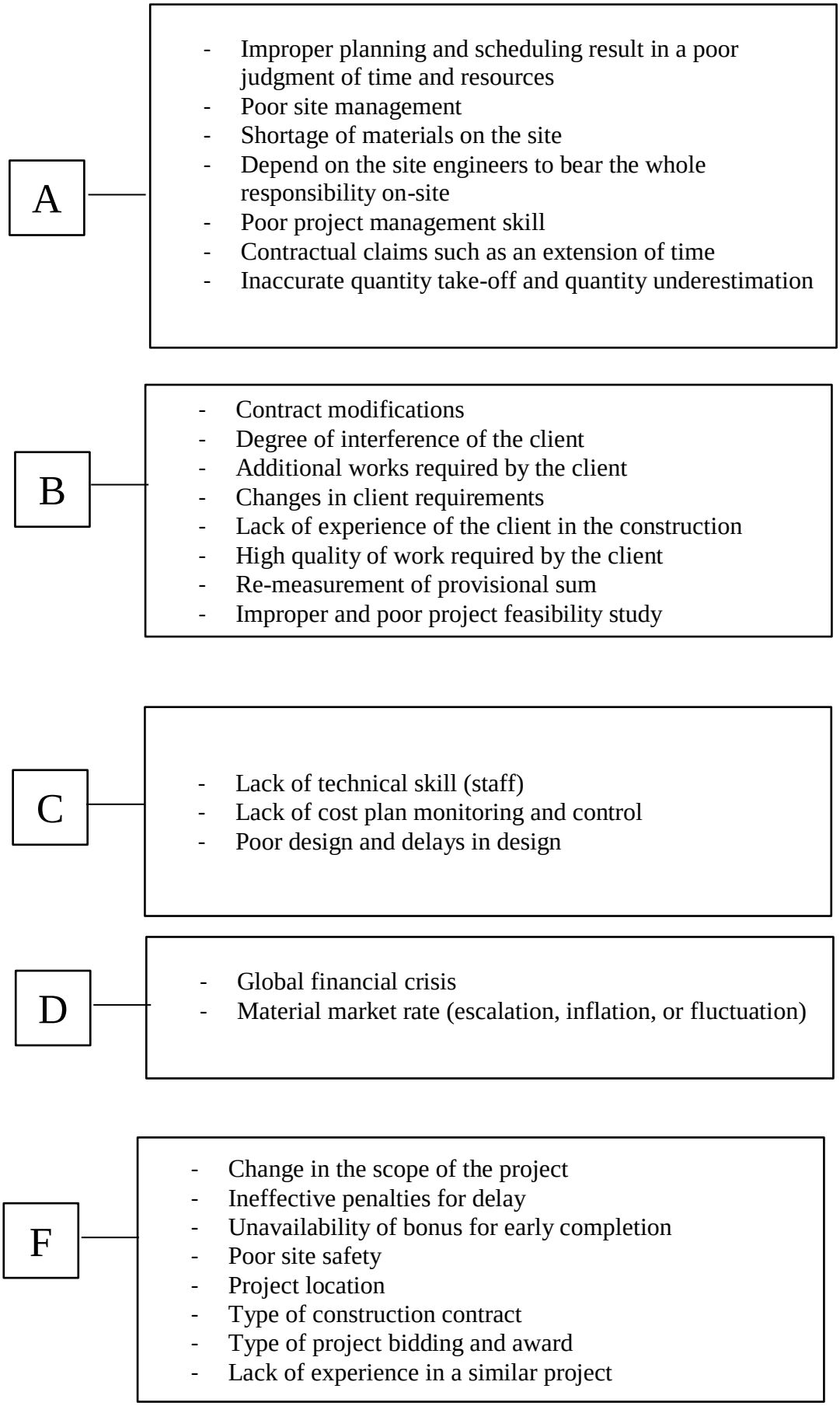
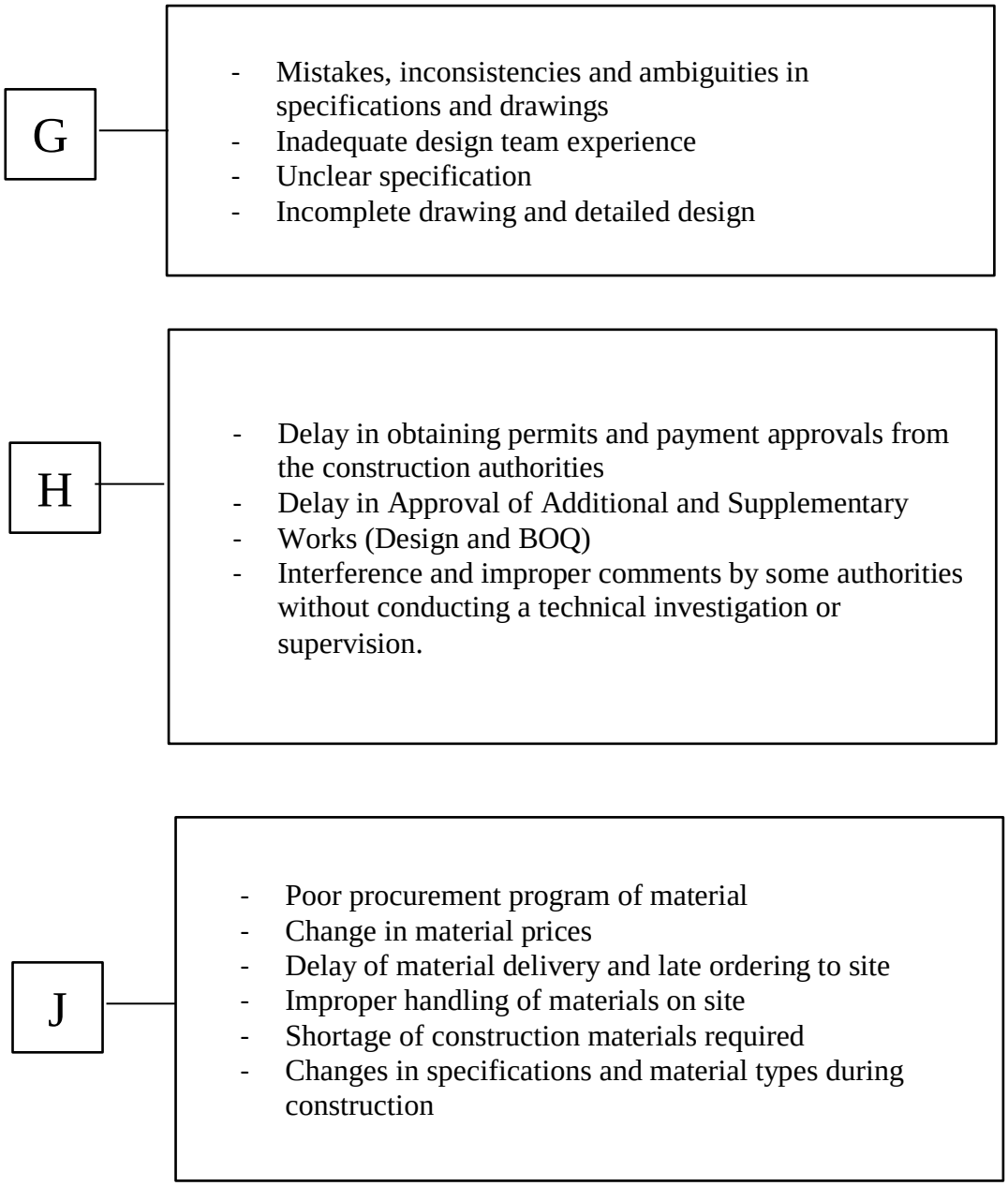


Figure 4-1: Theoretical Framework of Time Overrun Factors


Cost Overrun Factor
Contractors
A
Clients
B
Consultants
C
Economic Conditions
D
Projects
F
Design and Documentations
G
Governement and Construction Authority
H
Materials
J
Labor and Equipment
K
External Factors
L


A
- Improper planning and scheduling result in a poor judgment of time and resources
- Poor site management
- Shortage of materials on the site
- Depend on the site engineers to bear the whole responsibility on-site
- Poor project management skill
- Contractual claims such as an extension of time
- Inaccurate quantity take-off and quantity underestimation
B
- Contract modifications
- Degree of interference of the client
- Additional works required by the client
- Changes in client requirements
- Lack of experience of the client in the construction
- High quality of work required by the client
- Re-measurement of provisional sum
- Improper and poor project feasibility study
C
- Lack of technical skill (staff)
- Lack of cost plan monitoring and control
- Poor design and delays in design
D
- Global financial crisis
- Material market rate (escalation, inflation, or fluctuation)
F
- Change in the scope of the project
- Ineffective penalties for delay
- Unavailability of bonus for early completion
- Poor site safety
- Project location
- Type of construction contract
- Type of project bidding and award
- Lack of experience in a similar project


G
- Mistakes, inconsistencies and ambiguities in specifications and drawings
- Inadequate design team experience
- Unclear specification
- Incomplete drawing and detailed design
H
- Delay in obtaining permits and payment approvals from the construction authorities
- Delay in Approval of Additional and Supplementary
- Works (Design and BOQ)
- Interference and improper comments by some authorities without conducting a technical investigation or supervision.
J
- Poor procurement program of material
- Change in material prices
- Delay of material delivery and late ordering to site
- Improper handling of materials on site
- Shortage of construction materials required
- Changes in specifications and material types during construction

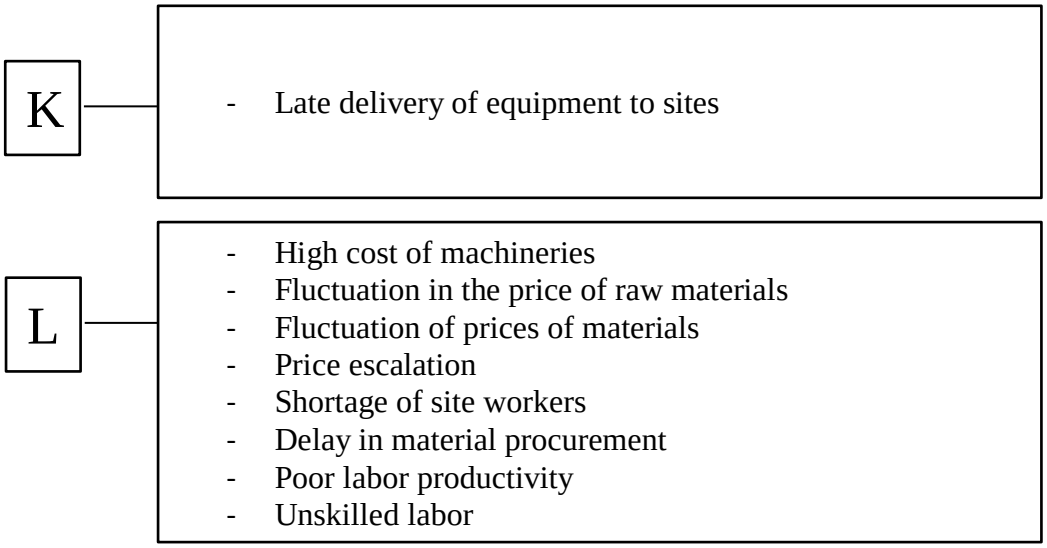


Figure 4-2: Theoretical Framework of Cost Overrun Factors

The third objective of this research is to develop a framework of resolution mechanisms to minimize overruns as shown in Figure 4-3.

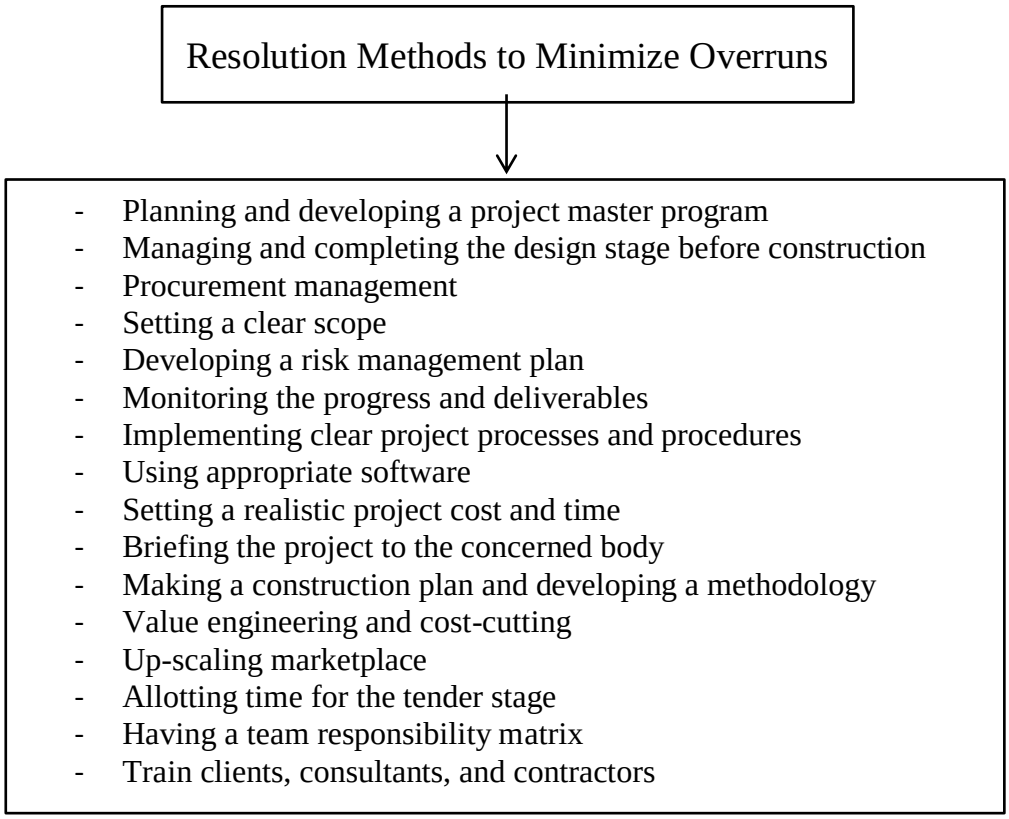


Figure 4-3 Frame Work to Minimize Overruns

4.4 Hypothesis tests on factors of time and cost overruns

Finding out whether there is a relationship between time and cost overruns with their factors is one of the objectives of this thesis. The aim of a hypothesis test is to avoid being deceived by random events. The tests also helped researchers ascertain if respondents concur with such points of view.

