



**ADDIS ABABA UNIVERSITY
COLLEGE OF BUSINESS AND ECONOMICS**

***IMPACT OF COST FLUCTUATION OF MAJOR CONSTRUCTION
MATERIALS ON THE PROJECT COST IN THE CASE OF
ETHIOPIAN ROADS ADMINISTRATION (ERA)***

**BY
Biruhehiwot Zerihun**

**DECEMBER 2024
ADDIS ABABA, ETHIOPIA**

**IMPACT OF COST FLUCTUATION OF MAJOR
CONSTRUCTION MATERIALS ON THE PROJECT COST IN
THE CASE OF ETHIOPIAN ROADS ADMINISTRATION (ERA)**

**BY
Biruhehiwot Zerihun**

**A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF BUSINESS ADMINISTRATION IN FINANCE (MBA)**

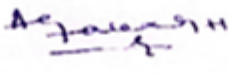


ADVISOR: Dr. ALEM HAGOS

**DECEMBER 2024
ADDIS ABABA, ETHIOPIA**

IMPACT OF COST FLUCTUATION OF MAJOR CONSTRUCTION MATERIALS ON THE PROJECT COST IN THE CASE OF ETHIOPIAN ROADS ADMINISTRATION (ERA)

BY
Biruhehiwot Zerihun

Approved by Board of Examiners

<u>Dr. Alem Hagos</u> Advisor	 Signature	<u>Dec 19 2024</u> Date
<u>Dr. Tenkir Seifu</u> External Examiner	 Signature	<u>Dec 19, 2024</u> Date
<u>Dr. Yohannes Workalemahu</u> Internal Examiner	 Signature	<u>Dec 19, 2024</u> Date
_____ Chairman	_____ Signature	_____ Date

DECLARATION

I, Biruhehiwot Zerihun, declare that this thesis "*Impact of Cost Fluctuation of Major Construction Materials on the Project Cost in Case the of Ethiopian Roads Administration (ERA)*", is my own work, produced in partial fulfilment of the requirement for the award of my Postgraduate Degree in Business Administration from Addis Ababa University, Faculty of Business and Economics with the cooperation and direction of my research supervisor, Dr. Alem Hagos. All sources have been acknowledged in the thesis, and it has not led to the award of any degree or diploma program at this or any other school.

Biruhehiwot Zerihun



Dec ,19, 2024

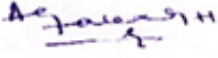
Name of Student

Signature

Date

CERTIFICATE

This is to certify that the thesis entitled :, "IMPACT OF COST FLUCTUATION OF MAJOR CONSRUCTION MATERIALS ON THE PROJECT COST IN THE CASE OF ETHIOPIAN ROADS ADMINISTRATION (ERA) ", submitted in partial fulfilment of the requirements for the degree of Masters of Business Administration (MBA) of the postgraduate Studies, Addis Ababa University is the record of original research carried out by Biruhehiwot Zerihun under my supervision and that it has not formed any part of the basis for the award of degree of any other university. The assistance and support given throughout the course of this study has been appropriately acknowledged. So, I recommend that it is accepted as satisfying the need of a thesis.

<u>Dr. Alem Hagos</u>		<u>Dec 19 2024</u>
Name of Supervisor	Signature	Date

ACKNOWLEDGMENT

I thank God for the opportunity, strength and guidance to start and complete this study. Secondly, I would like to thank my family and friends for their continuous support.

I would like to thank my supervisor, Alem Hagos (PhD) from Addis Ababa University, for his guidance through each stage of the process and his constructive comment and warmly welcomed approach without which this paper could not be completed.

Lastly, I would like to express my gratitude to everyone who gave their time to supply the necessary data and documents that were used as a source for this investigation.

TABLE OF CONTENTS

DECLARATION	3
CERTIFICATE	5
ACKNOWLEDGMENT	6
LIST OF TABLES	10
LIST OF FIGURES	11
List of Acronyms	1
ABSTRACT	2
CHAPTER ONE	3
INTRODUCTION	3
1.1 Chapter Introduction	3
1.2 Background of the Study	3
1.3 Organization under Study	6
1.4 Statement of the Problem	7
1.5 Research Question	8
1.6 Objective of the Study	8
1.7 Significance of the Study	9
1.8 Scope of the Study	10
1.9 Limitation of the Study	10
1.10 Organization of the Research Report	11
CHAPTER TWO	12
LITERATURE REVIEW	12
2.1 Chapter Introduction	12
2.2 Review of Theoretical Literature	12
2.3 Empirical Literature Review	18
2.4 Research Gap and Justification of the Research Project	23
2.5 Conceptual Framework	24
CHAPTER THREE	25
RESEARCH DESIGN & METHODOLOGY	25
3.1 Introduction	25
3.2 Study area Description	25
3.3 The Projects under the Study	26

3.4	Research Approach	29
3.5	Research Design.....	30
3.6	Unit of Analysis	30
3.7	. Data Type and Sources	30
3.8	Target Population and Sampling.....	31
3.9	. Data Collection Method	33
3.10	The Research’s Credibility	35
3.11	Data Management and Quality	36
3.12	Data Analysis and Interpretation	36
3.13	Ethical Considerations	38
CHAPTER FOUR.....		40
RESULTS, ANALYSIS, AND INTERPRETATION.....		40
4.1.	Introduction.....	40
4.2.	Result, Analysis and Interpretation using Secondary Data.....	40
4.2.1.	Price Trend Using Secondary Data.....	40
4.2.1.1.	Fuel Price Trend.....	40
4.2.1.2.	Bitumen Price Trend.....	41
4.2.1.3.	Steel Price Trend.....	43
4.2.1.4.	Cement Price Trend	44
4.2.2.	Impact of the increment of price of Fuel, Cement, steel and Bitumen on the Monthly Project Cost.....	45
4.2.3.	Price Adjustment from Payment Certificates	46
4.2.3.1.	Impact of Cost fluctuation of Construction materials in regards to the Price Adjustment 47	
4.2.3.2.	Impact of Fuel Price Fluctuation on the Project Cost.....	48
4.2.3.3.	Impact of Cement Price Fluctuation on the Project Cost.....	49
4.2.3.4.	Impact of Reinforcement Bar Price Fluctuation on the Project Cost.....	50
4.2.3.5.	Impact of Bitumen Price Fluctuation on the Project Cost	51
4.2.3.6.	Total Impact of the Construction Materials Price Fluctuation on the Project Cost.....	52
4.2.3.7.	Impact of Fluctuation on the Budget allocated by ERA.....	57
4.3.	Using Primary Data (60 Respondents)	58
4.4.	Qualitative Analysis using Interview	60
4.5.	Impact of Variable by Inferential Analysis.....	61
4.6.	Relationship among variables by means of Correlation Analysis	61
4.7.	Precise Impact on Project Cost Fluctuations by Regression Analysis.....	62

4.8.	Direct (Straightforward) Impact of Price Fluctuation using Secondary Data and Simple Regression Analysis.....	66
4.9.	Discussions	72
CHAPTER FIVE		75
SUMMARY OF MAJOR FINDINGS, CONCLUSION AND RECOMMENDATIONS		75
5.1	Introduction.....	75
5.2	Summary of Major Findings.....	75
5.3	Conclusions.....	77
5.4	Recommendations.....	77
5.5	Implications.....	78
5.6	Directions for Future Studies	78
REFERENCE		79
Annex	82
Appendix I –Questionnaire	82
Annex II - Interview.....	86
Appendix III- Data.....	87

LIST OF TABLES

Table 3.3-1 ERA Projects	26
Table 3.3-2 Case Study ERA Projects	27
Table 3.3-3 Approximate Weightings for Price Adjustment Formula	28
Table 3.8-1 Target Population Strata Target Population	32
Table 3.9-1 Sources of Price used for the Study Analysis.....	34
Table 3.10-1 Analysis of the level of Reliability	35
Table 4.2-1 The Impact of Fuel Price Fluctuation on the Project Cost for Five years	48
Table 4.2-2 The Impact of Cement Price Fluctuation on the Project Cost for Five years.....	49
Table 4.2-3 The Impact of Reinforcement Bar Price Fluctuation on the Project Cost for Five years	50
Table 4.2-4 The Impact of Bitumen Price Fluctuation on the Project Cost for Five years	51
Table 4.2-5 Impact of Price Fluctuation of Construction Materials on Project Cost	53
Table 4.2-6 ERA's Report on the Impact of Cost Fluctuation of Construction Material on the Budget Allocated for Projects.....	57
Table 4.3-1 Analysis of Questionnaire Respondents.....	58
Table 4.6-1 Correlation Test Result (N= 60).....	61
Table 4.7-1 Regression Results - Model Summary	64
Table 4.7-2 Regression Test Results ANOVA	65
Table 4.7-3 Analysis of Regression Results	65
Table 4.8-1 Simple Regression Results- Model Summary.....	67
Table 4.8-2 Simple Regression Results- ANOVA	68
Table 4.8-3 Simple Regression Results- Coefficients	70
Table 4.8-4 Table of Coefficients	71

LIST OF FIGURES

Figure 2.5-1 Conceptual Framework	24
Figure 3.2-1 Location Map of the Study Area	25
Figure 4.2-1 Fuel Cost trend	40
Figure 4.2-2 Bitumen Cost trend	42
Figure 4.2-3 Steel Cost Trend	43
Figure 4.2-4 Cement Price Trend	44
Figure 4.2-5 Amount of Work and Price Adjustment	45
Figure 4.2-6 Price Adj. due to Fluctuation	54
Figure 4.2-7 Amount of Work and Price Adjustment	54
Figure 4.7-1 Normality Test Result (N=60)	63
Figure 4.7-2 Linearity (N=60)	64

List of Acronyms

ERA- Ethiopian Roads Administration

ETCA- Ethiopian Transport Construction Authority

FIDIC- Fédération Internationale des Ingénieurs-Conseils

PMBOK- Project Management Body of Knowledge

RII- Relative Importance Index

IPC-Interim Payment Certificate

ABSTRACT

The aim of this study was to ascertain the potential impact of large construction material pricing fluctuations on the projects of the Ethiopian Roads Administration (ERA). Both qualitative and quantitative data were collected using a descriptive and explanatory study technique. Primary data were collected using questionnaires and interview guideline, while secondary data were obtained from eight projects with five years of data (60 months) via contractor's payment certificates and progress reports. The respondents were Ethiopian Road Administration Engineers, Consultants, and Contractors working on the eight projects listed. Only 60 of the 70 questionnaires that were distributed for this study's study region were accurately filled out and returned, yielding an 86% response rate. While quantitative data was analysed using statistics analysis, which included computations of mean and percentage as well as inferential analysis (multivariate as well as basic regression and correlation processes), qualitative data was analysed using content analysis. In situations where the connections were clear-cut, simple linear regression was able to effectively illustrate the relationship between the two variables. Since the materials used in the road projects are in large quantity, a rise in fuel prices could have an impact on the overall cost of road construction projects due to higher equipment and material transportation expenses. In addition, bitumen prices have fluctuated over time, with higher figures showing up in certain projects. Additionally, there are variations in the quantity of work that is subject to price adjustments; the majority of ERA projects experience delays and necessitate extending deadlines. Contractors may file claims for price increases that exceed their expectations of the price adjustment if they are granted additional time to complete their projects. Ultimately, it was found that fuel, steel, cement, and bitumen all had positive and significant effects on project cost. According to the study's findings, although material costs have not risen consistently over time, they have usually done so to the degree that they can significantly affect the overall cost of road construction projects. Based on the data, this study came to the conclusion that bitumen, steel, cement, and fuel had a favourable and significant impact on project cost. This study suggests that planning, monitoring, reporting, and adapting are essential elements of cost control that ERA should take into account.