4.4.1 Hypothesis tests on factors of time overrun

It is possible to determine whether there is agreement among responders with the help of the time overrun hypothesis test.

- The null hypothesis (H0) states that there is no agreement between the time overrun with their identified causes.
- The Alternative Hypothesis (Ha): There is a strong relationship between the time overrun with their identified factors.

4.4.2 Hypothesis Tests on Factors of Cost Overrun

It can also be possible to determine whether there is agreement among responders with the help of the cost overrun hypothesis test.

- The null hypothesis (H0) states that there is no agreement between the cost overrun with the identified causes or factors.
- The Alternative Hypothesis (Ha): There is a strong relationship between the cost overrun with the identified factors.

4.5 Regression Modeling

4.5.1 Regression Modeling of Time Overrun

The second objective of this research work is to formulate the relationship between time and cost overruns with their factors. This was done by the multiple regression method. The method of multiple regression modeling was adopted to check the interrelation of independent and dependent variables that cause the time overrun of the building projects.

The time overruns of the seven-building projects were assumed to be the dependent variables whereas the top seven causes of overruns from five main categories were taken as independent variables in the multiple regression model.

The top seven causes of overruns based on their level of significance for each of the five categories in the seven project sites are input into the SPSS V26 software as shown in Table 4-7.

Table 4-7 Mean Score of the Five Major Categories

	Category of Causes					Time overrun of sites	
Rank	A	B	C	F	G	Project Site	Time Overrun
1	4.050	4.114	4.171	4.057	3.857	Negelle	1.529
2	3.936	4.071	4.057	3.986	3.829	Nedjo	1.376
3	3.879	3.986	3.800	3.871	3.821	Bedelle	1.414
4	3.850	3.679	3.736	3.743	3.514	Haromaya	1.290
5	3.843	3.600	3.714	3.571	2.829	Dodola	1.219
6	3.607	3.564	3.650	3.367	2.179	Ambo B S	1.214
7	3.493	3.464	3.614	3.050	1.943	Yabello B S	0.919

Category A is causes related to contractors, Category B is causes related to clients, Category C is causes related to consultants, Category F is causes related to the project and Category G is causes related to design and documentation

4.5.1.1 Coefficient of Determination R^2 and ANOVA

The robustness or the strength of the regression model can be determined by examining the model coefficient of determination. The coefficient of determination R^2 regression model explained over 96.4% of the variation in time overrun in the case study school building projects explained by explanatory variables.

Table 4-8 Coefficient of Determination R^2 of Time Overrun

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.982[a]	0.964	0.787	0.0899
a. Predictors: (Constant), Causes Related to Design and Documentation, Causes Related to Consultants, Causes Related to Contractors, Causes Related to Clients, Causes Related to the Project				

Table 4-9 Analysis of Variance of Time Overrun

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.220	5	0.044	5.433	0.314[b]
	Residual	0.008	1	0.008		
	Total	0.228	6			

a. Dependent Variable: Time Overrun

b. Predictors: (Constant), Causes Related to Design and Documentation, Causes Related to Consultants, Causes Related to Contractors, Causes Related to Clients, Causes Related to the Project

Table 4-10 Regression Analysis Coefficients of Time Overrun

Coefficients[a]											
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	-1.739	2.378		-0.731	0.598	-31.956	28.478			-1.739
	Causes Related to Contractors	0.163	1.044	0.161	0.156	0.902	-13.102	13.428	0.033	29.998	0.163
	Causes Related to Clients	0.358	0.689	0.491	0.52	0.695	-8.392	9.108	0.04	25.097	0.358
	Causes Related to Consultants	-0.424	0.619	-0.461	-0.685	0.618	-8.287	7.439	0.078	12.773	-0.424
	Causes Related to the Project	0.935	0.775	1.732	1.206	0.441	-8.915	10.785	0.017	58.081	0.935
	Causes Related to Design and Documentation	-0.242	0.218	-1.022	-1.113	0.466	-3.01	2.525	0.042	23.75	-0.242

a. Dependent Variable: Time Overrun

Table 4-10 presented the final results of the regression equation of time overruns and its ANOVA statistics. The regression model explained over 96.4% of the variation in time overrun in Ifa Boru School building projects in the Oromia regional state, Ethiopia explained

by explanatory variables. This means that the regression model is adequate and a whole significant. The derived equation for the regression model of the time overrun, Y is described below.

$$Y = -1.739 + 0.163A + 0.358B - 0.424C + 0.935F - 0.242G$$

Where A represents causes related to contractors, B denotes causes related to clients, C represents causes related to consultants F represents causes related to the project and G is causes related to design and documentation.

The regression model has a strong correlation coefficient R equal to 0.982 and the coefficient of determination, R square equals 0.964 which is the best fit which means that 96.4% of the total variation in time overrun can be explained by the model. It has to be noted that seven of the previously identified thirty-six input factors were only considered by the developed model. This indicates that the remaining factors were found to have no significant effect on the project time overrun.

4.5.2 Regression Model of Cost Overrun

The method of multiple regression modeling was adopted to check the interrelation of independent and dependent variables that cause the cost overrun of the building projects. The cost overruns of the seven-building projects were assumed to be the dependent variables whereas the top seven causes of overruns from five main categories were taken as independent variables in the multiple regression model. The top seven causes of overruns based on their level of significance for each of the five categories in the seven project sites are input into the SPSS V26 software as shown in Table 4-11.

Table 4-11 Mean Score of the Five Major Categories of Cost Overrun

	Category of causes					Cost Overrun of Sites	
Rank	A	B	F	J	L	Project Site	Cost Overrun
1	4.036	4.114	4.057	4.057	4.021	Haromaya	1.139
2	4.021	4.071	3.971	3.936	3.721	Ambo B S	0.772
3	3.929	4.050	3.936	3.879	3.571	Dodola	0.717
4	3.907	3.986	3.879	3.864	3.414	Nedjo	0.711
5	3.879	3.950	3.786	3.721	3.386	Negelle	0.578
6	3.800	3.600	3.429	2.979	3.371	Bedelle	0.563
7	3.764	3.564	3.364	2.564	3.357	Yabello B S	0.475

4.5.2.1 Coefficient of Determination, R^2 and ANOVA

The coefficient of determination R^2 regression model explained over 98.9% of the variation in cost overrun in the case study school building projects explained by explanatory variables.

Table 4-12 Coefficient of Determination R^2 of Cost Overrun

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
2	0.995[a]	0.989	0.936	0.0550
a. Predictors: (Constant), Causes Related to External Factors, Causes Related to Materials, Causes Related to Contractors, Causes Related to Clients, Causes Related to the Project				

Table 4-13 Analysis of Variance of Cost Overrun

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	0.279	5	0.056	18.425	0.175[b]
	Residual	0.003	1	0.003		
	Total	0.282	6			
a. Dependent Variable: Cost Overrun b. Predictors: (Constant), Causes Related to External Factors, Causes Related to Materials, Causes Related to Contractors, Causes Related to Clients, Causes Related to the Project						

Table 4-14 Regression Analysis Coefficients of Cost Overrun

Coefficients[a]											
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part
2	(Constant)	4.564	3.311		1.379	0.399	-37.500	46.628			
	Causes Related to Contractors	-1.603	1.167	-0.756	-1.373	0.401	-16.435	13.229	0.868	-0.808	-0.142
	Causes Related to Clients	-2.540	1.605	-2.663	-1.582	0.359	-22.936	17.857	0.744	-0.845	-0.164
	Causes Related to the Project	2.206	1.698	2.765	1.299	0.418	-19.369	23.781	0.793	0.792	0.135
	Causes Related to Materials	0.263	0.278	0.690	0.946	0.518	-3.272	3.799	0.727	0.687	0.098
	Causes Related to External Factors	0.861	0.323	0.981	2.669	0.228	-3.239	4.961	0.952	0.936	0.277
a. Dependent Variable: Cost Overrun											

Table 4-14 presented the final results of the regression equation of cost overruns and its ANOVA statistics. The regression model explained over 98.9% of the variation in cost overrun in Ifa Boru School building projects in the Oromia regional state, Ethiopia explained by explanatory variables. This means that the regression model is adequate and a whole significant. The derived equation for the regression model of cost overrun, Y is described below.

$$Y = 4.564 + 2.206F + 0.861L + 0.263J - 1.603A - 2.540B$$

Where A represents causes related to contractors, B denotes causes related to clients, F represents causes related to the project, J represents causes related to Materials and L is causes related to external factors

The regression model has a strong correlation coefficient R equal to 0.995 and the coefficient of determination, R square equals 0.989 which is the best fit which means that 98.9% of the total variation in cost overrun can be explained by the model. It has to be noted that seven of the previously identified thirty-six input factors were only considered by the developed model. This indicates that the remaining factors were found to have no significant effect on the project cost overrun.

4.5.3 Validation of Regression Models

The validity of the developed regression models for the two overruns can be checked by calculating the percentage of error. The percentage of error of the time or cost overrun can be calculated using the following equation:

$$Percentage\ of\ Error = \left|\frac{Actual\ Overrun - Predicted\ Overrun}{Actual\ Overrun}\right| \times 100$$

Table 4-15 Validation of Regression Model for Time Overrun

No	Project Site	Actual Time Overrun	Predicted Time Overrun	%Error
1	Negelle	1.529	1.483	2.99
2	Nedjo	1.376	1.438	4.49
3	Bedelle	1.414	1.402	0.86
4	Haromaya	1.290	1.269	1.65
5	Dodola	1.219	1.254	2.89
6	Ambo B S	1.214	1.197	1.43
7	Yabello B S	0.919	0.918	0.06

As can be shown from Table 4-15, the maximum percentage in the error of the predicted time overrun is 4.49% which is very small, this indicates that the validity of the developed time overrun regression model is very good.

Table 4-16 Validation of Regression Model for Cost Overrun

No	Project Site	Actual Cost Overrun	Predicted Cost Overrun	%Error
1	Haromaya	1.139	1.125	1.25
2	Ambo B S	0.772	0.778	0.81

3	Dodola	0.717	0.757	5.60
4	Nedjo	0.711	0.691	2.83
5	Negelle	0.578	0.559	3.13
6	Bedelle	0.563	0.580	2.98
7	Yabello B S	0.475	0.464	2.27

As can be shown from Table 4-16, the maximum percentage in the error of the predicted time overrun is 5.60% which is very small, this indicates that the validity of the developed cost overrun regression model is very good.

4.6 Triangulation With the Previous Research Output

Triangulation in research refers to the use of various datasets, methodologies, theories, and/or investigators to address a research question. It's a research technique that can help to improve the reliability and validity of research conclusions while minimizing the impact of any study biases.

Data triangulation is one method to improve validity and reliability. Utilizing several data sources and collection methods is known as data triangulation. Research data acquired through various methods and sources can be combined and converged to remove any biases and improve the trustworthiness of the results. To confirm validity and dependability, the researcher has employed data triangulation as one method. To eliminate the ambiguity of items and preserve the precision to be clear for the participants to answer correctly, structured questionnaires, interviews, and document reviews have been employed.

Tsegay and H. Luo (2017) identified improper project feasibility studies the first, late site delivery for construction work and design the second lack of on-time finance and payments the third interference in the execution of work the fourth slowness in decision making the fifth and Poor communication and coordination the sixth most important client-related factors. Tsegay and H. Luo (2017) identified the top four consultant-related causes. These are late in approving and receiving of complete work, poor communication and coordination, poor supervision and late testing & inspection and Inadequate experience of the consultant.

Chekol & Nuramo (2020) identified the top five factors contributing to time overrun are improper planning and scheduling, unrealistic contract duration, improper and poor project feasibility study, incomplete drawing, design details, and documents, slow response (late instruction, inspection, delay in approval). The top five factors contributing to cost overrun

are poor project (site), management / poor cost, control, wastage, construction cost underestimation, poor site investigation and feasibility study, and lack of experience (Chekol & Nuramo, 2020).

Similarly, Eyasu Tolera (2018), identified the top five consultant-related factors. These are weak in following up the planned work schedule by the contractor, inadequate planning and scheduling of work by the contractor, Shortage of contractors' materials on site, Poor site management and supervision by contractors, and Poor project manager abilities.

According to the study done by Sharma & Gupta (2021), the top five overrun factors identified in construction projects are delays in obtaining permission from authorities, poor supervision and site management, unrealistic time schedule, unforeseen ground conditions, and lack of skilled professionals (Sharma & Gupta, 2021). Based on the studies described above, the findings of this research agree with the results of the previous studies.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Time and cost overruns are the most common problems in construction projects, particularly school building projects, which face a variety of challenges that cause the project to be delayed and result in cost overruns. The objective of this research is to identify significant causes and effects of construction time and cost overruns for the case studied boarding school projects, to formulate a relationship between these overruns with their corresponding causes, and to offer resolution mechanisms of time and cost overruns to mitigate their effects by developing a conceptual framework. Consequently, this study addressed the essential aspects that determine project time and cost overrun during both the preconstruction and construction phases, focusing on the four major industry groups (consultant, client, and contractor and regulatory bodies).

Based on descriptive research, the relative importance index was used to score 140 selected attributes linked with project cost and time overruns as assessed by clients, consultants, contractors, and regulatory bodies in Ifa Boru school building projects.

From the Ifa Boru boarding school projects, time and cost overrun are mainly due to improper planning and scheduling resulting in poor judgment of time and resources, delays in mobilization, inappropriate construction methods, poor site management, and shortage of materials on site are the main factors contributing to time overruns from the contractor side. The degree of interference and additional work with changes in requirements of the client, contract modification and high-quality work requirements are major causes of time overruns identified from the client side. The absence of consultants on site, design mistakes and errors, and lack of technically skilled staff are the most significant causes of time overrun identified from the consultant side.

Moreover, the delay in obtaining permits and payment approvals from the construction authorities, delay in the approval of additional and supplementary works (design and BOQ), Lack of supervision by authorities regarding whether the project is run properly, Interference and improper comments by some authorities without conducting a technical investigation or supervision, are some of the main causes of time overruns.

To meet the second objective of the research, a regression analysis was performed to develop a relationship between overruns with their factors. The results of regression analysis indicated that causes related to the materials causes related to the nature of the project, and causes related to external factors significantly contribute to the occurrence of cost overruns on the school building projects.

Finally, a conceptual framework of resolution mechanisms was established to minimize the effects of time and cost overruns.

5.2 Recommendations

The author has some recommendations for the stakeholders involved in the boarding school projects to minimize the overruns.

Firstly, planning and developing a project master program and managing and completing the design stage before construction, establishing a procurement management system with a clear scope to manage and monitor the progress and deliverables on-site, which potentially reduces numerous mistakes and errors in the downstream construction phase should be practiced by each stakeholder.

Secondly, implementing clear and appropriate construction methods and effective reporting and monitoring procedures among the project parties, and setting a realistic project cost and time are the things to be exercised among the stakeholders to minimize overruns of construction projects.

Thirdly, If the design has errors or inconsistencies or it is not capable of being implemented or constructed, the contractor should notify the discovered design problems to the consultants as early as possible.

Furthermore, the increased price of raw materials or products due to inflation, fluctuations in exchange rates, changes in taxes, or duties should be managed by the contract. The emergence of unforeseen conditions, e.g., a significant difference in sub-surface ground conditions from what was expected should be approved by the consultant. The contract manager may approve the increase in cost/time extension in the following circumstances; necessary design modifications, unforeseen changes in conditions that materially affect costs,

additional/reduced scope of work, contract manager-directed acceleration or slowdown of contract progress, delayed, denied, or restricted access to the site.

In the case of a higher level of change orders/variations than expected (especially if they relate to high unit rates or prices). The contract manager needs to scrutinize all change order/variation requests and when granted, track and control cost increases. The contractor should provide proper contractual justification, analysis, method statements, evidence of the origin of additional costs, and the reasonableness of the cost increase.

Lastly, most of the critical design issues ranked are related to planning and scheduling, design and documentation, and construction. Therefore, it is recommended that there should be instituted clearly document specific guidelines for conducting detailed schedules and plans before construction and following the progress during construction.

5.2.1 Recommendation for Further Research

It has been recommended that further investigation in terms of developing predictive models should be undertaken to validate the similar shift in industry practices across varied sizes and types of projects at different locations. To this extent, non-linear regression analysis based on an independent collection of the factors should be performed to develop the prediction model and enhance the relevant body of knowledge further within the construction engineering and management domain.

REFERENCES

Abdalla, M. & Hussien, T., 2002. Causes of construction delay:Traditional Contracts. *International journal of project management,* Volume 20, pp. 67-73.

Abdel-Hafeez, M. M., El-Attair, S. S. & Abdel-Hafez, W. A., 2016. Factors Leading to Cost Overrun Occurrence in Construction Projects. *Port Side Engineering Research Journal,* 20(1), pp. 71-77.

Ahbab, C., 2012. *An Investigation on Time and Cost Overrun in Construction Projects.* Gazimağusa, North Cyprus: Eastern Mediterranean University.

Ahsan, K. & Gunawan, I., 2010. Analysis of cost and schedule performance of international development projects. *International Journal of Project Management 28 (2010) 68–78,* Volume 28, pp. 68-78.

Aibinu, A. &. J. G., 2002. *The effects of construction delays on project delivery in Nigerian construction industry:*. s.l.:International Journal of Project Management, 20 (2002): 593–599.
.

Akintoye, A., 2000. Analysis of factors influencing project cost estimating practice. *Construction Management and Economics,* 18(1), pp. 77-89.

Alaghbari, W., Kadir, M. R. A., Salim, A. & Ernawati, 2007. The significant factors causing delay of building construction projects in Malaysia. *Engineering, Construction and Architectural Management,* 14(2), pp. 192 - 206.

Al- Kharashi, A. & Skitmore, M., 2009. Causes of Delays in Saudi Arabian Public Sector Construction Projects. *Construction Management and Economics,* 27(1), pp. 3-23.

Arantes, A. & Ferreira, L. M. D., 2020. Underlying causes and mitigation measures of delays in construction projects. *Journal of Financial Management of Property and Construction,* 25(2), pp. 165-181.

Ashworth, A., 2004. *Cost Studies of Buildings.* 4th ed. England: Pearson Education Limited.

Assaf, S. A. & Al-Hejji, S., 2006. Causes of delay in large construction projects. *International Journal of Project Management,* Volume 24, p. 349–357.

Bank, W., 2018. *Contract Management Practice.* 1st ed. Washington DC: The world Bank.

Bhargava, A. et al., 2010. Three-Stage Least-Squares Analysis of Time and Cost Overrun in Construction Contracts. *Journal of Construction Engineering and Manangement,* 136(11), pp. 1207-1218.

Boermans, M. A. & Kattenberg, M. A., 2011. Estimating reliability coefficients with heterogeneous item weightings using Stata: A factor based approach. *Discussion Paper Series,* 1(1), pp. 11-19.

Bordat, C., McCullouch, B. G., Labi, S. & Sinha, K. C., 2004. *An Analysis of Cost Overruns and Time Delays of INDOT Projects,* Purdue University,West Lafayette, Indiana: INDOT Research.

Chekol, T. G. & Nuramo, D. A., 2020. *Key Factors Contributing to Time and Cost Overrun in Mega Sugar Construction Projects in Ethiopia:Public Administration in Ethiopia.* 1 ed. VLIRUOS, Belgium: Leuven University Press.

Dahlin, P. & Pesämaa, O., 2021. Drivers of cost and time overruns: A client and contractor perspective. *Organization, Technology and Management in Construction*, Volume 13, p. 2374–2382.

Daniel W M Chan and Kumaraswamy, M. M., 1997. A comparative study of causes of causes of time overruns in Hong kong construction projects. *InternationalJournalof ProjectManagement,* 15(1), pp. 55-63.

Doloi, H., 2013. Cost Overruns and Failure in Project Management Understanding the Roles of Key Stakeholders in Construction Projects. *Journal of Construction Engineering and Management*, 139(3), pp. 267-279.

El-Karim, M. S. B. A. A., Nawawy, O. A. M. E. & Abdel-Alim, A. M., 2017. Identification and assessment of risk factors affecting construction projects. *HBRC Journal,* 13(2), pp. 202-216.

Flyvbjerg, B., Holm, M. S. & Buhl, S., 2002. Underestimating Costs in Public Works Projects Error or Lie. *Journal of the American Planning Association,* 168(3), pp. 279-295.

Frimpong, Y., Oluwoye, J. & Crawford, L., 2003. Causes of delay and cost overruns in construction of groundwater projects in a developing countries Ghana as a case study. *International Journal of Project Management,* Volume 21, p. 321–326.

Gebre, F., 2021. *An Assessment of the Causes of Schedule Delay and Cost Overrun the Case of Bamacon Engineering Plc.* Addis Ababa: St. Mary's University.

Hinze, J., Selstead, G. & Mahoney, J. P., 1992. Cost Overruns on State of Washington Construction Contracts. *Transportation Research Record 1351,* Volume 1351, pp. 87-93.

Iyer, K. & Jha, K., 2005. Factors affecting cost performance: evidence from Indian construction projects. *International Journal of Project Management* , Volume 23, pp. 283-295.

Jahren, C. T. & Ashe, A. M., 1990. Predictors of Cost-Overrun Rates. *Journal of Construction Engineering and Management,* Volume 116, pp. 548-552.

Kaliba, C., Muya, M. & Mumba, K., 2009. Cost Escalation and Schedule delay in road Construction Projects in Zambia. *International Journal of project Management,* 27(5), pp. 522-531.

Kaming, P. F., Olomolaiye, P. O., Holt, G. D. & Harris, F. C., 1997. Factors influencing construction time and cost overruns on high-rise projects in Indonesia. *Construction Management and Economics,* 15(1), pp. 83-94.

Kangari, R., 1995. Risk Management Perceptions and Trends of U.S. Construction. *Journal of Construction Engineering and Management,* 121(4), pp. 422-429.

Kazaz, A., Ulubeyli, S. & Tuncbilekli, N. A., 2012. Causes of Delays in Construction Projects in Turkey. *Journal of Civil Engineering and Management,* 18(3), pp. 426-435.

Khayani, P. B., 2011. *A Bayesian Model for Controlling Cost Overrun in a Portfolio of Construction Projects: PhD Dissertation.* Boston, Massachusetts: Northeastern University.

Khoiry, M. A., Kalaisilven, S. & Abdullah, A., 2018. *A Review of Minimizing Delay in Construction Industries.* Universiti Kebangsaan Malaysia, EDP Sciences.

Koushki, P. A., Al- Rashid, K. & Kartam, N., 2005. Delays and cost increases in the construction of private residential projects in Kuwait. *Construction Management and Economics*, 23(3), pp. 285-294.

Larsen, J. K., Shen, G. Q., Lindhard, S. M. & Brunoe, T. D., 2015. Factors Affecting Schedule Delay, Cost Overrun, and Quality Level in Public Construction Projects. *Journal of Management in Engineering*, Volume 10, pp. 1-10.

Long, L.-H., Yong, L. J. & Young, D. L., 2008. Delay and Cost Overruns in Vietnam Large Construction Projects: A comparision with other selected countries. *KSCE Journal of Civil Engineering*, 12(6), pp. 367-377.

Love, P. E. D., Wang, X., Sing, C.-P. & Tiong, R. L. K., 2013. Determining the Probability of Project Cost Overruns. *Journal of Construction Engineering and Management,* 139(3), pp. 321-330.

Majid, M. Z. A. & McCaffer, R., 1998. Factors of Non-Excusable Delays That Influence Contractors' Performance. *Jurnal of Management in Engineering,* Volume 14, pp. 42-49.

Manavazhi, M. R. & Adhikari, D. K., 2002. Material and equipment procurement delays in highway projects in nepal. *International Journal of Project Management,* Volume 20, p. 627–632.

Melaku, S. et al., 2021. Analysis of Cost Overrun and Schedule Delays of Infrastructure Projects in Low Income Economies Case Studies in Ethiopia. *Advances in Civil Engineering,* Volume 2021, p. 15.

Motaleb, O. & Kishk, M., 2010. *An Investigation Into Causes and Effects of Construction Delays In UAE.* Leeds, UK, Egbu, C. (Ed) Procs 26th Annual ARCOM Conference, 6-8.

Mpofu, B., Ochieng, E. G., Moobela, C. & Pretorius, A., 2017. Profiling causative factors leading to construction project delays in the United Arab Emirates. *Engineering, Construction and Architectural Management,* 24(2), pp. 346-376.

Murali, S. & Kumar, S., 2019. Factors Affecting Overruns Construction Time and Cost: A Case Study. *International Journal of Recent Technology and Engineering (IJRTE),* 7(6C2), pp. 284-288.

Ndunguru, D. D., Niyonyungu, F. & Yang, X., 2020. Quantification of the Influence of Factors Causing Time and Cost Overruns in Tanzanian Construction Projects. *Open Journal of Business and Management, 2020, 8, 2133-2147,* Volume 8, pp. 2133-2137.

Nega, F., 2008. *Causes and effects of cost overrun on public building construction projects in Ethiopia, MSc Thesis.* Addis Ababa: Addis Ababa University.

Odeck, J., 2004. Cost overruns in road construction-what are their sizes and determinants. *Transport Policy* , 11(1), pp. 43-53.

Odeh, A. & Battaineh, H. T., 2002. Causes of Construction Delay Traditional Contracts. *International Journal of Project Management,* 20(1), pp. 67-73.

Ogunlana, S., Promkuntong, K. & Jearkjirm, V., 1996. Construction delays in a fast-growing economy: Comparing Thailand with other economies. *International Journalof Project Managementb,* 14(1), pp. 37-45.

Olawale, Y. A. & Sun, M., 2010. Cost and Time Control of Construction Projects Inhibiting Factors and Mitigating Measures in Practice. *Construction Management and Economics,* 28(5), pp. 509-526.

Peeters, W. & Madauss, B.-J., 2008. A proposed strategy against cost overruns in the space sector: The 5C Approach. *Space Policy* , Volume 24, pp. 80-89.

Pourrostam, T. & Ismail, A., 2011. Significant Factors Causing and Effects of Delay in Iranian Construction Projects. *Australian Journal of Basic and Applied Sciences,* 5(7), pp. 450-456.

Preuß, H., Andreff, W. & Weitzmann, M., 2019. *Cost and Revenue Overruns of the Olympic Games 2000–2018.* 1st ed. Springer Fachmedien Wiesbaden: Springer Gabler.

Rauzana, A. & Dharma, W., 2022. Causes of delays in construction projects in the Province of Aceh Indonesia. *PLOS ONE,* 17(1), p. 12.

Romero, S. M., Bohorquez, L. F. & Puentes, M. P. R., 2018. *Application of project management tools in engineering services companies Four case studies.* IOP Conf. Series: Journal of Physics: Conf. Series 1126 (2018) 012058, IOP Publishing Ltd.

Rowland, H., 1981. *The causes and effects of change orders on the construction process:Thesis and Dissertation.* Monterey,California: Dudlex Knox Library.