Keywords: *Bitumen, Cement, Fuel, Steel, Project Cost,*

CHAPTER ONE

INTRODUCTION

1.1 Chapter Introduction

The origin of the research idea is presented in this chapter. This section includes the study's background, the organization conducting it, the study's scope, limitations, significance, research questions, objectives, and study hypothesis.

1.2 Background of the Study

Economic growth is linked to a country's prosperity, and all contributing sectors—primary, secondary, tertiary, quaternary, and other—work to keep the economy stable (Musarat, Alaloul, & Liew, 2021). The construction business is one of the key industries that supports a country's economic growth. According to Charles Kenny's research from 2007, the construction industry holds a firm hold in most countries, with an average GDP of 5 to 7% and a global worth of \$1.7 trillion. The industry has seen a significant increase in value over time. Accordingly, in the year 2020 the Oxford Economics estimates the global construction market value between 2020 to 2030 at \$10.7 trillion with a growth rate expectation of \$4.5 Trillion (Economics, 2021).

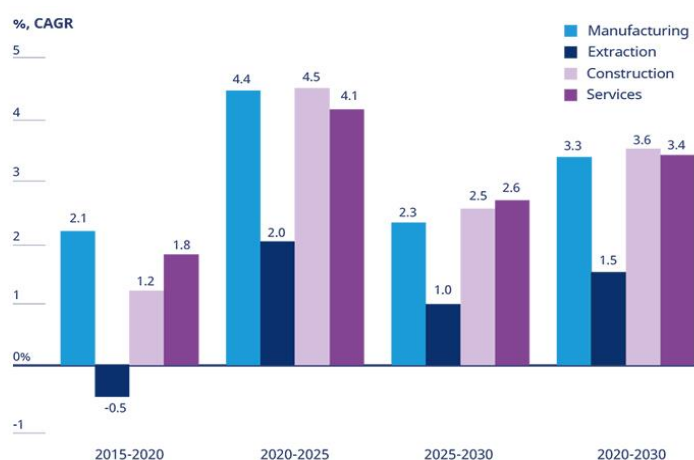


Figure 1.2 Global Headline Sector Growth

(Source: Oxford Economics/Haver Analytics, 2023)

The manufacturing, extractive, construction, and services sectors' estimated global growth rates from Oxford Economics are summed together above (See Figure 1). The sector also makes a huge contribution to Ethiopia. According to estimates from the National Bank of Ethiopia (NBE), the construction industry accounts for half of all industrial output in the nation. The construction industry contributed 9.4% of the nation's GDP in 2014–2015, according to the African Economic Outlook 2015 edition (Interiors, 2016). Moreover, the same increased to 15.9% in the subsequent year (2015–16), a notable increase of 6.5% in a single year (Veitch, 2018). The 2020/2021 annual report from the National Bank of Ethiopia states that the GDP proportions for the year 2020/2021 were 39.6% in services, 29.3% in industry, and 32.5% in agriculture. In relation to this, it was said that the construction sector accounts for 72.2% of the industrial output, with roads, railroads, dams, and residential buildings playing a major part. Nevertheless, despite its enormous contributions, the global construction industry faces a number of risks and uncertainties that have an impact on its productivity. Building projects can be incredibly difficult, full of risks both within and outside the building, uncertain, and often unanticipated.

Andualem (2020) examined earlier research on the identification and classification of hazards related to building projects in his study titled "Critical Risk in Construction Projects in Ethiopia." As a result, these researchers' studies generally classify construction risks as either internal or external. It was determined that internal risks are those that result from the project's features and are under the project team's control, whereas external risks are those that are outside the team's control and include risks related to politics, the economy, law, society, and the environment. (2020, Yadeta).

Price fluctuation is one of the main economic concerns affecting the sector. It is the change in price of commodities (i.e., goods, materials, and services) that are sold on the market. Price changes can occur in any market, including labor markets, international markets, and local markets (Mishra & Regmi, 2017). According to Zewdu and Aregaw (2015), rapid price swings and shortages of building materials are seriously limiting the growth of the construction industry. These swings make it impossible to complete projects within the predetermined parameters of quality, timeliness, and budgeted cost. Developing countries are more susceptible to price fluctuations than industrialized countries are because of their reliance on external factors (Mishra & Aithal, 2020).

Ethiopia is still developing, and there is still more to be done in this regard. In a growing country like ours, securing a sizeable amount of investment from both the public and private sectors is crucial to guaranteeing the required level of economic growth (Yigezu, 2008). The construction of roads constitutes a significant sector within Ethiopia's construction industry. In order to achieve the sector's declared goals, the Ethiopian Roads Administration (ERA), a federal organization, is currently in charge of developing federal road development projects across the country in collaboration with regional road authorities (ERA, 2011).

Ethiopia's road sector development is thought to have been severely financially constrained as a result of the recent price fluctuation in construction materials used in road projects. Due to the unpredictable and erratic monthly project price inflation, the government is challenged to safe and plan budget for new developments in keeping with and in line with previous historical records of engineering estimate (Dinsa, 2015). Although the issues causing Price fluctuations and delays in the majority of projects are of diverse kinds such as inflation, currency exchange rate variations, and changes in governmental regulations; yet these factors significantly affect how much it costs to construct roads in Ethiopia. (Zegeye, 2019).

Therefore, in order to manage the risk of the price fluctuation, price adjustment provisions are introduced in the Contracts to adjust the price that require price adjustment in the event of an upsurge or reduction in certain costs outside the controller of either gathering in the contract (Gebeyehu, 2017). For this reason, contracts for federal road construction projects in Ethiopia also include clauses for price adjustments that would pay the contractor or the employer if the price of labor, materials, equipment, or other factors such as changes in legislation increased or decreased (Zegeye, 2019).

With an emphasis on federal construction of road projects, this research will try to show the extent of the current price fluctuation, examine the existing price fluctuation administration practice i.e. price adjustment through indices with an adjustment limit of 20% CAP in Ethiopian Roads Administration and identify its origins, impacts on the works as well as on the Contractual parties and suggested solutions.

1.3 Organization under Study

As soon as the Italian occupiers were forced to leave the country, the Imperial Ethiopian Government decided that a Road Agency had to be set up in order to adequately extend, maintain, and upgrade the country's road network. Thus, the Imperial Highway Authority (IHA) was established by proclamation No. 115/1951 as a semi-autonomous body with the express duty of planning, designing, constructing, and maintaining roadways. A single independent authority (IHA) managed road development and upkeep for 26 years, from 1951 to 1977. The oversight body for ERA turned was the Ministry of Transport and Communication. Under proclamation 133/1978, the Ethiopian Roads Administration was reinstated and now includes the Highway Department in addition to the Rural Roads Department.

The organization was reformed as the Ethiopian Transport Construction Authority (ETCA) by proclamation No. 189/1980 by the Military Government that took over in 1974. ETCA was then subordinate to the newly formed Ministry of Construction. The Authority's responsibilities were increased by the proclamation, which broadened its mandate to include building municipal roads, railroads, seaports, and airports. Following the 1991 shift from a command-based to a market-oriented economy, ERA was re-established by decree No. 63/1993 to offer a strong administration under the guidance of a Board. The federal government was given responsibility for main roads, while the regional self-governments were given control over rural roads as part of the reform. When it came to rural roads, ERA's responsibility was then restricted to providing support in the form of technical assistance, training, and network planning as needed by regional governments.

In order to address the issue at hand, ERA was once again resurrected by proclamation No. 80/1997 with the objectives of administering and developing highways as well as guaranteeing the caliber of road construction. Since the new cabinet of ministers was formed in October 2001, the task of developing the nation's infrastructure has been assigned to a Ministry of Infrastructure and then a Ministry of Works and Urban Development. ERA, a department of the Ministry of Works and Urban Development that reports to the Board, is responsible for planning and creating both short- and long-term plans and programs for road construction, design, maintenance of trunk and major link roads, as well as contract administration (Devex, 2020).

1.4 Statement of the Problem

In the modern and emerging field of construction industry contract management, price adjustment is a provision. It can be found in the FIDIC Red Book, the World Bank's Project Service practice, and the United Nations Office for Small and Large Projects in contract management (Hanif, 2018). The base indices usually stipulate in contract data on base date and current indices are derived from the time of invoice submission. The formula for cost adjustment large work is different from cost evaluation for small work. But herein both methods will be demonstrated. Nevertheless, the price adjustment in Ethiopia is very rare practice and in most contract documents are not applicable (Solomon, 2017). Asnake (2021) also stated that the unanticipated increase in the rise of cost of Construction materials used in road construction is causing a significant impact on the Contractual Parties, The Client, the Contractor and Consultant.

The majority of nations have governmental and organizational entities that establish consumer pricing indexes for each type of building material, including cement, gravel, concrete, brick masonry, and so forth, as well as non-adjustable and adjustable products. Unfortunately, in Ethiopia the central statistics office mainly and predominately provides the consumer price indices only for food item and non-food items for every major city, and a few other items for country wide, which construction materials are rarely on its lists. So the cost indices for construction materials, equipment and labour are considered as of non-food item, which are the closest ones to them. Additionally, the progress of each project is detailed in their yearly report, which reveals that most of the time, projects in Ethiopia are not finished on schedule, within budget, or even to the required standard of quality.