Sambasivan, T. M., Nasoor, D. A. & Ponniah, S. V., 2017. Analysis of delays in Tanzanian construction industry: transaction cost economics (TCE) and structural. *Engineering, Construction and Architectural Management,* 24(2), pp. 1-36.

Shane, J. S., Molenaar, K. R., Anderson, S. & Schexnayder, C., 2009. Construction Project Cost Escalation Factors. *Journal of Management in Engineering,* 25(4), pp. 221-229.

Sharma, S. & Gupta, A. K., 2020. Identification and Management of Risk in Building and Infrastructure Projects. *Journal of Construction Engineering, Technology & Management,* 10(2), pp. 1-9.

Sharma, S. & Gupta, A. K., 2021. Analysis of Factors Affecting Cost and Time Overruns in Construction Projects.

Simushi, S. J., 2017. *An Integrated Management Strategy to Reduce Time and Cost Overruns on Large Projects: PhD Desertation.* Stellenbosch,South Africa: Stellenbosch University.

Sunday J. Odediran, B. F. A. &. F. O., 2012. A Study of Factors Influencing Overruns of Construction Projects In Nigeria. *Journal of Architecture, Planning & Construction Management,* 2(2), pp. 20-36.

Toor, S. & Ogunlana, S. O., 2008. Problems causing delays in major construction projects in Thailand. *Construction Management and Economics,* 26(4), pp. 3395-408.

Williams, T. J., 2021. *Relationships Between Cost Estimates, Scheduling and Project Success in the Construction Sector.* Walden University: Walden University.

Yang, J.-B. & Wei, P.-R., 2010. Causes of Delay in the Planning and Design Phases for Construction Projects. *Journal of Architectural Engineering,* 16(2), pp. 80-83.

APPENDIX A QUESTIONNAIRE

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

SCHOOL OF CIVIL ENGINEERING AND ARCHITECTURE

DEPARTMENT OF CIVIL ENGINEERING

Questionnaire for MSc Degree in Construction Engineering and Management

Dear respondents,

I am a postgraduate student for a Master of Science in Construction Engineering and Management (COEM), from Adama Science and Technology University, and now undertaking my research entitled **"Assessment of Time and Cost Overrun on Building Projects: A Case Study on Ifa Boru Boarding School Projects"**. As part of completing my MSc study, I would like to conduct an interview with you and your participation in the study is voluntary.

The purpose of this survey is to evaluate the causes and effects of the time and cost overrun of Ifa Boru Boarding School Construction Projects implemented in different parts of the country.

In this context, it has been considered that the participation of different professionals involved in the construction projects would give valuable input to meet the objective of this research. The questionnaire consists of four major parts, namely (1) Background Information, (2) Causes of Time and Cost Overrun, (3) Effects of Time and Cost Overrun, and (4) Resolution Methods of Time and Cost Overrun.

Hence, you are kindly requested to provide your genuine opinions regarding the proposed research by filling out the questionnaire. Moreover, I would like to assure you that the information gathered will be kept strictly confidential and used for academic purposes only.

I thank you so much, in advance, for your genuine comments.

Researcher's address

Name: Ebse Sileshi

Phone: _____

E-mail: _____

Advisor's Address

Name: Bahiru Beweket (PhD)

E-mail: _____

Please Respond to the Following Questions by Ticking ☑ In the Box and Writing on the Provided Space.

Part 1: Background Information

1. Name of the company you are currently involved in: _____
2. Address of the company:
   Location: _____
3. Type of the organization: Governmental ☐ NGOs ☐
4. In which side of the parties are you employed: Contractor ☐ Client ☐ Consultant ☐ Regulatory bodies ☐ Others (Please specify): _____
5. Experience (in years) of the company: ☐ <1 ☐ 1-3 ☐ 3-5 ☐ >5
6. Are there subcontractors in the project: YES ☐ NO ☐
7. Position of the respondent in the company: _____
8. Gender: ☐ Male ☐ Female
9. Age: ☐ <25 ☐ 25-30 ☐ 30-35 ☐ 35-40 ☐ >40
10. Contact information of the respondent (optional):
    E-mail: _____ Tel. No.: _____
11. Current highest academic qualification:
    Certificate/Diploma ☐ BSc. ☐ MSc. ☐ PhD. ☐
12. Field of study/specialization:
    Certificate/Diploma.: _____ BSc.: _____
    MSc.: _____ PhD.: _____
13. Overall work experience in your area of study (in years): _____

Part 2: Causes of Time and Cost Overrun

1. Please rate the following causes of construction Time Overrun on your opinion of their level of importance.

   Note: (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree

Sl. No.	2.1 Causes for Time Overrun	Rating				
		1	2	3	4	5
	A Causes Related to Contractors					
1	Poor performance and inadequate experience of contractors					
2	Improper planning and scheduling result in a poor judgment of time and resources					
3	Delay in mobilization					
4	Inappropriate construction methods					
5	Poor site management					
6	Shortage of materials on the site					
7	Unethical behaviors used to achieve a high level of profit					
8	Wastage of materials on site					
9	Improper method of competition in procurement					
10	Inadequate tender pricing					
11	Frequent change of sub-contractors					
12	Depend on the site engineers to bear the whole responsibility on-site					
13	Poor project management skill					
14	Lack of contractor's experience					
15	Financial difficulties faced by contractors					
16	Bad relation between management and labor					
17	Errors during constructions					
18	Contractual claims such as an extension of time					
19	Incompetent subcontractors					
20	Unsuitable construction equipment					
21	Improper construction methods					
22	Inaccurate quantity take-off and quantity underestimation					
23	Poor financial control on site					
24	Unqualified work					
25	Shortage of site workers					
	B Causes Related to Clients					
1	Lack of experience of the client in the construction					
2	Contract modifications					
3	Degree of interference of the client					
4	Delayed disbursing of payments					
5	Additional works required by the client					
6	High quality of work required by the client					
7	Poor contract management					

Sl. No.	2.1 Causes for Time Overrun	Rating				
		1	2	3	4	5
8	Poor communication & coordination with contractors					
9	Lack of finance control and payment arrangement skills					
10	Owner has no priority/ urgency to complete the project					
11	Unrealistic contract duration imposed by the owner					
12	Delays caused by the owner and his/her agent					
13	Financial problems faced by clients					
14	The practice of assigning the contract to the lowest bidder					
15	Lack of communication with the consultant					
16	Changes in client requirements					
17	Re-measurement of provisional sum					
18	Improper and poor project feasibility study					
19	Poor procurement method for contractor selection					
20	Slow decision making					
	C Causes Related to Consultants					
1	Lack of consulting experience					
2	Dispute between contractor and consultant					
3	Lack of technical skill (staff)					
4	Delay in payment and material approval					
5	Delay in instructing labor					
6	Absence of consultant on site					
7	Delay in approval of tests and poor inspection					
8	Delay in instructing site engineers in case of lack of understanding in construction drawings					
9	Poor contract management					
10	Mistakes and errors in design					
11	Underestimate project duration					
12	Slowdown in design preparation					
13	Delay in approval of design changes					
14	Lack of cost plan monitoring and control					
15	Inadequate project preparations					
16	Incomplete design at tendering stage					
17	Poor design and delays in design					
18	Lack of coordination in the design phase					
19	Frequent design change					
20	Slow response (late instruction, inspection, delay in approval)					
	D Causes Related to Economic Condition					
1	Global financial crisis					
2	Design change due to market demand					
3	Material market rate (escalation, inflation, or fluctuation)					
	E Causes Related to Environmental Condition					
1	Unknown geological condition					
2	Bad weather condition					

Sl. No.	2.1 Causes for Time Overrun	Rating				
		1	2	3	4	5
3	Accidents during construction					
4	Changes in laws and regulations					
	F Causes Related to the Project					
1	Complexity of the project					
2	Change in the scope of the project					
3	Project location					
4	The original contract duration is too short					
5	Corruption					
6	Ineffective penalties for delay					
7	Unavailability of bonus for early completion					
8	Type of construction contract					
9	Type of project bidding and award					
10	Lack of experience in a similar project					
11	Lack of communication between project members					
12	Poor site safety					
	G Causes Related to Design and Documentation					
1	Mistakes, inconsistencies and ambiguities in specifications and drawings					
2	Inadequate design team experience					
3	Unclear specification					
4	Incomplete drawing and detailed design					
5	Project design complexities					
6	Inadequate investigations by the designer during the design phase					
7	Poor design and delay in the design					
8	Slow revision of drawing in case of change in design					
9	Poor documentation and no detailed written procedure					
	H Causes related to Government and Construction Authority					
1	Lack of supervision by authorities regarding whether the project is run properly.					
2	Interference and improper comments by some authorities without conducting a technical investigation or supervision.					
3	Bureaucracy in government agencies					
4	Delay in obtaining permits and payment approvals from the construction authorities					
5	Delay in Approval of Additional and Supplementary Works (Design and BOQ)					
	I Causes Related to Administrative & Management Condition					
1	Inaccurate construction planning					
2	Delays in decisions making					
3	Delay in resolving disputes					
4	Poor managerial skill					
5	Slow inspection and testing procedure used in a project					

Sl. No.	2.1 Causes for Time Overrun	Rating				
		1	2	3	4	5
6	Lack of high technology					
7	Lack of personnel training and management support					
8	Inadequate review					
9	Delay in payment					
	J Causes Related to Materials					
1	Poor procurement program of material					
2	Delay of material delivery and late ordering to site					
3	Improper handling of materials on site					
4	Inappropriate material quality					
5	Change in material prices					
6	Shortage of construction materials required					
7	Changes in specifications and material types during construction					
	K Causes Related to Labor and Equipment					
1	Shortage of manpower (skilled and unskilled labor)					
2	Poor productivity of labor					
3	Shortages of contactor’s administrative staff					
4	Low-level skill of manpower					
5	Lack of technical professionals in the contractor’s organization					
6	Lack of experience of staff on the contractor side					
7	Labor strikes by the contractor workforce					
8	Lack of maintenance for equipment					
9	Equipment availability and failure					
10	Low efficiency of the machinery					
11	Late delivery of equipment to sites					
	L Causes Related to External Factors					
1	High cost of machineries					
2	Fluctuation in the price of raw materials					
3	Unforeseen site condition					
4	Shortage of site workers					
5	Delay in material procurement					
6	Unpredictable weather condition					
7	Poor labor productivity					
8	Unskilled labor					
9	Equipment failure					
10	Labour absenteeism					
11	High cost of labour					
12	Fluctuation of prices of materials					
13	Acceleration					
14	Price escalation					
15	Slow information flow between parties					
	Additional Causes (If Any)					
1						

Sl. No.	2.1 Causes for Time Overrun	Rating				
		1	2	3	4	5
2						
3						
4						
5						

2. Please rate the following causes of construction **Cost Overrun** on your opinion of their level of importance.

Note: (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree

Sl. No.	2.1 Causes for Cost Overrun	Rating				
		1	2	3	4	5
	A Causes Related to Contractors					
1	Poor performance and inadequate experience of contractors					
2	Improper planning and scheduling result in a poor judgment of time and resources					
3	Delay in mobilization					
4	Inappropriate construction methods					
5	Poor site management					
6	Shortage of materials on the site					
7	Unethical behaviors used to achieve a high level of profit					
8	Wastage of materials on site					
9	Improper method of competition in procurement					
10	Inadequate tender pricing					
11	Frequent change of sub-contractors					
12	Depend on the site engineers to bear the whole responsibility on-site					
13	Poor project management skill					
14	Lack of contractor's experience					
15	Financial difficulties faced by contractors					
16	Bad relation between management and labor					
17	Errors during constructions					
18	Contractual claims such as an extension of time					
19	Incompetent subcontractors					
20	Unsuitable construction equipment					
21	Improper construction methods					
22	Inaccurate quantity take-off and quantity underestimation					
23	Poor financial control on site					
24	Unqualified work					
25	Shortage of site workers					
	B Causes Related to Clients					
1	Lack of experience of the client in the construction					
2	Contract modifications					

Sl. No.	2.1 Causes for Cost Overrun	Rating				
		1	2	3	4	5
3	Degree of interference of the client					
4	Delayed disbursing of payments					
5	Additional works required by the client					
6	High quality of work required by the client					
7	Poor contract management					
8	Poor communication & coordination with contractors					
9	Lack of finance control and payment arrangement skills					
10	Owner has no priority/ urgency to complete the project					
11	Unrealistic contract duration imposed by the owner					
12	Delays caused by the owner and his/her agent					
13	Financial problems faced by clients					
14	The practice of assigning the contract to the lowest bidder					
15	Lack of communication with the consultant					
16	Changes in client requirements					
17	Re-measurement of provisional sum					
18	Improper and poor project feasibility study					
19	Poor procurement method for contractor selection					
20	Slow decision making					
	C Causes Related to Consultants					
1	Lack of consulting experience					
2	Dispute between contractor and consultant					
3	Lack of technical skill (staff)					
4	Delay in payment and material approval					
5	Delay in instructing labor					
6	Absence of consultant on site					
7	Delay in approval of tests and poor inspection					
8	Delay in instructing site engineers in case of lack of understanding in construction drawings					
9	Poor contract management					
10	Mistakes and errors in design					
11	Underestimate project duration					
12	Slowdown in design preparation					
13	Delay in approval of design changes					
14	Lack of cost plan monitoring and control					
15	Inadequate project preparations					
16	Incomplete design at tendering stage					
17	Poor design and delays in design					
18	Lack of coordination in the design phase					
19	Frequent design change					
20	Slow response (late instruction, inspection, delay in approval)					
	D Causes Related to Economic Condition					
1	Global financial crisis					