On other hand, previous studies did not give a great attention on the impact of cost fluctuation on project cost rather there are interested in investigation of price adjustment. Such as Asnake (2021) and others like Eleyan (2018) focused on factors Affecting Cost Escalation in Construction Project and Mulugeta (2018) assessed conditions of contract problems. These creates different adjustments used in different contracts. Although cost fluctuations have been a source of uncertainty, we may control this uncertainty by examining how they affect the cost of the project. The lack of a clear scope, unclear project objectives, project restrictions, poor design, unclear contract, and other unknowns are the sources of uncertainty. Since both are causing events with a probability of less

than 100%, which is what is characterized as a risk, this uncertainty is always translated into risks (Rameezdeen et al., 2018).

One of the main organizations that contracts out development work is the Department of Roads. Price increases are also regarded as a significant problem that impedes the advancement of the project since they reduce the benefit received by contract workers, resulting in significant losses and placing the project in a challenging position. Project staff is at a loss as to whether to forecast the state of the economy and other variables prior to contract settlement and determine the worth of the price adjustment, or whether to forego forecasting and mobilizing beforehand for the ongoing computation of price adjustment. Thus, this study examined the impact of cost fluctuation of the major Construction Materials on project cost in Ethiopian Roads Administration's Road Projects in Ethiopia.

1.5 Research Question

- What is the existing price fluctuation of fuel, steel, bitumen and cement in Ethiopian Roads Administration's Road Projects in Ethiopia?
- What is the current project cost of including price adjustment of selected projects in Ethiopian Roads Administration's selected road projects?
- What is the relationship between price fluctuation of fuel, steel, bitumen and cement and Projects Cost in Ethiopian Roads Administration's selected road projects?
- What is the impact of price fluctuation of fuel, steel, bitumen and cement on projects cost in Ethiopian Roads Administration's selected road projects?

1.6 Objective of the Study

1.6.1 Main Objective of the Study

To examine the impact of Cost Fluctuation of Major Construction Materials on the Projects Cost in Case of Ethiopian Roads Administration (ERA)

1.6.2 Specific Objectives

- To assess the existing price fluctuation of fuel, steel, bitumen and cement in Ethiopian Roads Administration's Road Projects in Ethiopia
- To identify the current project cost trend of including price adjustment of selected projects in Ethiopian Roads Administration's selected road projects
- To examine the relationship between price fluctuation of fuel, steel, bitumen and cement and Projects Cost in Ethiopian Roads Administration's selected road projects
- To investigate the impact of price fluctuation of fuel, steel, bitumen and cement on projects cost in Ethiopian Roads Administration's selected road projects

1.7 Significance of the Study

A federal government agency known as Ethiopian Roads Administration (ERA) serves as the client. Its duties include contract administration, design and management of trunk and key link roads, and long- and short-term planning and program development. The Ethiopian government assigns the required budget, both from the coffer & from international loans and donations to the Ethiopian Roads Administration (ERA) to accomplish the planned works.

As an administration with a significant amount of resource and budget being administered; the occurrence of cost fluctuation in construction materials in road projects is a concerning issue that affects the budget allocation & administration and hence needs to be addressed as well as managed.

This research will assist in analyzing the status cost fluctuation of construction materials in road projects. It will view the subject matter from the angles of the key stakeholders (Client, Contractor and Consultant) involved in the projects, to clearly point out the specific impact it causes on the project cost.

In this regard, the study will assist the Client and other contractual parties in the project in precisely determining the degree to which the cost fluctuations of construction materials affect the project and in identifying methods of managing those variations so as to reduce the impact on project costs and stakeholders. Consequently, this will be advantageous when used as a factor in project budget allocation. Furthermore, because this is a broad and delicate topic, the research's conclusions will be used as a basis for other studies, which will lead to greater clarity and improved management of construction project cost fluctuations in road projects.

1.8 Scope of the Study

The scope of the study was the identification of the impact of cost fluctuation of the construction materials in Road Projects on the Project cost in the Case of Ethiopian Roads Administration (ERA). The target dependent variable of this study is project cost while the independent variables are factors include cost fluctuation of Fuel, Cement, Reinforcement Bar and Bitumen

The study targeted its focus to gather information from both five years secondary data of fuel, steel, bitumen and cement from eight projects and primary data from the client, consultant and contractor. The area of focused on the client side are the counterpart and Senior Engineers from the Construction Project Management (CPM) Directorates that are involved in the administration of the project, and also the counterparts from ERA's Planning and Program Management Directorate that is involved in the budget allocation of projects. Similarly, from the Consultant and Contractor perspective the Project Manager and coordinator are kept in the focus to provide the required information to assist the study. This study covered the road projects in ERA. The Subject projects have both local and international Contractual parties involved in the provision of the Works and Services of the project.

1.9 Limitation of the Study

Numerous aspects are involved in the broad topic of investigating why main construction input costs fluctuate in road projects. The factors are numerous, connected, and have origins in several industries. Furthermore, the issue of fluctuating construction material costs is very broad in scope because it has an impact on our entire nation.

Accordingly, considering the available time and the scope of the research, this study has limited to focus on only the major factors that contribute to the major construction materials in road projects. ERA is a federal organization that administers more than 300 road projects (as per the semi-annual report of ERA in the EFY 2015). Furthermore, the data organization and management is not organized and hence it made it very difficult to find the required data and also collect the same as per the planned schedule.

1.10 Organization of the Research Report

This chapter includes the study's history, problem statement, fundamental research questions, objectives, definitions of words, study significance, and study scope. The study-related literature is covered in this chapter. It includes an introduction, a theoretical and empirical review, and the study's conceptual framework. The following chapter includes descriptions of the research's nature and design, subjects and participants, data sources, tools and instruments utilized for data collecting, data collection procedures, and data analysis techniques. The study's results are summarized and discussed in the fourth chapter, which also covers data presentation, analysis, and interpretation. Lastly, the fifth chapter is divided into four sections: a summary of findings, conclusions, limitations of the study and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Chapter Introduction

An overview and critical analysis of pertinent literature are provided in this chapter. Cost adjustment consider the fluctuation of cost of materials, equipment and labour due to currency fluctuation, inflation, shortage of materials due to some other on-going project, or any other circumstances that varies the cost. It can result in increase or decrease of actual cost, depending on the fluctuation of current indices comparing to base indices (Hanif, 2018). Therefore, it covers cost fluctuation concepts, theories and models and project cost concepts and models. In addition, it includes the relationship between cost fluctuation and project cost performance based on empirical studies. It also contains the study conceptual framework.

2.2 Review of Theoretical Literature

2.2.1 Definition and Concepts of Cost Fluctuation

According to Anjay and Aithal (2020), the development sector's procedures make it subject to average cost variation and bank economic reports, among other factors. These forces include both domestic and foreign marketplace dynamics. It has created a very apparent global trend in the current economic environment. Due to the nation's reliance on outside sources, it becomes especially crucial in developing nations. Contractors are immediately impacted by changes in market prices at all levels. Price fluctuations also have an impact on the customer and the beneficiaries of the building project, in addition to the contractor. Today, inflation is a persistent problem that affects the entire development sector. Contract employees face tremendous vulnerability when it comes to providing and funding chips.

However, because contract workers are unable to predict with precision the long-term profits on their endeavours and must reallocate significant funds to cover asset expenditures, their efficiency is affected. Therefore, it is crucial to recognize the trends in the price fluctuations of various construction components at different points throughout a project in order to more accurately

estimate risk. In essence, risk management is not a novel idea; instead, it has been implemented naturally through the advice of professionals. Project risk management include categorizing influencing elements that can have a negative impact on a project's budget, timeline, or quality standards; listing the probable consequences of the discovered risk; and implementing measures to manage and mitigate the potential impression. The riskier the action is, the costlier the consequences if the wrong decision is made (Andualem, 2020).

Low labor productivity has been identified as a primary cause of project delays and cost overruns. Construction projects globally have encountered severe time and cost overruns. Thus, increasing construction labor productivity is essential (Sudhakumar, et al., 2014). For any type of construction, a human resource like a workforce needs to be effective and productive. If this is no longer the case, the entire construction process is plagued by numerous setbacks and disruptions, which lengthens the project's duration and raises its cost (Kumar, 2016). The construction industry's primary activity is working on projects to build new structures or renovate old ones for a variety of clients. Since projects are the main focus of the construction industry, the success of a construction company is reliant on the success of its projects. Undertakings entail trying new things. In the context of business, it usually refers to producing something that another party desires and is prepared to pay for. Projects have goals, which means they have to be constructed correctly, within a budget, and finished by a certain date. Ensuring that all of those goals are accomplished is the essence of project management (Anjay and Aithal, 2020).

All forms of civil engineering works are planned, carried out, and evaluated (follow-up) by the construction industry. Some of the major projects in the construction business involve physical infrastructure, such as buildings, communications, energy-related construction, water supply, and sanitation works (Sudhakumar, et al., 2014). The construction sector is regarded as the actual engine of the country's economy, driving all physical development. It is an important source of energy for a nation's economy and has a big impact on other industrial sectors' productivity and efficiency. Without a building facility, it is challenging to consider large investments in industries like manufacturing, agriculture, fisheries, and so forth (Shambel, 2018). Economic analyses weigh the advantages and disadvantages of novel therapies and services, and they are increasingly utilized to guide decisions about the distribution of healthcare resources. These choices usually take into account how much more cost-effective a new intervention is in comparison to the way things are being done now. The

ratio of the difference in costs to the change in benefits between the new intervention and the current practice is known as the incremental cost-effectiveness ratio (Alison, 2016).

2.2.2 Project Cost

This section looks at project cost management, including how to estimate, account for, and then control project expenses using a plan. This aids in examining the precise manner in which the performing organization budgets for and considers costs, as well as how project size influences the cost estimate process (Sudhakumar, et al., 2014). Project costs include more than just the price of the supplies needed to finish the work. One of the largest project expenses could be labor costs. To estimate the cost of labor needed to finish the project, the project manager must rely on time estimations. Furthermore, the price of the tools and supplies required to finish the project task must be factored into the project expenses (Eleyan, 2018). Calculating the expenses of the resources that have been identified as being necessary to finish the project task is the process of cost estimate. The individual or team performing the estimating has to take into account any conditions, potential variations, and other reasons why the estimate might differ from the actual amount. Pricing and cost estimating are two very different things (Anjay and Aithal, 2020). The price of the resources needed to finish the project job is known as a cost estimate. On the other hand, pricing involves a profit margin. Stated differently, a business that undertakes projects on behalf of other organizations might calculate the project's estimated cost (Nuru and Ilias, 2014).

Many project elements from the Initiation and Planning process groups are important for cost estimation. This procedure also depends on the performing organization's policies and historical data. The Work Breakdown Structure (WBS) is notably integrated as an input into five primary planning processes: activity definition, resource planning, risk management planning, cost estimation, and cost budgeting (Eleyan, 2018). Usually, the next step involves depending on the resource requirements, which is the sole result of resource planning and a crucial input for cost estimation (Brownstein, 2021). Resources will be needed for the project; labor skills, material capabilities, and equipment functionality must all be taken into consideration. The estimator must be aware of each resource's cost in order to calculate resource rates (Brownstein, 2021).

A time or measurement unit, such as cost per hour, cost per metric ton, or cost per use, should be used to express the cost. It can also be necessary to estimate the rates themselves if the rates of the resources

are unknown. Undoubtedly, a skewed estimate for the project will arise from skewed rates on the estimates. Ultimately, we obtain an approximation of the activity duration, which forecasts the project duration and is required for project finance decisions. The duration of the activities will assist the executing organization in estimating the project's overall cost, which will include financing fees (Shamble, 2018). Any project's final cost is influenced by a number of factors, including the cost of labor, the cost of materials, and the cost of equipment. For a project to be completed within budget, these costs need to be estimated, planned for, and tracked (Nuru and Ilias, 2014).

In order to assess if a project is worthwhile, whether the project deliverables will be profitable, and whether the project will be profitable, management and customers will want to know how much a project will cost. Analogous estimation, which forecasts the cost of the current project using comparable previous data, is one method of predicting project costs. To predict project costs, parametric modeling is used as a parameter, such as cost per metric ton; top-down estimating takes a similar project as a cost baseline and factors in current project conditions to predict costs; bottom-up estimating starts from zero and adds the expenses from top-down (Eleyan, 2018).

One of the largest costs in the project budget could be the resources required to do the work. The tasks that the resources do have to be worthwhile of their time. Put another way, the project manager does not want to pay an engineer a certain amount of money per hour to handle file tasks that an administrative assistant with a certain amount of money per hour is capable of performing. Additionally, there are four different types of costs associated with projects: direct costs are expenses that are specific to the project and cannot be allocated to operations or other projects (Kumar, 2016). Conversely, indirect costs can be distributed among several projects that share a training room or piece of equipment, as can variable costs, which change based on the circumstances inside the project while fixed costs stay the same. One final expense is known as opportunity costs. This is a unique cost because it's actually the cost of a missed opportunity rather than anything the organization has to pay out of money. The opportunity cost is the amount lost when a company that completes projects for others has to sacrifice one project in order to finish another (Shamble, 2018).

The process of methodically and effectively managing the formulation, implementation, and analysis of contracts with the goal of maximizing and mitigating operational and financial performance is known as contract life cycle management. A construction contract is an agreement between a business

(the client) and a customer (the contractor) in which the contractor commits to building a building, road, or other project (Kumar, 2016). Since the majority of construction contracts will have been awarded based on a set of agreed-upon contract criteria (general or specific), it will be important to confirm that all of the terms and conditions—especially those pertaining to quality, stage completion, and health and safety—are met. When that part of the contract starts, it's also essential to make sure that the commissioning processes and appropriate drawings are prepared. This is due to the fact that proficient project management necessitates a broad understanding of the construction sector (Shambel, 2018).

Integrating schedule and cost data to create a baseline or guide system for tracking, evaluating, and managing performance is the task of project control. According to Suresh and Sivakumar (2019), project control can be handled by the project manager or by a project analyst or auditor working independently inside the project team. Controlling and project planning are intertwined. Some practitioners really assert that these roles are inseparable. Control cannot exist without plans and objectives since performance must be evaluated in accordance with predetermined standards. The three steps of controlling are assessing where you are in relation to a goal, determining what needs to be done, and taking the appropriate corrective action to reach or surpass your goals (Brownstein, 2021).

According to Kerzner (2017), these crucial procedures for control along these lines include: evaluating the extent to which goals are being achieved through official and informal reports; Assessing: identifying the reason(s) for and potential solutions to major performance deviations from the plan; correcting: using corrective measures to reverse an unfavorable trend or capitalize on an exceptionally favorable trend. Monitoring and controlling involves influencing the variables that could evade integrated change control so that only authorized changes are implemented, monitoring ongoing project activities against the project management plan and the project performance baseline, and recommending preventive action in anticipation of potential problems (Project Management Institute, Inc., 2017).

2.2.3 Theories related to Project

2.2.3.1 Theory of Project Management

The Project Management Institute, Inc. (2017) came to the further conclusion that the notion that a paradigmatic revolution of the project management discipline is necessary is supported by anomalies that arise in the application of this underlying project management theory. According to Kerzner (2017), there are three theories of management that seem to underpin project management: the dispatching model, the thermostat model, and management as planning. One way to describe classical (project) management is as management of action or the application of a closed system. This is because the term "action" is central to the concept of a project and forms the basis of the three theories of management. According to Shambel (2018), a project management theory ought to be prescriptive, elucidating how actions contribute to the objectives established. However, it was also mentioned that the current project management doctrine has deliberate flaws in its theoretical foundation, and that foundation is implicit in his book, *The Underlying Theory of Project Management Is Outdated*. Thus, it can be said that the Project Management Body of Knowledge is a valuable theory of project management. It is essentially sufficient to support the assertion that project management is undergoing a paradigm shift. The dispatching model, the thermostat model, and planning are the foundations of project management.

2.2.3.2 Theory of Projects

A project is commonly understood to be tightly tied to the conversion of inputs into outputs and to encapsulate the key presumptions of that perspective. Projects are short-term, as opposed to long-term, systems created by groups within or between organizations to complete specific tasks within time limitations. First and foremost, projects are seen as transient efforts according to the current idea of projects. This rule covers both the widely held belief that projects deal with the conversion of inputs into outputs and its expansions, which see operations as being centered on the creation of flow value. Complete transformation can be broken down into manageable tasks according to the prevalent conception of projects; however, extending this idea to include operations as flow would clarify this idea and state that transformation flow would refine this notion to say that transformation flows are distinct from task operations (Suresh and Sivakumar, 2019).

The prevalent theory states that the best way to maximize project execution overall is to execute each task optimally and in the optimal order. Flow theory, on the other hand, would somewhat alter this and state that the best way to optimize project execution overall is to combine perfect task execution with optimal process flows. Precepts, assumptions, and even certain implicit rules that don't work well or don't sufficiently address the reality of large, complicated projects are present in the anticipated theories of projects. These characteristics described correspond to a so-called neo-classical viewpoint (Shambel, 2018). It is not sufficient to simply arrange a sequence of tasks in this important addition to the current theory of projects. The impacting factors are varied, spread out, and of equal significance. As such, it helps to approach each effort as a short-term venture. As such, it helps to approach each effort as a short-term venture. It addresses the creation of flow values as well as the conversion of inputs into outputs.

2.3 Empirical Literature Review

2.3.1 Management Method for Construction Material Cost Fluctuation

According to Anjay and Aithal (2020), there isn't a single price adjustment algorithm that works in all circumstances. In order to influence performance, various formulas are used for contracts of varying sizes and for various components. A contract may specify one or more payment currencies. A contract with price adjustment clauses should include at least one price adjustment formula for each currency of payment. Contracts for large-scale, intricate plant and construction may also include a few, easily identifiable areas, such as location, accessibility, schedule, or any other unique characteristics that may lead to different approaches for planning, organizing the project, or accounting for expenses. Comparing the many outcomes that arise in the building business is therefore concerning.

However, according to Andualem (2020), the most important construction risk has the biggest detrimental effects on the timeliness, cost, and quality of construction projects. The second and third most significant risks in the construction sector, by the way, are non-payment of the minimum interim payment and submittal and approval of construction papers. These risks, which fall under the categories of financial and management risks, respectively, could impede the project's advancement since they could cause delays in payment and document approvals from the

consultant and the customer. This can be the result of the management' inability to make prompt decisions.

According to Asnake (2021), inflationary price increases for building supplies can result in delays, lower profits, subpar quality, and problems with cash flow. It is therefore the main factor influencing price changes in public projects. The three main directly involved components of building expenses are material, labor, and equipment expenditures. Price adjustment clauses are incorporated into the provisions, regardless of changes in the cost of these direct cost components. The main external factors considered to be responsible for price increases in Ethiopian federal road construction projects are limited capacity of material producers, fluctuating currency exchange rates, rising global demand for construction materials, and increases in material costs or price fluctuations.

Ultimately, increased project costs, project finance issues related to cash flow, delays, and disagreements between partners are the primary consequences of price escalation identified in this research. According to the poll, the majority of contractors, consultants, and clients rated the federal road building projects' present price escalation administration system (practice) as very good. According to Anjay and Aithal (P2020), the majority of clients, consultants, and contractors assess it as good. Major strategies to manage/administer price escalation in road construction projects include taking into account fluctuation/escalation clauses, taking into account locally available materials in design, conducting frequent cost monitoring throughout the project, developing program-wide contingencies, and developing risk management protocol (Andualem, 2020).

2.3.2 Cost Fluctuation of Cement

According to Brownstein's (2021) research, there are two main approaches to managing the effects of changes in material prices, particularly those of cement: (i) assigning risk and responsibility through contractual clauses; and (ii) adopting proactive steps to prevent or lessen impacts on the project. It was discovered that by incorporating clauses in the contract that equitably divide liability in a way that is acceptable to both parties, these risks can be minimized or completely eliminated. Last but not least, it is critical that the parties start a conversation to discuss how to be proactive for the projects that are currently under way. According to Vamsidhar et al. (2014), the

fundamental inputs of construction include manufactured goods like plywood and burnt clay products, as well as building materials like cement, sand, and reinforcement steel and concrete. The investigation showed that steel, cement, aggregate, bricks, composite materials, equipment, and labor costs are the main factors influencing price increases in the construction industry.