Sl. No.	2.1 Causes for Cost Overrun	Rating				
		1	2	3	4	5
2	Design change due to market demand					
3	Material market rate (escalation, inflation, or fluctuation)					
	E Causes Related to Environmental Condition					
1	Unknown geological condition					
2	Bad weather condition					
3	Accidents during construction					
4	Changes in laws and regulations					
	F Causes Related to the Project					
1	Complexity of the project					
2	Change in the scope of the project					
3	Project location					
4	The original contract duration is too short					
5	Corruption					
6	Ineffective penalties for delay					
7	Unavailability of bonus for early completion					
8	Type of construction contract					
9	Type of project bidding and award					
10	Lack of experience in a similar project					
11	Lack of communication between project members					
12	Poor site safety					
	G Causes Related to Design and Documentation					
1	Mistakes, inconsistencies and ambiguities in specifications and drawings					
2	Inadequate design team experience					
3	Unclear specification					
4	Incomplete drawing and detailed design					
5	Project design complexities					
6	Inadequate investigations by the designer during the design phase					
7	Poor design and delay in the design					
8	Slow revision of drawing in case of change in design					
9	Poor documentation and no detailed written procedure					
	H Causes related to Government and Construction Authority					
1	Lack of supervision by authorities regarding whether the project is run properly.					
2	Interference and improper comments by some authorities without conducting a technical investigation or supervision.					
3	Bureaucracy in government agencies					
4	Delay in obtaining permits and payment approvals from the construction authorities					
5	Delay in Approval of Additional and Supplementary Works (Design and BOQ)					
	I Causes Related to Administrative & Management Condition					

Sl. No.	2.1 Causes for Cost Overrun	Rating				
		1	2	3	4	5
1	Inaccurate construction planning					
2	Delays in decisions making					
3	Delay in resolving disputes					
4	Poor managerial skill					
5	Slow inspection and testing procedure used in a project					
6	Lack of high technology					
7	Lack of personnel training and management support					
8	Inadequate review					
9	Delay in payment					
	J Causes Related to Materials					
1	Poor procurement program of material					
2	Delay of material delivery and late ordering to site					
3	Improper handling of materials on site					
4	Inappropriate material quality					
5	Change in material prices					
6	Shortage of construction materials required					
7	Changes in specifications and material types during construction					
	K Causes Related to Labor and Equipment					
1	Shortage of manpower (skilled and unskilled labor)					
2	Poor productivity of labor					
3	Shortages of contactor’s administrative staff					
4	Low-level skill of manpower					
5	Lack of technical professionals in the contractor’s organization					
6	Lack of experience of staff on the contractor side					
7	Labor strikes by the contractor workforce					
8	Lack of maintenance for equipment					
9	Equipment availability and failure					
10	Low efficiency of the machinery					
11	Late delivery of equipment to sites					
	L Causes Related to External Factors					
1	High cost of machineries					
2	Fluctuation in the price of raw materials					
3	Unforeseen site condition					
4	Shortage of site workers					
5	Delay in material procurement					
6	Unpredictable weather condition					
7	Poor labor productivity					
8	Unskilled labor					
9	Equipment failure					
10	Labour absenteeism					
11	High cost of labour					
12	Fluctuation of prices of materials					

Sl. No.	2.1 Causes for Cost Overrun	Rating				
		1	2	3	4	5
13	Acceleration					
14	Price escalation					
15	Slow information flow between parties					
	Additional Causes (If Any)					
1						
2						
3						
4						
5						

Part 3 Effects of Time and Cost Overrun

1. Please rank the impacts or effects of Time Overrun below in what you consider to be the most influential effect of time overrun.

Note: (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree

Sl. No.	3.1 Effects of Time Overrun	Rating				
		1	2	3	4	5
1	Disputes among the parties					
2	Arbitration					
3	Litigation					
4	Abandonment					
5	Increase in project costs					
6	Increases market risk					
7	Overall efficiency decreases					
8	Decreasing customer's faith and trust					
9	Increases stress on the overall team					
10	Negative social impact					
11	Poor quality of work					
13	Require Additional Agreement					
14	Dissatisfaction of the client and/or end-users					
15	Negative attitude toward the construction industry by the society					
17	Reduce the contribution of the construction industry to the national economic growth					
18	Prevent the planned property and service production growth rate					
19	Erode the mutual trust and respect among the stakeholders and weakens the construction industry					
20	Distorts fair and equitable resource distribution					
21	Discourages the investment in school projects					
22	Creates frustration for stakeholders					

Sl. No.	3.1 Effects of Time Overrun	Rating				
		1	2	3	4	5
23	Creates a skeptical outlook on an appraisal of other new construction projects					
24	Pours money unnecessarily into the project at hand at the expense of other new projects					
25	High cost of supervision and contract administration for consultants					
26	Delayed payments to contractors					
27	Additional cost/expense on the user rental/lease/costs					
28	Budget shortfall adversarial relationship between participants of the project					
29	Loss of profit for non-completion to the contractor					
30	The contractor will suffer from a budget shortfall of the client					
	Additional Effects of Time Overrun (If Any)					
1						
2						
3						
4						
5						

2. Please rank the impacts or effects of **Cost Overrun** below in what you consider to be the most influential effect of cost overrun

Note: (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree

Sl. No.	3.1 Effects of Cost Overrun	Rating				
		1	2	3	4	5
1	Disputes among the parties					
2	Arbitration					
3	Litigation					
4	Abandonment					
5	Increase in project costs					
6	Increases market risk					
7	Overall efficiency decreases					
8	Decreasing customer's faith and trust					
9	Increases stress on the overall team					
10	Negative social impact					
11	Poor quality of work					
13	Require Additional Agreement					
14	Dissatisfaction of the client and/or end-users					
15	Negative attitude toward the construction industry by the society					
17	Reduce the contribution of the construction industry to the national economic growth					

Sl. No.	3.1 Effects of Cost Overrun	Rating				
		1	2	3	4	5
18	Prevent the planned property and service production growth rate					
19	Erode the mutual trust and respect among the stakeholders and weakens the construction industry					
20	Distorts fair and equitable resource distribution					
21	Discourages the investment in school projects					
22	Creates frustration for stakeholders					
23	Creates a skeptical outlook on an appraisal of other new construction projects					
24	Pours money unnecessarily into the project at hand at the expense of other new projects					
25	High cost of supervision and contract administration for consultants					
26	Delayed payments to contractors					
27	Additional cost/expense on the user rental/lease/costs					
28	Budget shortfall adversarial relationship between participants of the project					
29	Loss of profit for non-completion to the contractor					
30	The contractor will suffer from a budget shortfall of the client					
	Additional Effects of Cost Overrun (If Any)					
1						
2						
3						
4						
5						

Part 4 Resolution Methods of Time and Cost Overrun

1. Please rank the resolution methods for time and cost overrun

Note: (1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree

Sl. No.	4.1 Resolution Methods of Time and Cost Overrun	Rating				
		1	2	3	4	5
1	Planning and developing a project master program					
2	Implementing clear project processes and procedures					
3	Managing and completing the design stage before construction					
4	Procurement management					
5	Using appropriate software					
6	Setting a realistic project cost and time					
7	Setting a clear scope					
8	Developing a risk management plan					
9	Briefing the project to the concerned body					

Sl. No.	4.1 Resolution Methods of Time and Cost Overrun	Rating				
		1	2	3	4	5
10	Making a construction plan and developing a methodology					
11	Value engineering and cost-cutting					
12	Up-scaling marketplace					
13	Allotting time for the tender stage					
14	Having a team responsibility matrix					
15	Train clients, consultants, and contractors					
16	Monitoring the progress and deliverables					
	Additional Resolution Mechanisms (If Any)					
1						
2						
3						
4						
5						

3. Please provide if you have any additional comments/suggestions about the **causes** of **time and cost overrun** in construction projects.

_____

_____

_____

_____

_____

4. Please put your **resolution method** to minimize /control mechanism for a time and cost overrun that have been faced on Ifa Boru boarding school projects.

_____

_____

_____

_____

_____

*****I am Grateful for Your Kind Cooperation. *****

APPENDIX 5B RESPONSE TO QUESTIONNAIRES

Background of the Respondents

The respondents were having different roles like a project manager, site engineer, contractor consultant, regulatory body, and others. These survey forms were filled by respondents having experience working in different parts of Ethiopia. The number of respondents along with their roles and years of experience are shown in Table 5-1.

Table 5-1B Background Information of the Respondents

Category	Range	Number of Participants	Percentage
Type of the Organization	Governmental	110	78.57
	Nongovernmental	30	21.43
	Total	140	100
Role of Participants	Contractor	70	50.00
	Consultant	40	28.57
	Client	20	14.29
	Regulatory bodies	10	7.14
	Total	140	100
Years of Experience of the company	<1	-	-
	1-3	25	17.86
	3-5	40	28.57
	>5	75	53.57
	Total	140	100
Subcontractors	YES	95	67.86
	NO	45	32.14
	Total	140	100
Position of the respondents	Project Manager	7	5.00
	Site Engineer	27	19.29
	Resident Engineer	14	10.00
	Office Engineer	28	20.00
	Foreman	33	23.57
	Others	31	22.14
	Total	140	100
Years of Experience of the respondents	<1	-	-
	1-3	25	17.86
	3-5	48	34.29
	>5	67	47.86

	Total	140	100
Academic Qualification of the respondents	Certificate/Diploma	15	10.71
	BSc	78	55.71
	MSc	44	31.43
	PhD	3	2.14
	Total	140	100

Table 5-2B Statistical Summary of Background of the Respondents

		Type of the organization	Role of Participants	Years of Experience of the company	Are there Subcontractors	Position of the respondent	Age of the respondent	Gender of the respondent	Years of Experience of the Respondent	Academic Qualification
N	Valid	140	140	140	140	140	140	140	140	140
	Missing	0	0	0	0	0	0	0	0	0
Mean		1.21	1.79	3.36	1.32	4.04	3.24	1.37	3.30	2.14
Median		1.00	1.50	4.00	1.00	4.00	3.00	1.00	3.00	2.00
Mode		1	1	4	1	5	3	1	4	2
Std. Deviation		0.412	0.943	0.769	0.469	1.568	1.162	0.485	0.756	0.618
Variance		0.170	0.889	0.591	0.220	2.459	1.351	.235	0.571	0.382

Table 5-3B Type of the organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Governmental	110	78.6	78.6	78.6
	Nongovernmental	30	21.4	21.4	100.0
	Total	140	100.0	100.0	

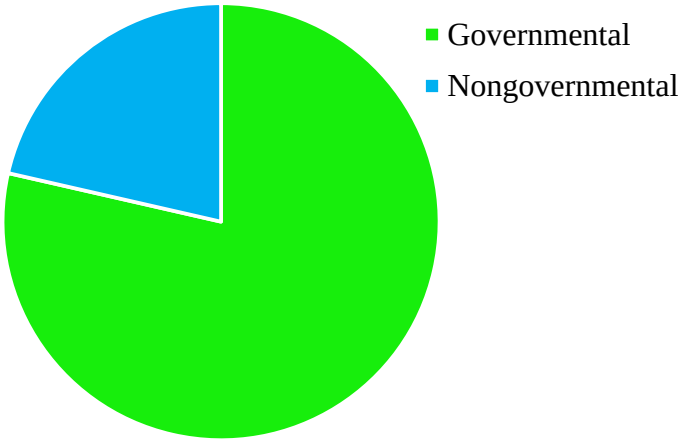


Figure 5-1 Type of the organization

Table 5-3 and Figure 5-1 present the type of organization in which the participants are currently involved. According to the survey, 78.6% of the respondents are involved in governmental organizations and the remaining 21.4% of the respondents are in the nongovernmental organizations.

Table 5-4B Role of the Respondents

Category		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Contractor	70	50.0	50.0	50.0
	Consultant	40	28.6	28.6	78.6
	Client	20	14.3	14.3	92.9
	Regulatory bodies	10	7.1	7.1	100
	Total	140	100	100	

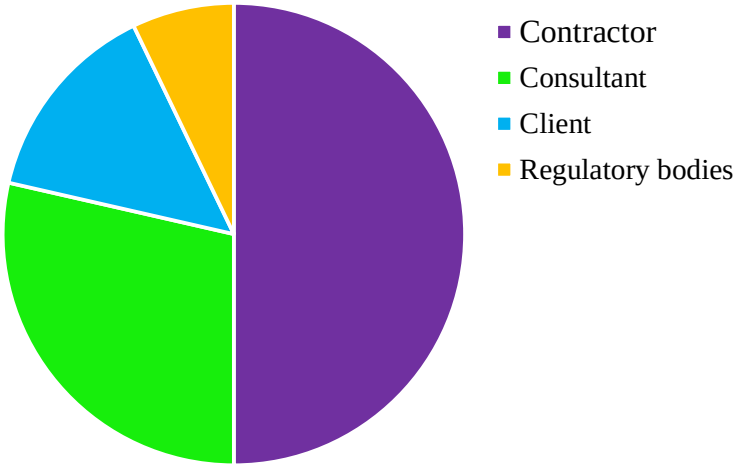


Figure 5-2 Role of the Respondents

As can be shown in Figure 5-2 and Table 5-4, 50% of the participants have reported that they are working on the contractor side, 28.6% on the consultant side,14.3% on the client side, and 7.1% on the regulatory bodies.