Solomon (2017) discovered that while cement costs vary between factories, their pricing trends are often comparable; as a result, the prices provided by the two businesses can be regarded as credible and trustworthy. Furthermore, the price of cement will continue to rise in stability and competition as a result of the entry of two new cement price setters into Ethiopia, Dangote and Derba. Additionally, this study discovered that the establishment of new cement plants, such National and Habesha, has been crucial in keeping the price of cement stable in the Ethiopian market. According to this case study, the two cement plants that were "the largest producers and price setters"—Muger and Messebo—were the primary suppliers of cement for ERA projects. Nonetheless, the Ethiopian cement market has stabilized and grown more competitive since the opening of the Derba Cement Factory in February 2012 and the Dangote Cement Factory a year later.

- **Hypothesis 1 – H1- Cost Fluctuation of Cement has a positive and significant impact on Projects Cost in Ethiopian Roads Administration’s Road Projects in Ethiopia**

2.3.3 Cost Fluctuation of Fuel on Projects Cost

Anjay and Aithal (2020) recognized the issues with price volatility in the construction sector and the need for pricing adjustments to support cost fluctuations. The best price adjustment algorithm for building contracts is a contentious issue. All parties involved, including the customer, consultant, and contractor, are impacted by price adjustments. This study compared the various formulas of price adjustment of ten contracts starting inside 2010 A.D. to 2019 A.D. and demonstrated the trend of the cost of construction components, such as labor, material, gasoline, equipment, etc. When the price adjustment factor is compared using various formulas, it becomes clear that the values of the price adjustment factors vary and fluctuate over time. The factors that contribute to the rising cost of building materials were also discussed by Wondimagegn and Esubalew (2022), including changes in government policies and laws, a shortage of raw materials,

fluctuations in the price of fuel and electricity, inadequate infrastructure, unfortunate corruption, fluctuating labor and plant costs, and seasonal variations.

- **Hypothesis 2 – H2- Cost Fluctuation of Fuel has a positive and significant impact on Projects Cost in Ethiopian Roads Administration’s Road Projects in Ethiopia**

2.3.4 Cost Fluctuation of Reinforcement Bar

According to Solomon's (2017) research, Ethiopia has several providers of reinforcing bars, the majority of which are importers from Turkey. Because of the supplier's reputation and dependability, the choice of reinforcement bar supplier typically results in the first point of contention between the contractor and the engineer during the contract implementation phase, as well as between the employer and the contractor during the tender evaluation period. Due to the fact that the Ethiopian Public Procurement Agency (PPA) and ERA's procurement policies permit bids to choose their own supplier (importer or producer), the employer is not permitted to become involved in the process other than by raising concerns about the validity and credibility of the quotation. From this angle, the case study shows that during the pre-contract award meeting, the employer had doubts about the credibility and dependability of the reinforcement bar providers. However, the employer is not required to choose the supplier or reject the supplied base price quotation because of the nation's free market policy and the fact that the majority of importers are qualified to offer reinforcement bar with a free and equal market opportunity. Shambel (2018) added that within a single month, there are variations in reinforcing bar pricing as well as price patterns. Remarkably, a solitary supplier provided disparate quotes for two distinct projects within the same timeframe.

- **Hypothesis 3 – H3- Cost Fluctuation of Reinforcement Bar has a positive and significant impact on Projects Cost in Ethiopian Roads Administration’s Road Projects in Ethiopia**

2.3.5 Cost Fluctuation of Bitumen

In order to determine the elements influencing cost escalation in construction projects and to look into the causes of cost escalation, Eleyan (2018) examined the current state of bitumen cost escalation in building projects. The building industry in the Gaza Strip is confronted with a number

of difficulties, such as growing prices for building materials and other inputs, inflation in both local and foreign markets, and other elements that drive up project costs. construction material and permit costs, the cost of construction permits and approvals, the absence of an efficient supervisory system, inaccurate cost estimates, project modifications, the caliber of work, and the tools and machinery needed to complete the tasks and activities necessary for the project's completion.

Additionally, Anjay and Aithal (2020) discovered that bitumen and fuel prices are unpredictable due to their temporal fluctuations. The NRB index of labor, material, and equipment, or fuel, is used in the PPMO formula for price adjustment. The labor index rose by 44.86% between June 2015 and June 2019. The Equipment index has climbed by 31.54% and the Material index has fluctuated, rising by 20.66%. When the price adjustment factor is compared using various formulas, it becomes clear that the values of the price adjustment factors vary and fluctuate over time.

In their 2018 study, Rameezdeen et al. concentrated on mitigating price escalation and adjustment. The issues with contract management are to getting upfront payment at the prescribed rate specified in the agreement. Since payment would be made after the work is completed, the contractor needs to get working capital before starting the primary work. The contractor may obtain the initial working capital by borrowing money from the bank at the prevailing interest rate, which will cause the project cost to automatically increase. Consequently, this study found that the contractor is not provided with an advance payment free of interest (economic issues) due to the terms of his contract. The estimations are too low, which could cause the bid to seem unusually low and interfere with the contract's execution. The borrower pays a hefty price because the estimates are excessively high or because events don't happen, which affects the economy and efficiency of the contract. The worst-case situation is when the bid price increases more than anticipated, in which case the conditions are lowered or rebids are made.

- **Hypothesis 4 – H4- Cost Fluctuation of Bitumen has a positive and significant impact on Projects Cost in Ethiopian Roads Administration’s Road Projects in Ethiopia**

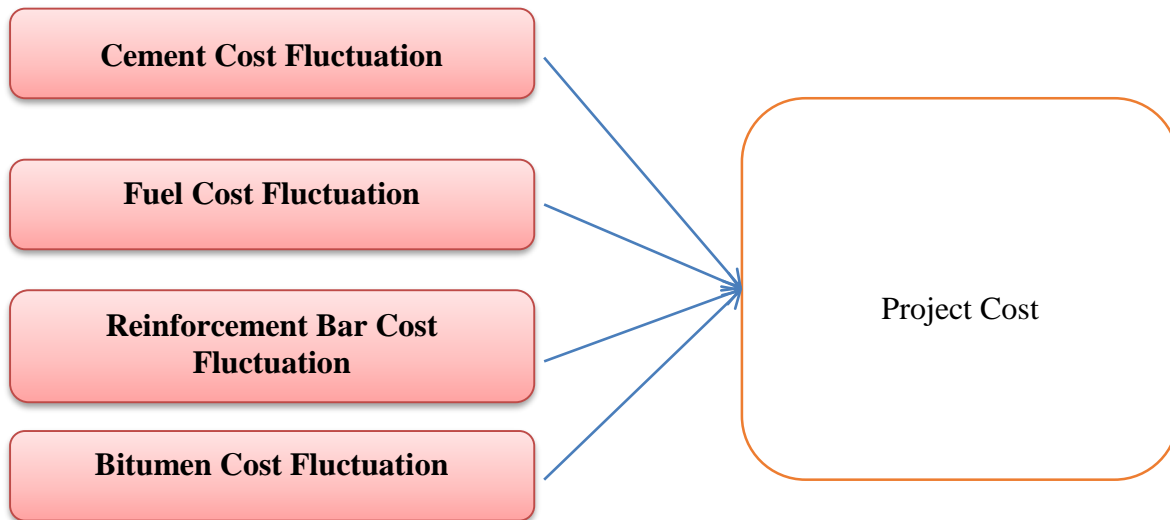
2.4 Research Gap and Justification of the Research Project

Prior research, such as Asnake (2021), concentrated on a set of justification metrics to address a price cost fluctuation problem at the grass route level. Andualem (2020) recognized the main risks connected to construction projects that are anticipated to have an impact on project performance in Ethiopia over the course of the project life cycle. From the literature, a number of risk indicators for construction projects were found. Mulugeta (2018) also concentrated on clauses concerning price adjustments, termination, claim substantiation and dispute resolution processes, contract form comprehension, and compliance of certain clauses with Ethiopian legislation.

Solomon (2017) investigated the federal road development projects in Ethiopia that use the current price adjustment valuation techniques. These studies and others of a similar nature concentrated on cost factors, performance challenges, and variations in price. Brownstein (2021) advised moving forward with projects in the current economic environment, assuming the risk that further fluctuations will lead to increases in construction costs, delays in the construction schedule, and/or disputes with contractors and material suppliers. This is because the construction industry is uncertain due to the fluctuations in commodity prices.

The recent, extraordinary price increase has had a multifaceted effect on the building industry. The community of contractors and subcontractors has undoubtedly complained about diminished or destroyed profit margins in addition to substantial project losses. The repercussions of this sharp price increase have been significant, encompassing not just lost revenue but also damaged or destroyed building firms (Anjay and Aithal, 2020). Changes in price may have an impact on owners, contractors, and the project itself. The primary consequences of pricing fluctuations on contractors, if they are not fairly reimbursed, are project finance issues with cash flow (Rameezdeen, et al., 2018). Consequently, the impact of cost variation on project cost in Ethiopia's road sector was evaluated in this study.

2.5 Conceptual Framework



**Figure 2.5-1 Conceptual Framework
Adapted from Brownstein (2021)**

According to Brownstein (2021), a number of reasons, such as COVID-19-related shutdowns and limitations, residual tariffs and quotas, a surge in single-family house development, and even cases of hoarding and profiteering, are driving or contributing to these variations. Even the most carefully thought out and executed construction projects could face disastrous consequences due to the recent volatility in building material pricing. Variations in the cost of building materials provide a significant and long-term risk to construction projects, regardless of the underlying reason. In addition to resulting in unexpected increases in building costs, these variations run the risk of postponing project completion deadlines because of shortages or rationing of materials. This study investigated the impact of cost fluctuation of the major Construction Materials in terms of major materials cost fluctuation on project cost in Ethiopian Roads Administration's Road Projects in Ethiopia.

CHAPTER THREE

RESEARCH DESIGN & METHODOLOGY

3.1 Introduction

In general, this chapter covers the materials utilized for the research as well as techniques for gathering and analysing data. Data collection methods, data quality control (validity and reliability), research design, study population, sample size and selection, sampling procedures, data analysis, ethical considerations, and plans for dissemination are all included.

3.2 Study area Description

The study was done in Addis Ababa city, Ethiopia. Addis Ababa lies in a few Kilo Metres west of the east African rift, is populated by people from the different region of Ethiopia. The geographic coordinates is $9^{\circ}1'48''$ N and $38^{\circ}44'24''$ E with an estimated area of 527km (203 sq. mi), population of 10,000,000 peoples live.