Table 5-5B Position of the Respondent

Category		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Project Manager	7	5.0	5.0	5.0
	Site Engineer	27	19.3	19.3	24.3
	Resident Engineer	14	10.0	10.0	34.3
	Office Engineer	28	20.0	20.0	54.3
	Foreman	33	23.6	23.6	77.9
	Others	31	22.1	22.1	100.0
	Total	140	100.0	100.0	

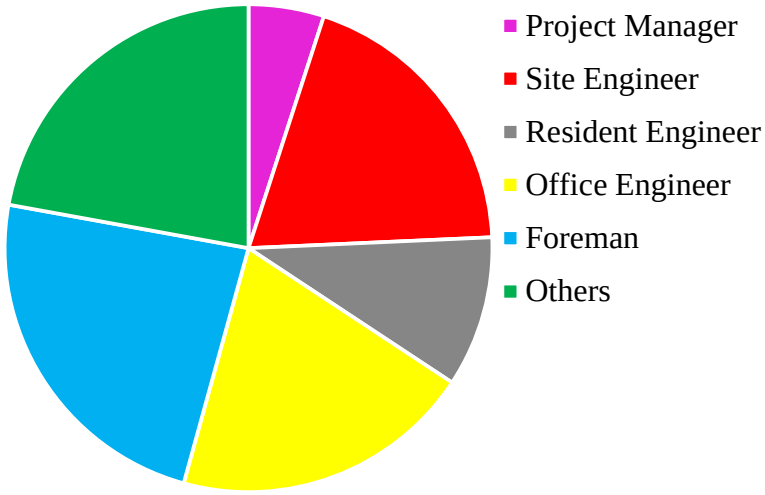


Figure 5-3 Position of the Respondents

According to the survey, 5% of the respondents are project managers,19.3% are site engineers,10% are resident engineers,20% are office engineers, and 23.6% are foremen that work in different sections of the company in the seven projects (Figure 5-3 and Table 5-5).

Table 5-6B Academic Qualification of the Respondents

Category		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Certificate/Diploma	15	10.7	10.7	10.7
	BSc	93	66.4	66.4	77.1
	MSc	29	20.7	20.7	97.9
	PhD	3	2.1	2.1	100.0
	Total	140	100.0	100.0	

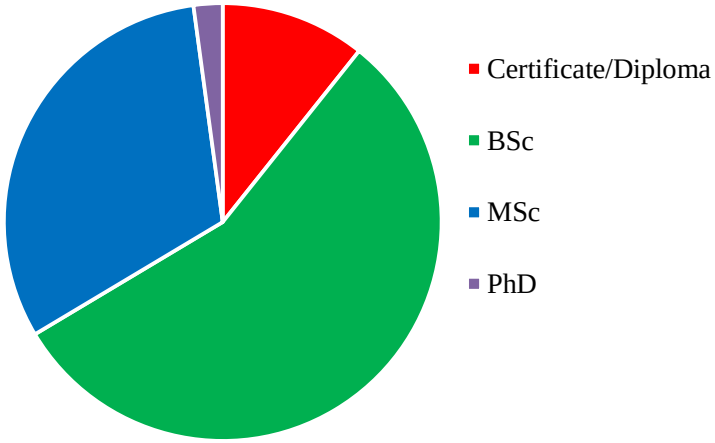


Figure 5-4 Academic Qualification of the Respondents

According to the survey conducted from the seven projects, 10.7% of the respondents reported that they are certificate/diploma, 66.4% are BSc holders, 20.7% are MSc holders and only 2.1% are PhD holders.,23.6% are foremen that work in different sections of the company in (Figure 5-4 and Table 5-6).

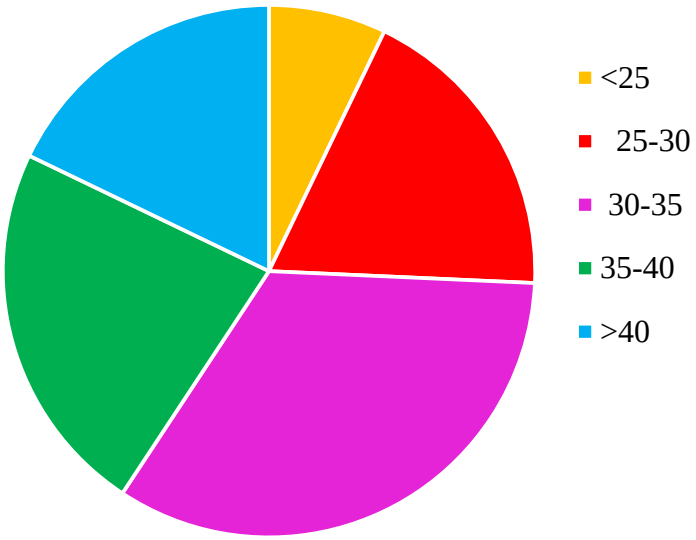


Figure 5-5 Age of the Respondents

Table 5-7B Age of the Respondents

Category		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<25	10	7.1	7.1	7.1
	25-30	26	18.6	18.6	25.7
	30-35	49	35.0	35.0	60.7
	35-40	30	21.4	21.4	82.1
	>40	25	17.9	17.9	100.0
	Total	140	100.0	100.0	-

As can be shown in Figure 5-5 and Table 5-7, 7.1% of the participants have reported that they are under the age of 25, 18.6% are between the age of 25-30,35% are between the age of 30-35, 21.4% are between the age of 35-40 and 17.9% are above the age of 40.

Table 5-8B Response of the Respondents to Causes of Time Overrun

ID	Causes of Time Overrun	Frequency of Occurrence				
		Rating				
		SDA	DA	N	A	SA
		1	2	3	4	5
	A Causes Related to Contractors					
A1	Poor performance and inadequate experience of contractors	35	43	36	19	7
A2	Improper planning and scheduling result in a poor judgment of time and resources	9	13	17	24	77
A3	Delay in mobilization	12	16	15	23	74
A4	Inappropriate construction methods	13	20	10	25	72
A5	Poor site management	16	14	13	29	68
A6	Shortage of materials on the site	12	16	20	26	66
A7	Unethical behaviors used to achieve a high level of profit	38	29	27	25	21
A8	Wastage of materials on site	23	37	30	16	34
A9	Improper method of competition in procurement	37	28	28	27	20
A10	Inadequate tender pricing	41	32	36	18	13
A11	Frequent change of sub-contractors	20	22	34	39	25
A12	Depend on the site engineers to bear the whole responsibility on-site	10	23	27	48	32
A13	Poor project management skill	18	17	20	32	53
A14	Lack of contractor's experience	23	32	20	33	32
A15	Financial difficulties faced by	12	36	28	26	38

	contractors					
A16	Bad relation between management and labor	40	54	18	25	3
A17	Errors during constructions	24	24	30	39	23
A18	Contractual claims such as an extension of time	12	37	26	28	37
A19	Incompetent subcontractors	43	49	22	21	5
A20	Unsuitable construction equipment	52	50	17	19	2
A21	Improper construction methods	57	48	24	8	3
A22	Inaccurate quantity take-off and quantity underestimation	60	32	24	9	15
A23	Poor financial control on site	25	32	27	34	22
A24	Unqualified work	42	32	27	23	16
A25	Shortage of site workers	44	36	12	22	26
	B Causes Related to Clients					
B1	Lack of experience of the client in the construction	15	27	32	34	32
B2	Contract modifications	14	15	21	42	48
B3	Degree of interference of the client	9	12	11	30	78
B4	Delayed disbursing of payments	18	34	8	38	42
B5	Additional works required by the client	10	11	13	31	75
B6	High quality of work required by the client	14	13	21	59	33
B7	Poor contract management	42	46	20	15	17
B8	Poor communication & coordination with contractors	32	43	10	35	20
B9	Lack of finance control and payment arrangement skills	22	31	18	52	17
B10	Owner has no priority/ urgency to complete the project	45	56	16	15	8
B11	Unrealistic contract duration imposed by the owner	35	39	19	23	24
B12	Delays caused by the owner and his/her agent	18	23	21	48	30
B13	Financial problems faced by clients	21	32	10	42	35
B14	The practice of assigning the contract to the lowest bidder	35	44	11	36	14
B15	Lack of communication with the consultant	43	47	17	18	15
B16	Changes in client requirements	10	15	14	29	72
B17	Re-measurement of provisional sum	10	43	67	13	7

B18	Improper and poor project feasibility study	20	23	14	38	45
B19	Poor procurement method for contractor selection	18	29	12	38	43
B20	Slow decision making	23	14	11	45	47
	C Causes Related to Consultants					
C1	Lack of consulting experience	41	37	49	7	6
C2	Dispute between contractor and consultant	22	32	23	31	32
C3	Lack of technical skill (staff)	10	20	22	24	64
C4	Delay in payment and material approval	24	29	7	37	43
C5	Delay in instructing labor	38	49	10	29	14
C6	Absence of consultant on site	8	9	10	37	76
C7	Delay in approval of tests and poor inspection	12	15	28	45	40
C8	Delay in instructing site engineers in case of lack of understanding in construction drawings	15	18	16	43	48
C9	Poor contract management	51	43	11	19	16
C10	Mistakes and errors in design	9	10	17	32	72
C11	Underestimate project duration	21	22	19	45	33
C12	Slowdown in design preparation	30	19	17	39	35
C13	Delay in approval of design changes	22	32	16	38	32
C14	Lack of cost plan monitoring and control	25	24	23	37	31
C15	Inadequate project preparations	53	49	12	19	7
C16	Incomplete design at tendering stage	36	38	30	22	14
C17	Poor design and delays in design	58	22	21	24	15
C18	Lack of coordination in the design phase	24	27	11	43	35
C19	Frequent design change	18	13	9	48	52
C20	Slow response (late instruction, inspection, delay in approval)	18	11	16	43	52
	D Causes Related to Economic Condition					
D1	Global financial crisis	19	22	21	30	48
D2	Design change due to market demand	42	44	20	22	12
D3	Material market rate (escalation, inflation, or fluctuation)	23	24	17	34	42
	E Causes Related to Environmental Condition					
E1	Unknown geological condition	11	18	10	35	66

E2	Bad weather condition	48	40	12	13	27
E3	Accidents during construction	65	34	10	12	19
E4	Changes in laws and regulations	43	47	35	10	5
	F Causes Related to the Project					
F1	Complexity of the project	54	51	8	21	6
F2	Change in the scope of the project	9	11	18	27	75
F3	Project location	11	13	15	29	72
F4	The original contract duration is too short	12	10	31	18	69
F5	Corruption	43	47	30	12	8
F6	Ineffective penalties for delay	8	16	40	40	36
F7	Unavailability of bonus for early completion	14	12	15	54	45
F8	Type of construction contract	35	46	23	25	11
F9	Type of project bidding and award	35	34	14	25	32
F10	Lack of experience in a similar project	21	23	20	52	34
F11	Lack of communication between project members	25	27	30	32	26
F12	Poor site safety	25	39	35	23	18
G1	Mistakes, inconsistencies and ambiguities in specifications and drawings	10	14	19	40	57
G2	Inadequate design team experience	35	25	28	33	19
G3	Unclear specification	11	13	20	41	55
G4	Incomplete drawing and detailed design	52	45	20	12	11
G5	Project design complexities	59	48	19	10	4
G6	Inadequate investigations by the designer during the design phase	10	12	24	41	53
G7	Poor design and delay in the design	63	42	22	9	4
G8	Slow revision of drawing in case of change in design	14	16	24	56	30
G9	Poor documentation and no detailed written procedure	63	52	18	4	3
H1	Lack of supervision by authorities regarding whether the project is run properly.	17	26	8	54	35

H2	Interference and improper comments by some authorities without conducting a technical investigation or supervision.	21	11	30	49	29
H3	Bureaucracy in government agencies	22	24	20	64	10
H4	Delay in obtaining permits and payment approvals from the construction authorities	13	14	20	33	60
H5	Delay in Approval of Additional and Supplementary Works (Design and BOQ)	13	18	17	34	58
	I Causes Related to Administrative & Management Condition					
I1	Inaccurate construction planning	32	58	22	18	10
I2	Delays in decisions making	17	23	12	45	43
I3	Delay in resolving disputes	13	26	38	34	29
I4	Poor managerial skill	45	50	17	18	10
I5	Slow inspection and testing procedure used in a project	10	14	25	53	38
I6	Lack of high technology	23	28	20	53	16
I7	Lack of personnel training and management support	59	41	10	18	12
I8	Inadequate review	57	53	12	13	5
I9	Delay in payment	15	16	22	54	33
	J Causes Related to Materials					
J1	Poor procurement program of material	9	12	18	46	55
J2	Delay of material delivery and late ordering to site	11	10	21	41	57
J3	Improper handling of materials on site	9	11	16	58	46
J4	Inappropriate material quality	10	9	16	65	40
J5	Change in material prices	10	18	17	47	48
J6	Shortage of construction materials required	11	17	16	52	44
J7	Changes in specifications and material types during construction	32	25	19	42	22
	K Causes Related to Labor and Equipment					
K1	Shortage of manpower (skilled and unskilled labor)	17	18	20	50	35
K2	Poor productivity of labor	16	21	23	55	25
K3	Shortages of contactor's administrative staff	18	20	32	47	23

K4	Low-level skill of manpower	12	21	20	55	32
K5	Lack of technical professionals in the contractor's organization	16	23	18	50	33
K6	Lack of experience of staff on the contractor side	19	22	32	43	24
K7	Labor strikes by the contractor workforce	45	35	14	22	24
K8	Lack of maintenance for equipment	26	42	10	54	8
K9	Equipment availability and failure	21	16	20	43	40
K10	Low efficiency of the machinery	53	23	35	18	11
K11	Late delivery of equipment to sites	14	18	20	53	35
	L Causes Related to External Factors					
L1	High cost of machineries	8	7	36	57	32
L2	Fluctuation in the price of raw materials	13	10	20	57	40
L3	Unforeseen site condition	21	14	20	56	29
L4	Shortage of site workers	35	37	19	24	25
L5	Delay in material procurement	26	30	24	30	30
L6	Unpredictable weather condition	12	18	20	52	38
L7	Poor labor productivity	43	47	24	16	10
L8	Unskilled labor	33	58	10	25	14
L9	Equipment failure	31	42	23	26	18
L10	Labour absenteeism	36	39	16	24	25
L11	High cost of labour	26	30	24	40	20
L12	Fluctuation of prices of materials	12	24	14	52	38
L13	Acceleration	17	10	40	50	23
L14	Price escalation	5	10	37	54	34
L15	Slow information flow between parties	21	14	30	56	19

Table 5-9B Response Rate of Respondents for Cost Overruns

ID	2.1 Causes for Cost Overrun	Frequency of Occurrence				
		Rating				
		SDA	DA	N	A	SA
		1	2	3	4	5
	A Causes Related to Contractors					
A1	Poor performance and inadequate experience of contractors	35	43	36	19	7
A2	Improper planning and scheduling result in a poor judgment of time and resources	11	13	14	24	78
A3	Delay in mobilization	19	26	24	29	42

A4	Inappropriate construction methods	24	14	22	19	61
A5	Poor site management	10	15	13	26	76
A6	Shortage of materials on the site	12	14	20	20	74
A7	Unethical behaviors used to achieve a high level of profit	38	29	27	25	21
A8	Wastage of materials on site	23	37	30	16	34
A9	Improper method of competition in procurement	37	28	28	27	20
A10	Inadequate tender pricing	41	32	36	18	13
A11	Frequent change of sub-contractors	20	22	34	39	25
A12	Depend on the site engineers to bear the whole responsibility on-site	13	11	24	20	72
A13	Poor project management skill	13	20	10	25	72
A14	Lack of contractor's experience	23	32	20	33	32
A15	Financial difficulties faced by contractors	12	36	28	26	38
A16	Bad relation between management and labor	40	54	18	25	3
A17	Errors during constructions	24	24	30	39	23
A18	Contractual claims such as an extension of time	16	14	22	18	70
A19	Incompetent subcontractors	43	49	22	21	5
A20	Unsuitable construction equipment	52	50	17	19	2
A21	Improper construction methods	57	48	24	8	3
A22	Inaccurate quantity take-off and quantity underestimation	16	17	20	18	69
A23	Poor financial control on site	25	32	27	34	22
A24	Unqualified work	42	32	27	23	16
A25	Shortage of site workers	44	36	12	22	26
	B Causes Related to Clients					
B1	Lack of experience of the client in the construction	12	13	16	28	71
B2	Contract modifications	9	12	11	30	78
B3	Degree of interference of the client	10	13	12	27	78
B4	Delayed disbursing of payments	18	34	8	38	42
B5	Additional works required by the client	11	11	13	30	75
B6	High quality of work required by the client	14	13	21	59	33
B7	Poor contract management	42	46	20	15	17
B8	Poor communication & coordination with contractors	32	43	10	35	20
B9	Lack of finance control and payment arrangement skills	22	31	18	52	17
B10	Owner has no priority/ urgency to complete the project	45	56	16	15	8
B11	Unrealistic contract duration imposed	35	39	19	23	24

	by the owner					
B12	Delays caused by the owner and his/her agent	18	23	21	48	30
B13	Financial problems faced by clients	21	32	10	42	35
B14	The practice of assigning the contract to the lowest bidder	35	44	11	36	14
B15	Lack of communication with the consultant	43	47	17	18	15
B16	Changes in client requirements	10	15	14	29	72
B17	Re-measurement of provisional sum	23	14	11	45	47
B18	Improper and poor project feasibility study	20	23	14	38	45
B19	Poor procurement method for contractor selection	18	29	12	38	43
B20	Slow decision making	10	43	51	21	15
	C Causes Related to Consultants					
C1	Lack of consulting experience	41	37	49	7	6
C2	Dispute between contractor and consultant	22	32	23	31	32
C3	Lack of technical skill (staff)	10	14	21	23	72
C4	Delay in payment and material approval	24	29	7	37	43
C5	Delay in instructing labor	38	49	10	29	14
C6	Absence of consultant on site	16	10	24	37	53
C7	Delay in approval of tests and poor inspection	12	15	28	45	40
C8	Delay in instructing site engineers in case of lack of understanding in construction drawings	15	18	16	43	48
C9	Poor contract management	51	43	11	19	16
C10	Mistakes and errors in design	14	13	25	41	47
C11	Underestimate project duration	21	22	19	45	33
C12	Slowdown in design preparation	30	19	17	39	35
C13	Delay in approval of design changes	22	32	16	38	32
C14	Lack of cost plan monitoring and control	12	14	18	25	71
C15	Inadequate project preparations	53	49	12	19	7
C16	Incomplete design at tendering stage	36	38	30	22	14
C17	Poor design and delays in design	16	13	21	24	66
C18	Lack of coordination in the design phase	24	27	11	43	35
C19	Frequent design change	18	13	9	48	52
C20	Slow response (late instruction, inspection, delay in approval)	18	11	16	43	52
	D Causes Related to Economic Condition					
D1	Global financial crisis	19	22	21	30	48

D2	Design change due to market demand	42	44	20	22	12
D3	Material market rate (escalation, inflation, or fluctuation)	23	24	17	34	42
	E Causes Related to Environmental Condition					
E1	Unknown geological condition	11	18	10	35	66
E2	Bad weather condition	48	40	12	13	27
E3	Accidents during construction	65	34	10	12	19
E4	Changes in laws and regulations	43	47	35	10	5
	F Causes Related to the Project					
F1	Complexity of the project	54	51	8	21	6
F2	Change in the scope of the project	9	11	18	27	75
F3	Project location	18	13	15	29	65
F4	The original contract duration is too short	45	32	31	21	11
F5	Corruption	43	47	30	12	8
F6	Ineffective penalties for delay	11	14	15	28	72
F7	Unavailability of bonus for early completion	13	11	16	32	68
F8	Type of construction contract	21	23	20	27	49
F9	Type of project bidding and award	25	22	19	25	49
F10	Lack of experience in a similar project	25	23	20	42	30
F11	Lack of communication between project members	25	27	30	32	26
F12	Poor site safety	11	10	31	21	67
	G Causes Related to Design and Documentation					
G1	Mistakes, inconsistencies and ambiguities in specifications and drawings	10	14	19	40	57
G2	Inadequate design team experience	11	13	20	41	55
G3	Unclear specification	10	12	24	41	53
G4	Incomplete drawing and detailed design	14	16	24	56	30
G5	Project design complexities	59	48	19	10	4
G6	Inadequate investigations by the designer during the design phase	23	12	24	41	43
G7	Poor design and delay in the design	63	42	22	9	4
G8	Slow revision of drawing in case of change in design	43	16	24	27	30
G9	Poor documentation and no detailed written procedure	63	52	18	4	3
	H Causes related to Government and Construction Authority					

H1	Lack of supervision by authorities regarding whether the project is run properly.	21	11	30	49	29
H2	Interference and improper comments by some authorities without conducting a technical investigation or supervision.	17	26	8	54	35
H3	Bureaucracy in government agencies	22	24	20	64	10
H4	Delay in obtaining permits and payment approvals from the construction authorities	13	14	20	33	60
H5	Delay in Approval of Additional and Supplementary Works (Design and BOQ)	13	18	17	34	58
	I Causes Related to Administrative & Management Condition					
I1	Inaccurate construction planning	32	58	22	18	10
I2	Delays in decisions making	17	23	12	45	43
I3	Delay in resolving disputes	13	26	38	34	29
I4	Poor managerial skill	45	50	17	18	10
I5	Slow inspection and testing procedure used in a project	10	14	25	53	38
I6	Lack of high technology	23	28	20	53	16
I7	Lack of personnel training and management support	59	41	10	18	12
I8	Inadequate review	57	53	12	13	5
I9	Delay in payment	15	16	22	54	33
	J Causes Related to Materials					
J1	Poor procurement program of material	9	12	16	28	75
J2	Delay of material delivery and late ordering to site	11	10	21	41	57
J3	Improper handling of materials on site	9	11	16	58	46
J4	Inappropriate material quality	46	31	16	32	15
J5	Change in material prices	10	18	15	25	72
J6	Shortage of construction materials required	11	17	16	52	44
J7	Changes in specifications and material types during construction	32	25	19	42	22
	K Causes Related to Labor and Equipment					
K1	Shortage of manpower (skilled and unskilled labor)	17	18	20	50	35
K2	Poor productivity of labor	16	21	23	55	25
K3	Shortages of contactor's administrative staff	18	20	32	47	23
K4	Low-level skill of manpower	12	21	20	55	32

K5	Lack of technical professionals in the contractor's organization	16	23	18	50	33
K6	Lack of experience of staff on the contractor side	19	22	32	43	24
K7	Labor strikes by the contractor workforce	45	35	14	22	24
K8	Lack of maintenance for equipment	26	42	10	54	8
K9	Equipment availability and failure	21	16	20	43	40
K10	Low efficiency of the machinery	53	23	35	18	11
K11	Late delivery of equipment to sites	14	18	15	21	72
	L Causes Related to External Factors					
L1	High cost of machineries	8	12	17	35	68
L2	Fluctuation in the price of raw materials	13	10	20	57	40
L3	Unforeseen site condition	35	14	20	34	37
L4	Shortage of site workers	24	13	20	51	32
L5	Delay in material procurement	17	10	40	50	23
L6	Unpredictable weather condition	43	18	17	40	22
L7	Poor labor productivity	24	18	20	40	38
L8	Unskilled labor	21	14	30	56	19
L9	Equipment failure	31	42	23	26	18
L10	Labour absenteeism	36	39	16	24	25
L11	High cost of labour	26	30	24	40	20
L12	Fluctuation of prices of materials	12	24	14	52	38
L13	Acceleration	45	12	40	30	13
L14	Price escalation	21	14	20	56	29
L15	Slow information flow between parties	34	14	27	46	19

Table 5-10B Response of respondents on the Effects of Time and Cost Overrun

Effects of Overruns		Frequency of Occurrence				
		Rating				
		SDA	DA	N	A	SA
ID	Name of Effects	1	2	3	4	5
EF1	Disputes among the parties	9	12	16	29	74
EF2	Arbitration	23	23	35	37	22
EF3	Litigation	39	35	34	14	18
EF4	Abandonment	34	47	30	17	12
EF5	Increase in project costs	24	25	21	33	37
EF6	Increases market risk	11	13	14	28	74
EF7	Overall efficiency decreases	21	15	20	31	53
EF8	Decreasing customer's faith and trust	12	14	12	32	70
EF9	Increases stress on the overall team	11	15	13	33	68
EF10	Negative social impact	12	13	20	28	67
EF11	Poor quality of work	20	26	42	34	18
EF12	Require Additional Agreement	23	13	26	38	40

EF13	Dissatisfaction of the client and/or end-users	13	11	17	38	61
EF14	Negative attitude toward the construction industry by the society	14	11	18	38	59
EF15	Reduce the contribution of the construction industry to the national economic growth	12	15	19	39	55
EF16	Prevent the planned property and service production growth rate	12	13	20	44	51
EF17	Erode the mutual trust and respect among the stakeholders and weakens the construction industry	12	14	22	39	53
EF18	Distorts fair and equitable resource distribution	13	15	24	56	32
EF19	Discourages the investment in school projects	17	12	13	44	54
EF20	Creates frustration for stakeholders	14	15	16	42	53
EF21	Creates a skeptical outlook on an appraisal of other new construction projects	24	12	21	36	47
EF22	Pours money unnecessarily into the project at hand at the expense of other new projects	17	15	22	54	32
EF23	High cost of supervision and contract administration for consultants	18	12	12	44	54
EF24	Delayed payments to contractors	24	15	24	45	32
EF25	Additional cost/expense on the user rental/lease/costs	28	26	30	23	33
EF26	Budget shortfall adversarial relationship between participants of the project	21	15	20	43	41
EF27	Loss of profit for non-completion to the contractor	13	15	20	40	52
EF28	The contractor will suffer from a budget shortfall of the client	21	14	22	29	54

Table 5-11B Response of Respondents on Resolution Methods of Time and Cost Overrun

Name of Resolution Method		Frequency of Occurrence				
		Rating				
		SDA	DA	N	A	SA
		1	2	3	4	5
RE1	Planning and developing a project master program	11	13	10	46	60
RE3	Managing and completing the design stage before construction	11	14	10	45	60
RE4	Procurement management	12	18	17	24	69
RE7	Setting a clear scope	13	10	16	49	52
RE8	Developing a risk management plan	15	17	11	34	63

RE16	Monitoring the progress and deliverables	14	14	17	43	52
RE2	Implementing clear project processes and procedures	9	18	20	54	39
RE5	Using appropriate software	14	10	25	49	42
RE6	Setting a realistic project cost and time	23	15	13	24	65
RE9	Briefing the project to the concerned body	15	10	20	59	36
RE10	Making a construction plan and developing a methodology	22	12	17	45	44
RE11	Value engineering and cost-cutting	16	23	44	29	28
RE12	Up-scaling marketplace	43	25	15	24	33
RE13	Allotting time for the tender stage	34	39	26	23	18
RE14	Having a team responsibility matrix	28	48	26	24	14
RE15	Train clients, consultants, and contractors	32	47	28	20	13