Figure 3.2-1 Location Map of the Study Area
(Source: Google map 2023)

3.3 The Projects under the Study

This study has concentrated on the impact of cost fluctuation of major construction materials on the project's cost in the case of road projects administered under the Ethiopian Roads Administration (ERA).

The Ethiopian Roads Administration has a total of 189 active construction projects being administered under Six (06) of its Construction Projects Management (CPM) Program Directorates during the time of the research as shown here below:

Table 3.3-1 ERA Projects

No.	CPM Program Directorates	Number of Active Projects being administered in the directorate
1.	East CPM Program Directorate	25
2.	West CPM Program Directorate	38
3.	North CPM Program Directorate	47
4.	South CPM Program Directorate	32
5.	Central CPM Program Directorate	42
6.	Expressway and Special Projects CPM Program Directorate	5
Total		189

Source: ERA 2024-Progress Reports

Out of the 189 projects, this study based its case on projects which fulfil the undermentioned criteria.

- *Projects active for Five years (June 2018 to June 2023);*
- *Projects with DB (Design Build) contract delivery method; and*
- *Projects with Price Adjustment Provision.*

Accordingly, as per the aforementioned requirements, 8 out of 189 projects qualify for the study as shown here-below:

Table 3.3-2 Case Study ERA Projects

No.	CPM Program Directorates	Number of Projects that fir for the study	Remark
1.	East CPM Program Directorate	0	No DB project active for Five Year
2.	West CPM Program Directorate	2	
3.	North CPM Program Directorate	2	
4.	South CPM Program Directorate	1	
5.	Central CPM Program Directorate	3	
6.	Expressway and Special Projects CPM Program Directorate	0	No DB project active for Five Year
Total		8	

Source: ERA 2024-Progress Reports and Contract Documents

Definition of Key Terms from the Works Contract of the Projects

Definition of Contract Price, Price Adjustment and Price Adjustment CAP as per the provisions of the DB Contract:

- **Contract Price:**

- (a) *Payment of Works executed by the Contractor shall be effected based on the total lump sum amount, which is the governing contract amount.*
- (b) *The amount certified in each payment certificate, before deducting for advance repayment, shall be adjusted by applying the respective price adjustment factor to the payment amount due:*

$$P_n = A + \frac{bLn}{L_o} + \frac{cMn}{M_o} + \frac{DEn}{E_o} + \dots etc$$

Where:

***P_n** is a price adjustment factor to be applied to the amount for the payment of the work carried out in each month excluding Design and Employer’s Representative Facilities;*

A is a constant, specified on the Contractor’s bid, representing the non-adjustable portion in Contractual payments;

***b,c,d etc.,** are weightings or coefficient representing the estimated proportion of each cost element (labour , material, equipment etc) in the works or sections thereof, as specified in the Contractor’s bid; the sum of A,b,c,d etc..., shall be one;*

***L_o,M_o,E_o etc.,** are the base cost indices or reference prices of the cost elements at the date 28 days prior to the deadline for bid submission*

- **Sub-Clause 13.1 [Approximate Weightings for Price Adjustment Formulae]**

Table 3.3-3 Approximate Weightings for Price Adjustment Formula

<i>Description of Index</i>	<i>% Range of Weighting</i>
<i>Fixed/Non Adjustable</i>	<i>30</i>
<i>Fuel</i>	<i>9.5-17</i>
<i>Bitumen</i>	<i>8-12</i>
<i>Steel Reinforcement Bar</i>	<i>2.5-5</i>
<i>Cement</i>	<i>4-6.5</i>
<i>Equipment</i>	<i>38-47</i>
<i>Total</i>	<i>100%</i>

Source: ERA 2024-Works Contract Documents

- **Sub-Clause 22 [Price Adjustment CAP]:** “*The cumulative total price adjustment amount which is going to be due to the Contractor for the rise in the cost if the adjustable labor, contractor’s equipment, plant, materials input shall not be more than 20% of the revised contract price excluding provisional sums, day works and price adjustment amount). Accordingly, the Contractor is advised to properly plan and execute the works so as to complete the works before such limits are surpassed.*”

3.4 Research Approach

While quantitative research measures the problem by generating numerical data or data that can be converted into useful statistics, qualitative research looks for patterns in concepts and points of view. Therefore, in order to address research issues that involve the collecting of qualitative data rather than quantitative data, qualitative studies often have what, how, and why inquiries. Questions that cannot be addressed by qualitative or quantitative approaches alone are addressed by mixed research designs (quantitative and qualitative). When combined, quantitative and qualitative approaches can work well together, despite their differences (Jilcha, 2019). Combining detailed information of participant viewpoints with the ability to identify patterns and generalizations, mixed approaches yield a more comprehensive picture.

The methodology or approach used to carry out the research is referred to as the research approach. It mostly entails choosing the research questions, the conceptual framework that must be used, and the suitable research methodology, such as primary or secondary research, among others. On the other hand, quantitative research focuses on quantifying the scale, range, frequency, etc. of events by gathering and evaluating numerical data. Additionally, mixed-method incorporates both quantitative and qualitative data gathering and analysis within a single research project or investigation program (Creswell, 2014).

This **study employed a mixed research methodology**. Conversely, qualitative research poses open-ended questions and gathers verbatim data from subjects or events. The researcher seeks out in-depth evaluations of project costs, price escalations and Price adjustment. This explains the cost management procedures now used in Ethiopia's road sector, as well as the activities that determine cost fluctuations, project costs, and patterns unique to that group of participants.

3.5 Research Design

All that a researcher needs to do is put different research methodologies and approaches into a structural framework, which is known as a research design. The study design provides a methodical strategy to accompany a researcher on their journey into the unknown. According to the goal of the study, there are three different kinds of research designs: exploratory, descriptive, and causal (Creswell, 2014). The exploratory study uses a hybrid research approach that primarily uses contemporaneous triangulation to provide additional insight and ideas for determining the true nature of the problem being studied. The descriptive research is based on previous understanding and aims to describe certain phenomena; it is more of a means than a goal because it stimulates further explanation.

The purpose of research designs is to provide legitimate, objective, accurate, and cost-effective answers to research questions. Accordingly, this study outlined the features of cost fluctuations and project costs in the road sector. The information gathered from the survey was evaluated and interpreted using statistical models, such as percentages, to determine the mean and standard deviation for the study's whole population. This study also looked at the application of statistical methods in an empirical analysis of the cause and effect relationship between dependent and independent variables. *Thus, the research used descriptive and explanatory research design.*

3.6 Unit of Analysis

The study's unit of analysis was employees from the surveyed Ethiopian Road Administration, Contractors, Consultants and individual experts.

3.7. Data Type and Sources

The data for this study used both primary and secondary data. The primary data was collected through questionnaire and Interview from employees of the Ethiopian Road Administration, Contractors, Consultants and individual experts. The Secondary data is collected from Monthly Progress Reports, Monthly Interim Payment Certificates (*Five Year Data*), ERA Annual Budget for Projects (*Five Year Data*), Contractors' payment certificate, Contract Agreements, Variation Orders, and other relevant documents.

3.8 Target Population and Sampling

3.8.1 Target Population

To make the study's findings more broadly applicable, the researcher determined the target population. Thus, 85 employees of the three contractual parties participating in the road project—the Ethiopian Roads Administration as the client, the Supervision Consultant, and the Contractor—made up the study's overall target population. The following are the main categories into which the questionnaire survey respondents are divided: **Client-** Ethiopian Roads Administration, Respective respondents: Counter-part Engineer, Team Leaders of the respective project, **Supervision Consultant:** Respective respondents- The Resident Engineer of the project and Contract Administration Head and **Contractor:** Respective respondents- The Project Manager of the and the Contract Administration Head of the Project.

3.8.2 Sample size and Sampling Techniques

In this study, the sample size was assessed and calculated based on the known sampling formula called Yamane's formula for calculating sample size.

$$n = \frac{N}{1+N(e)^2} \dots\dots\dots \text{Equation 1}$$

$$n = \frac{85}{1 + 85 (0.05)^2}$$
$$= 70$$

Where n = number of sample size and N = Total number of study population e= level of confidence to have in the data or degree of freedom which is 95% apply for this study with 5% error.

Table 3.8-1 Target Population Strata Target Population

Type (Strata)	Target Population	Proportion	Sample
Client- Ethiopian Roads Administration:	31	0.8235	26
Respective respondents: Counter-part Engineer, Team Leaders of the respective project	15	0.8235	12
Top Supervision Consultant: The Resident Engineer of the project and Contract Administration Head	18	0.8235	15
Contractor: The Project Manager of the project and the Contract Administration Head of the Project	21	0.8235	17
Total	85		70

Source: Ethiopian Roads Administration, 2023/24

This study employed both *probability and non-probability sampling methods*. The proportionate stratified random sampling technique provided the foundation for selecting samples from the target population among probability sampling techniques. It is crucial to use this sample technique to fairly choose employees from senior, middle, and other levels of staff according to their relative proportions.

The base of the strata was their engagement in road project related activities and their supportive role partnership in implementation road projects in Ethiopian Roads Administration in various areas around the study area. It was stratified by **Client-** Ethiopian Roads Administration, Respective respondents: *Counter-part Engineer, Team Leaders and Directors of the respective project*, **Supervision Consultant:** *The Resident Engineer of the project and Contract Administration Head* and **Contractor:** *The Project Manager of the project and the Contract Administration Head of the Project*. Every targeted employee has the opportunity to participate in the survey. Additionally, it used a straightforward random selection technique to find study participants within the workforce.

Purposive sampling, a non-probability sample approach, was employed to pick the questioned organization in Ethiopian Roads Administration, Contractor, Consultant and obtain qualitative data. Purposive sample was chosen in order to include people with more expertise, familiarity with the topic, and wealth of data in the research domain. Furthermore, Bertaux (1981), who claimed that a minimal sample size for an interview was fifteen, was used to determine the interviewee sample size, which was fifteen.

3.9. Data Collection Method

A questionnaire was used to gather the data, which was then arranged and tallied to depict the current condition of events. As well, an interview was prepared and collected qualitative data. This research used various instruments to collect the relevant information to identify the impact the increase of cost of construction materials has on the cost of the project in road projects being administered by ERA. In addition to the Questionnaire and Interview, a desk study of the secondary data was conducted to collect the required data for the research.