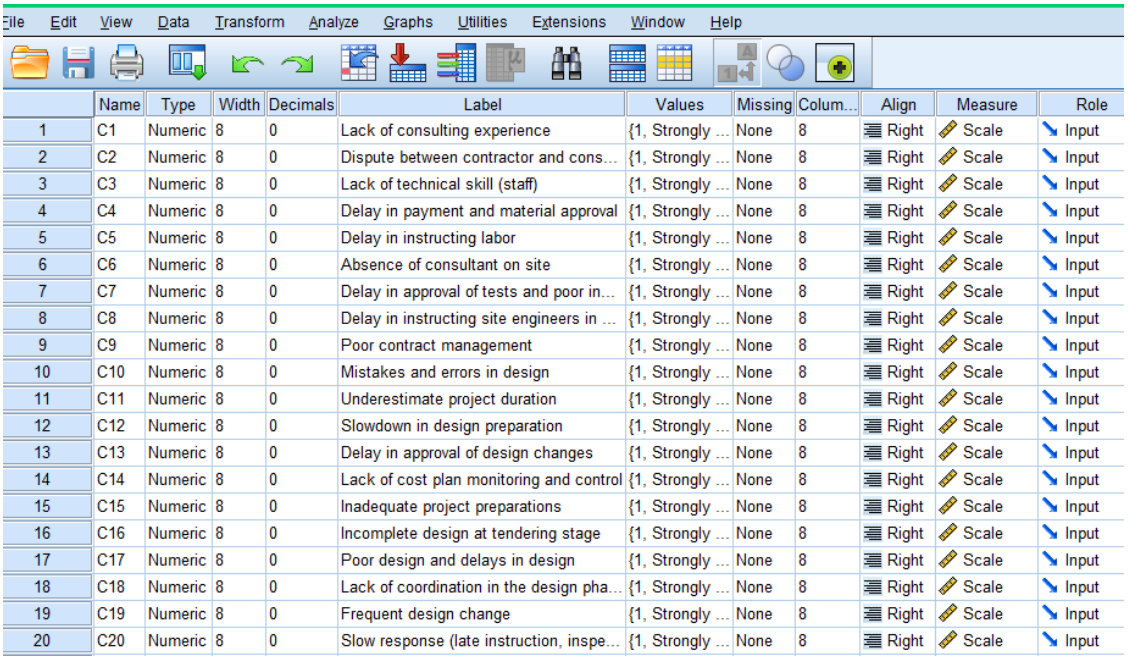
Appendix C SPSS INPUTS AND OUTPUTS

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

	Name	Type	Width	Decim...	Label	Values	Missing	Columns	Align	Measure	Role
1	A1	Numeric	1	0	Poor performance and inadequate experience of contract...	{1, Strongl...	None	12	Right	Scale	Input
2	A2	Numeric	1	0	Improper planning and scheduling result in a poor judgme...	{1, Strongl...	None	12	Right	Scale	Input
3	A3	Numeric	1	0	Delay in mobilization	{1, Strongl...	None	12	Right	Scale	Input
4	A4	Numeric	1	0	Inappropriate construction methods	{1, Strongl...	None	12	Right	Scale	Input
5	A5	Numeric	1	0	Poor site management	{1, Strongl...	None	12	Right	Scale	Input
6	A6	Numeric	1	0	Shortage of materials on the site	{1, Strongl...	None	12	Right	Scale	Input
7	A7	Numeric	1	0	Unethical behaviors used to achieve a high level of profit	{1, Strongl...	None	12	Right	Scale	Input
8	A8	Numeric	1	0	Wastage of materials on site	{1, Strongl...	None	12	Right	Scale	Input
9	A9	Numeric	1	0	Improper method of competition in procurement	{1, Strongl...	None	12	Right	Scale	Input
10	A10	Numeric	1	0	Inadequate tender pricing	{1, Strongl...	None	12	Right	Scale	Input
11	A11	Numeric	1	0	Frequent change of sub-contractors	{1, Strongl...	None	12	Right	Scale	Input
12	A12	Numeric	1	0	Depend on the site engineers to bear the whole responsi...	{1, Strongl...	None	12	Right	Scale	Input
13	A13	Numeric	1	0	Poor project management skill	{1, Strongl...	None	12	Right	Scale	Input
14	A14	Numeric	1	0	Lack of contractor's experience	{1, Strongl...	None	12	Right	Scale	Input
15	A15	Numeric	1	0	Financial difficulties faced by contractors	{1, Strongl...	None	12	Right	Scale	Input
16	A16	Numeric	1	0	Bad relation between management and labor	{1, Strongl...	None	12	Right	Scale	Input
17	A17	Numeric	1	0	Errors during constructions	{1, Strongl...	None	12	Right	Scale	Input
18	A18	Numeric	1	0	Contractual claims such as an extension of time	{1, Strongl...	None	12	Right	Scale	Input
19	A19	Numeric	1	0	Incompetent subcontractors	{1, Strongl...	None	12	Right	Scale	Input
20	A20	Numeric	1	0	Unsuitable construction equipment	{1, Strongl...	None	12	Right	Scale	Input
21	A21	Numeric	1	0	Improper construction methods	{1, Strongl...	None	12	Right	Scale	Input
22	A22	Numeric	1	0	Inaccurate quantity take-off and quantity underestimation	{1, Strongl...	None	12	Right	Scale	Input
23	A23	Numeric	1	0	Poor financial control on site	{1, Strongl...	None	12	Right	Scale	Input
24	A24	Numeric	1	0	Unqualified work	{1, Strongl...	None	12	Right	Scale	Input
25	A25	Numeric	1	0	Shortage of site workers	{1, Strongl...	None	12	Right	Scale	Input

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

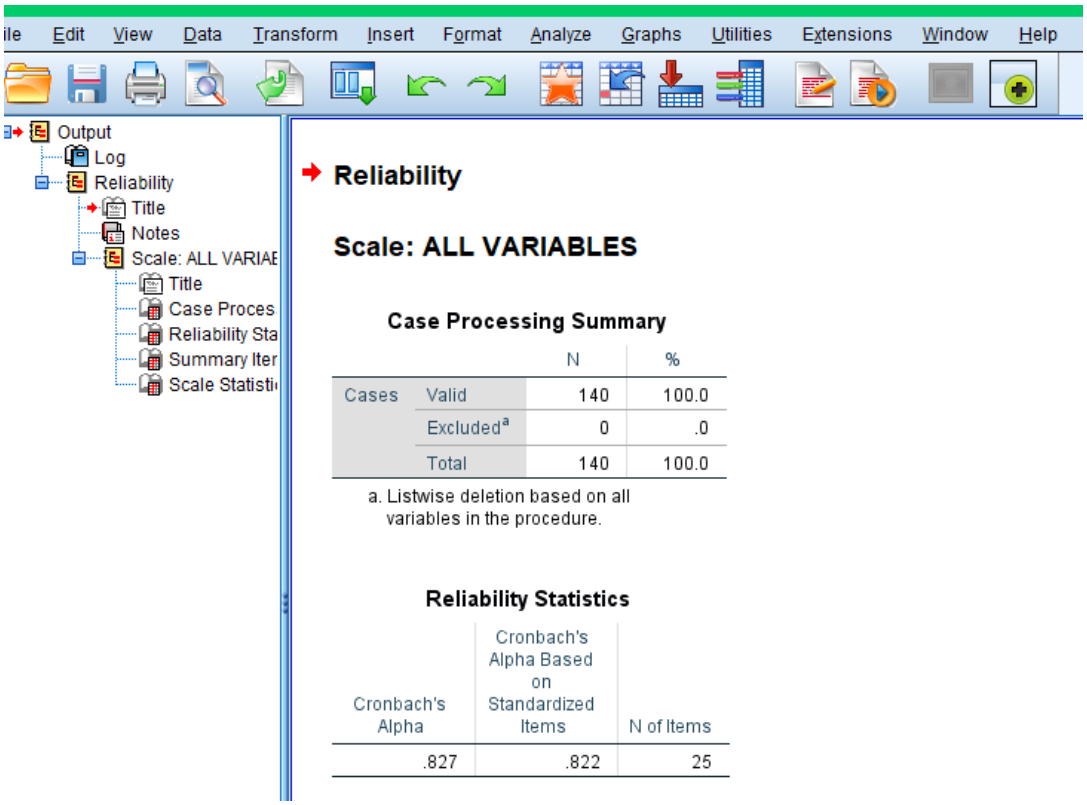
	Name	Type	Width	Decim...	Label	Values	Missing	Columns	Align	Measure	Role
1	B1	Numeric	8	1	Lack of experience of the client i...	{1.0, Strongl...	None	8	Right	Scale	Input
2	B2	Numeric	8	0	Contract modifications	{1, Strongly ...	None	8	Right	Scale	Input
3	B3	Numeric	8	0	Degree of interference of the client	{1, Strongly ...	None	8	Right	Scale	Input
4	B4	Numeric	8	0	Delayed disbursing of payments	{1, Strongly ...	None	8	Right	Scale	Input
5	B5	Numeric	8	0	Additional works required by the ...	{1, Strongly ...	None	8	Right	Scale	Input
6	B6	Numeric	8	0	High quality of work required by t...	{1, Strongly ...	None	8	Right	Scale	Input
7	B7	Numeric	8	0	Poor contract management	{1, Strongly ...	None	8	Right	Scale	Input
8	B8	Numeric	8	0	Poor communication & coordinat...	{1, Strongly ...	None	8	Right	Scale	Input
9	B9	Numeric	8	0	Lack of finance control and paym...	{1, Strongly ...	None	8	Right	Scale	Input
10	B10	Numeric	8	0	Owner has no priority/ urgency t...	{1, Strongly ...	None	8	Right	Scale	Input
11	B11	Numeric	8	0	Unrealistic contract duration imp...	{1, Strongly ...	None	8	Right	Scale	Input
12	B12	Numeric	8	0	Delays caused by the owner and...	{1, Strongly ...	None	8	Right	Scale	Input
13	B13	Numeric	8	0	Financial problems faced by clie...	{1, Strongly ...	None	8	Right	Scale	Input
14	B14	Numeric	8	0	The practice of assigning the con...	{1, Strongly ...	None	8	Right	Scale	Input
15	B15	Numeric	8	0	Lack of communication with the ...	{1, Strongly ...	None	8	Right	Scale	Input
16	B16	Numeric	8	0	Changes in client requirements	{1, Strongly ...	None	8	Right	Scale	Input
17	B17	Numeric	8	0	Re-measurement of provisional s...	{1, Strongly ...	None	8	Right	Scale	Input
18	B18	Numeric	8	0	Improper and poor project feasibil...	{1, Strongly ...	None	8	Right	Scale	Input
19	B19	Numeric	8	0	Poor procurement method for co...	{1, Strongly ...	None	8	Right	Scale	Input
20	B20	Numeric	8	0	Slow decision making	{1, Strongly ...	None	8	Right	Scale	Input



File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

	Name	Type	Width	Decimals	Label	Values	Missing	Colum...	Align	Measure	Role
1	C1	Numeric	8	0	Lack of consulting experience	{1, Strongly ...	None	8	Right	Scale	Input
2	C2	Numeric	8	0	Dispute between contractor and cons...	{1, Strongly ...	None	8	Right	Scale	Input
3	C3	Numeric	8	0	Lack of technical skill (staff)	{1, Strongly ...	None	8	Right	Scale	Input
4	C4	Numeric	8	0	Delay in payment and material approval	{1, Strongly ...	None	8	Right	Scale	Input
5	C5	Numeric	8	0	Delay in instructing labor	{1, Strongly ...	None	8	Right	Scale	Input
6	C6	Numeric	8	0	Absence of consultant on site	{1, Strongly ...	None	8	Right	Scale	Input
7	C7	Numeric	8	0	Delay in approval of tests and poor in...	{1, Strongly ...	None	8	Right	Scale	Input
8	C8	Numeric	8	0	Delay in instructing site engineers in ...	{1, Strongly ...	None	8	Right	Scale	Input
9	C9	Numeric	8	0	Poor contract management	{1, Strongly ...	None	8	Right	Scale	Input
10	C10	Numeric	8	0	Mistakes and errors in design	{1, Strongly ...	None	8	Right	Scale	Input
11	C11	Numeric	8	0	Underestimate project duration	{1, Strongly ...	None	8	Right	Scale	Input
12	C12	Numeric	8	0	Slowdown in design preparation	{1, Strongly ...	None	8	Right	Scale	Input
13	C13	Numeric	8	0	Delay in approval of design changes	{1, Strongly ...	None	8	Right	Scale	Input
14	C14	Numeric	8	0	Lack of cost plan monitoring and control	{1, Strongly ...	None	8	Right	Scale	Input
15	C15	Numeric	8	0	Inadequate project preparations	{1, Strongly ...	None	8	Right	Scale	Input
16	C16	Numeric	8	0	Incomplete design at tendering stage	{1, Strongly ...	None	8	Right	Scale	Input
17	C17	Numeric	8	0	Poor design and delays in design	{1, Strongly ...	None	8	Right	Scale	Input
18	C18	Numeric	8	0	Lack of coordination in the design pha...	{1, Strongly ...	None	8	Right	Scale	Input
19	C19	Numeric	8	0	Frequent design change	{1, Strongly ...	None	8	Right	Scale	Input
20	C20	Numeric	8	0	Slow response (late instruction, inspe...	{1, Strongly ...	None	8	Right	Scale	Input

Figure 5-6A Inputs to SPSS v26



ile Edit View Data Transform Insert Format Analyze Graphs Utilities Extensions Window Help

Output
Log
Reliability
Title
Notes
Scale: ALL VARIAE
Title
Case Proces
Reliability Sta
Summary Iter
Scale Statisti

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	140	100.0
	Excluded[a]	0	.0
	Total	140	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.827	.822	25

Figure 5-7C SPSS Results for Reliability Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.995[a]	.989	.936	.055045

a. Predictors: (Constant), Causes Related to External Factor, Causes Related to Materials, Causes Related to Contractors, Causes Related to Clients, Causes Related to the Project

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.279	5	.056	18.425	.175[b]
	Residual	.003	1	.003		
	Total	.282	6			

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Causes Related to External Factor, Causes Related to Materials, Causes Related to Contractors, Causes Related to Clients, Causes Related to the Project

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations		
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	4.564	3.311		1.379	.399	-37.500	46.628			
	Causes Related to Contractors	-1.603	1.167	-.756	-1.373	.401	-16.435	13.229	.868	-.808	-.142
	Causes Related to Clients	-2.540	1.605	-2.663	-1.582	.359	-22.936	17.857	.744	-.845	-.164
	Causes Related to the Project	2.206	1.698	2.765	1.299	.418	-19.369	23.781	.793	.792	.135
	Causes Related to Materials	.263	.278	.690	.946	.518	-3.272	3.799	.727	.687	.098
	Causes Related to External Factor	.861	.323	.981	2.669	.228	-3.239	4.961	.952	.936	.277

a. Dependent Variable: Cost Overrun

Figure 5-8C Regression Analysis Results