3.9.1 Questionnaire

Questionnaire is used for data collection meanwhile it was easy to get a wide range of data in a short period of time from each respondent. It is adapted from Solomon (2017) for cost fluctuation and Nuru and Ilias (2014) for project cost and effective scheduling performance. Both closed-ended and open-ended questions were included in the questionnaire designs. Five-point Likert scale measuring questions, ranging from strongly disagree to strongly agree, were used in its preparation. This is because the five-point Likert scale, which is a typical rating system that enables respondents to rank quality from best to worst or high to low, is commonly proposed by respondents as being more appropriate and understandable.

3.9.2 Interview

To get relevant information regarding the cost fluctuations of major materials and project costs of the studied project—the road project—interview sessions were organized using an interview questions. The study applied face to face to cover up to fifteen officers, employees and managers who was working in ERA, Contractor and Consultant's office.

3.9.3 Document Review - Desk Study

Table 3.9-1 Sources of Price used for the Study Analysis

No.	Description of Adjustable Item	Source of Price/ Index	Remark
1	Fuel	ERA Head Office-Selected Projects Payment Certificate, July 2018-June 2023, Price Source from NoC	Fuel price= Birr/Liter
2	Cement	ERA Head Office-Selected Projects Payment Certificate, July 2018-June 2023, Price Source from-Mugher Cement Factory	Cement Price=Birr/Qtl
3	Reinforcement Steel	ERA Head Office-Selected Projects Payment Certificate, July 2018-June 2023, Price Source from-Ethiopian Iron and Steel	Price of diameter 16 reinforcement bar is used
4	Bitumen	ERA Head Office-Selected Projects Payment Certificate, July 2018-June 2023, Price Source from-NoC	Bitumen Price= Birr/Ton

Source – Results of the Study, 2023/24

***Note: Assumptions: This study assumed no difference in the price due to brand difference*

In order to calculate the cost of construction input components for the five years, July 2018 was fixed as the base year, and the monthly price trend for the adjustable construction inputs was displayed. The data from the desk study served as a secondary data source to provide the pertinent information from the projects' Interim Payment Certificate (IPC), Progress Report, Contractors' payment certificate, Contract Agreements, Variation Orders, and other relevant documents that gave the researcher the required basis, in addition to the Literature Review, to identify the status of the road projects from fluctuation of construction materials on project. The developed questionnaire was serving as a primary data source that provides on the ground data in regards to the cause and factors of increase of cost of construction materials in the respective road projects.

3.10 The Research's Credibility

Any study's sharp decline in incorrect answer rates highlights the need to give special attention to two aspects of research design: validity and reliability.

3.10.1 Validity

In order to verify the look, applicability, and representativeness of the survey in this study, face and content validity are supported. It has the approval of several people, including subject-matter specialists in infrastructure development and construction project management. Ten professionals who are actively engaged in the field pretested the survey in addition to it. The checklist for the interview and questionnaire was modified using a few pertinent studies and literatures. Additionally, the instrument utilized to measure the targeted difficulties was able to meet the requirements of the survey, which was based on pertinent theories and tested by experts.

3.10.2 Pilot Test

To determine whether the questionnaires could yield the data needed to meet the study's goals and hypotheses, a pilot test was carried out in this investigation. In order to verify its validity, twelve questionnaires were circulated and sent to various road construction projects in Addis Ababa as well as project experts and professionals from the Addis Ababa Rod Authority.

3.10.3 Reliability

The Cronbach's alpha statistics were used to assess the instrument's degree of reliability, which is determined by the consistency of the variables. According to Croswell (2014), Cronbach's alpha is a reliability indicator linked to the variation explained by the underlying construct's true score.

Table 3.10-1 Analysis of the level of Reliability

Variables	. Cronbach's alpha	Items	Decision
Fuel	.780	4	Accepted
Bitumen	.815	4	Accepted
Cement	.812	4	Accepted
Steel	.801	4	Accepted
Project Costs	.798	6	Accepted

Source – Results of the Study, 2024

The scales' total Cronbach's alpha (more than 0.75 see Table 3) was used. As a result, it shows that the instrument of choice measures the variables chosen with accuracy and that the scales' reliability was extremely high, displaying a very good internal consistency among the measurement items.

3.11 Data Management and Quality

Supervisors verified the consistency and completeness of the data, and the primary investigator double-checked it. The lead investigator entered data and used SPSS V.25 for cleaning and analysis. Frequency analysis was used to verify the accuracy of the data entry, and range checks were performed each time. Data input errors were fixed by cross-referencing the completed surveys.

3.12 Data Analysis and Interpretation

The data was collected through the questionnaire that was recorded, edited, organized, analyzed, interpreted and presented based on research questions through descriptive statistical tools such as tables, figures, percentages, and standard deviation supported with SPSS V. 25 software.

Based on research questions, the secondary data—more especially, the data from the Interim Payment Certificates for the eight projects under investigation—was gathered, arranged, examined, analyzed and presented.

3.12.1 Descriptive Analysis

The mean and standard deviation were two examples of descriptive statistics that were used to describe the properties of the variables under investigation. To help with explaining and interpreting the research's findings, it was presented in a clear and meaningful way. In order to characterize the socio-demographic features of the participants and to compile the respondents' opinions regarding the difficulties with project management techniques, descriptive statistics were computed.

Additionally, the data was gathered in a qualitative manner. It was first written down, then arranged according to the study's goal. After that, it was coded, given meaning, categorized, edited, and structured thematically and through descriptive narration.

3.12.2 Analysis Using Inferential Statistics

Additionally, inferential statistics were used to examine the relationship between the independent variable (cost fluctuation of construction material) and the dependent variable (project cost), such as Pearson correlation and regression. Bivariate correlation was one of the inferential statistics used to examine the relationship between the independent and dependent variables. Furthermore, a multiple linear regression model was utilized to ascertain the combined influence on the relationship between the challenges of project management methods, while correlation and linear regression were used to test for relationships. According to Stephanie (2018), multiple linear regression may also be used to calculate the model's overall fit (variance explained) and the relative contributions of each predictor to the total variance explained. When someone decides to use multiple regression analysis for their data analysis, part of the procedure entails making sure that the data as the researcher wanted to analyze that can actually be analyzed using multiple regression.

Model Specification

The theoretical regression model serves as the foundation for the study's multiple linear regression model, as shown below.

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e$$

Where:

Y= Project Cost

a= the y intercept.

X₁ – Cost Fluctuation of Cement

b₁= the regression coefficient of X₁

X₂ – Cost of Fluctuation of Reinforcement Bar

B₂= the regression coefficient of X₂

X₃ – Cost Fluctuation of Fuel

B₃= the regression coefficient of X₃

X₄ – Cost Fluctuation of Bitumen

B₄= the regression coefficient of X₄

e= error term.

Model Assumptions

To confirm that the data supported the core assumptions of the traditional linear regression model, the following diagnostic tests were performed. For this exam, Stephanie's (2018) presumptions were applied.

- **Normality:** Descriptive statistics were employed in order to confirm the normalcy. A normal distribution is non-skewed and has a coefficient of kurtosis of. Normality is the form of the data distribution or a single metric variable and its relationship to the normal distribution, which is the benchmark for statistical methods.
- **Tests for Autocorrelation:** For the disturbance components of the CLRM, it is assumed that the covariance between the error terms across time (or cross-sectional, for that type of data) is zero. If not stated differently, it is assumed that the errors have no relationship. If there is no correlation between the errors, they are referred to as "auto correlated" or "serially correlated."
- **Heteroscedasticity** – It suggests that there is a variation in the error terms. Heteroscedasticity causes the estimators of the ordinary least squares method to become inefficient, and it also reduces the validity and reliability of hypothesis testing by underestimating variances and standard errors.
- **Multicollinearity:** A severe case of multicollinearity may be indicated by any correlation coefficient more than 0.7, which would lead to erroneous estimations and less reliable findings.

3.13 Ethical Considerations

The study took into account the generally recognized and thorough research ethics, which serves as a reminder that it is unethical for a researcher to conceal information from us or offer a biased report. They were informed that they could end the interview at any time. Confidentiality of the study was scrupulously maintained throughout. As was already noted, every piece of supporting paperwork and scientific data that was accessible was examined and appropriately acknowledged in terms of study ethics.

A standardized questionnaire was employed in the study to gather data. Good qualitative data from the questionnaires was used to elicit more viewpoints on the assertions. Since questionnaires also provide respondents with the anonymity needed for study, they were free to express their opinions. The goal of the study and the need that personal data be kept anonymous were explained to research participants. Furthermore, all research participants provided written consent after being fully informed. Respondents received assurances that the study would only be used for research, that their opinions would be considered when they answered, and that a standard question would be asked. The university and the appropriate authorities gave their approval for this research to be conducted.

CHAPTER FOUR

RESULTS, ANALYSIS, AND INTERPRETATION

4.1. Introduction

The chapter’s findings, analysis, and discussion are based on the impact that occurred on the cost of the eight case study projects due to the price fluctuation of the major construction inputs for five years as of July 2018 and the same is depicted through the undermentioned sections.

4.2. Result, Analysis and Interpretation using Secondary Data

4.2.1. Price Trend Using Secondary Data

The Interim Payment Certificate (IPC) of each case study projects were considered to extract the price fluctuation of the fuel price over the past Five (05) years as compared to the original price (Shown by Fo) considered in the contract.

4.2.1.1. Fuel Price Trend

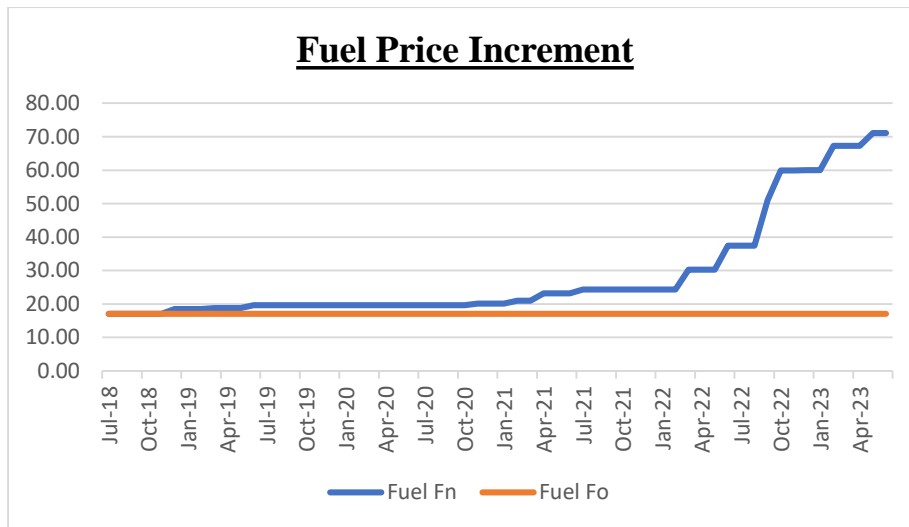


Figure 4.2-1 Fuel Cost trend

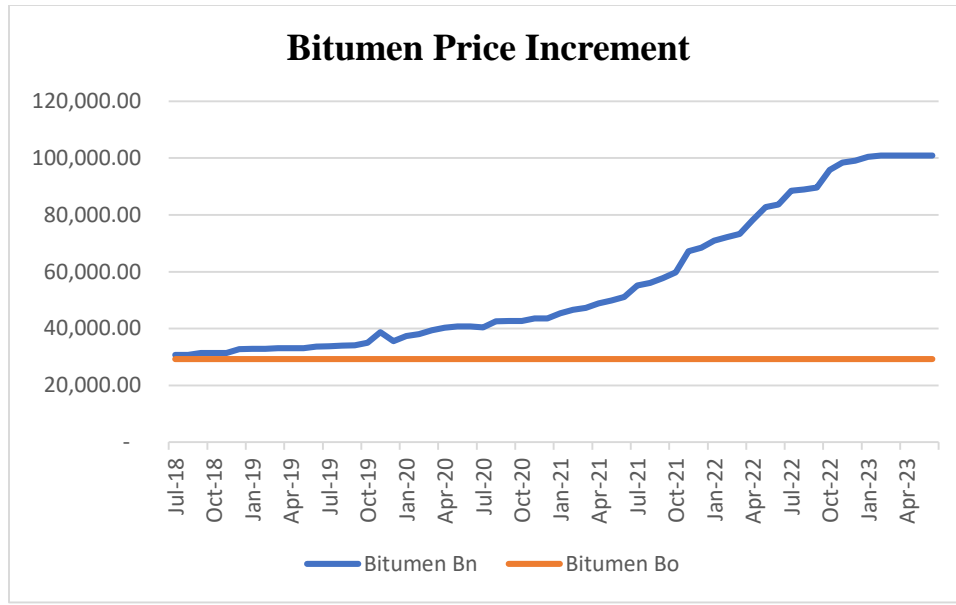
Source – ERA 2018 – 2023, Secondary Data, 2024

It is evident by looking at the above result that the cost of fuel has increased over time. As can be seen, the basic value of fuel for the ERA 8 projects was Birr 17.10 for the payment made in the month of July 2018 and Birr 17.06 per liter was the contractual price considered while calculating the overall project cost. In November 2018 it went up to Birr 18.53 and in June 2019, it raised once more to Birr 19.67 per liter in June 2019. The increase for the year was roughly Birr 2.61, which is regarded as a very little increase. However, during the course of a year, from November 2020 to November 2021, the increase nearly doubled to 4.26 per liter. November 2021 saw the beginning of a roaring price increase, starting at Birr 24.37 per Litter. From then, it went to 30.23 on March 2020, 37.41 on June 21, and on November 20, 2022, the year trend reached 59.88, with a documented growth in fuel prices of 35.51 percent.

A staggering 19% increase in price, from Birr 59.99 per Litter to 71.13, was also observed in the last six months of data. Up until the most recent ERA date, the cost of fuel for eight road construction projects has shockingly grown by 316% instead of decreasing. The cost of gasoline has climbed by more than 300 percent in these projects, and it is impossible to forecast with any degree of accuracy whether this cost would rise sharply throughout the course of a contract. It means expenses associated with transporting supplies and equipment can rise due to higher diesel fuel prices, which can impact the total cost of road construction.

4.2.1.2. Bitumen Price Trend

The cost of Bitumen (birr/ton) has been taken from the same projects and district rates of the respective district on which the project was implemented. The graphs below show the actual trend and the contract price cost of bitumen in the eight projects. As bitumen is used in road construction so all eight projects have been considered.



Bn = Fluctuated Price Bo = Contract price

Figure 4.2-2 Bitumen Cost trend

Source – ERA 2018 – 2023, Secondary Data, 2024

In a similar vein, it is evident that bitumen prices have changed over time. Base bitumen value in eight projects is Birr 29,285 birr per ton (*the contractual price considered while calculating the overall project cost*) and Birr 30,772.60 for contract price as of July 2018. Starting from the month October 2019 the rise in the price of Bitumen increased significantly.

The data indicates that over the five-year's the price of bitumen increased with an average of 92%, and the most recent price in the month of June 2023 was valued at 100,924.40 per metric ton, which represents a 245% increase from the contract price of 29,285. The average actual price payment over the course of the five years is Birr 56,173.89.

4.2.1.3. Steel Price Trend

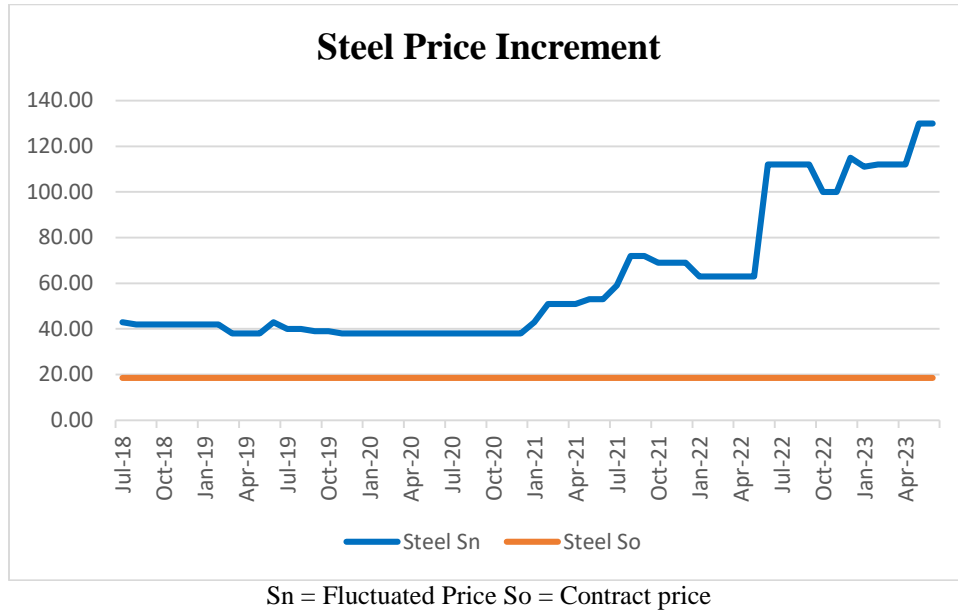
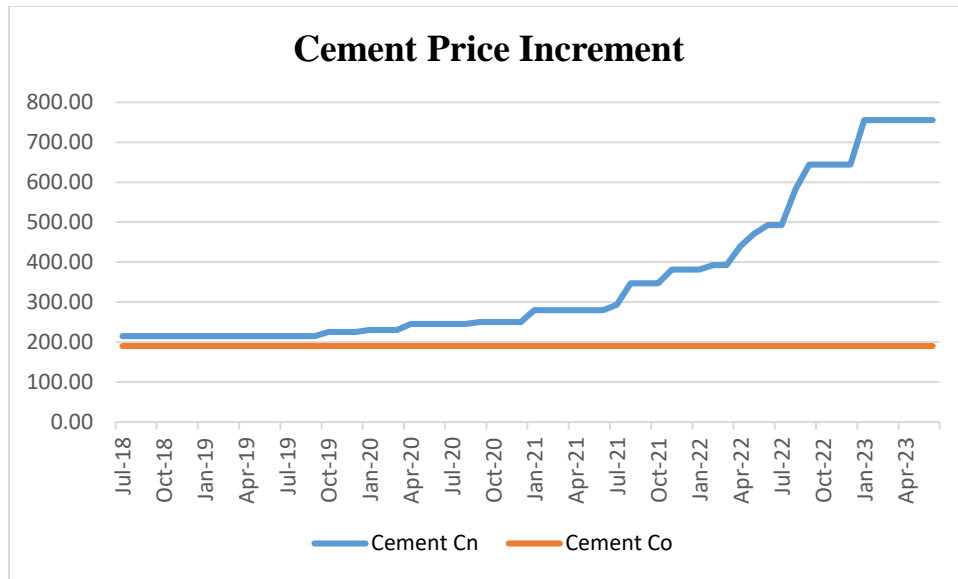


Figure 4.2-3 Steel Cost Trend

Source – ERA 2018 – 2023, Secondary Data, 2024

The price of reinforcement steel has been varying throughout time, as the accompanying figure illustrates. As can be observed, the cost of reinforcement steel shows an increasing tendency, with a base value of 43.00 Birr/Kg in July 2018 and a maximum of 71.13 Birr/Kg in June 2023. The cost of the reinforcing bar increased steadily between the reporting years, starting in January 2021 after declining in April 2019 and growing gradually but at a predictable rate until June 2023. The market then became unstable and rose to 112 Birr/kg in July 2022, which represents an inflated cost growth in less than a year and is three times (by 160%) higher than July 2022 to June 2023.

4.2.1.4. Cement Price Trend



Cn = Fluctuated Price Co = Contract Price

Figure 4.2-4 Cement Price Trend

Source – ERA 2018 – 2023, Secondary Data, 2024

The price of packed Cement shows a minor increase between July 2018 and December 2019, as the preceding figure illustrates. Then, from July 2020 to July 2021, there is a gradual increase in price. The price of cement rises dramatically starting in November 2021 and reaches its final value in June 2023. Between October 2017 and March 2022, October 2018 and March 2022, and October 2019 and March 2022, respectively, there was a 119.61, 104.21, and 104.21% increase in cement prices. In general, between July 2015 and March 2022, the price of cement increased by more than a factor of ten (111.64%), which is hardly predictable. This data shows that the trend of cement price displays increases of 14% in July 2019, 57% through July 2021, 60% in July 2022, and 53% in the final date value. It means the dynamics of supply and demand may also have an influence on cement prices. Prices are raised as there is a high demand and a limited supply for cement.

4.2.2. Impact of the increment of price of Fuel, Cement, steel and Bitumen on the Monthly Project Cost

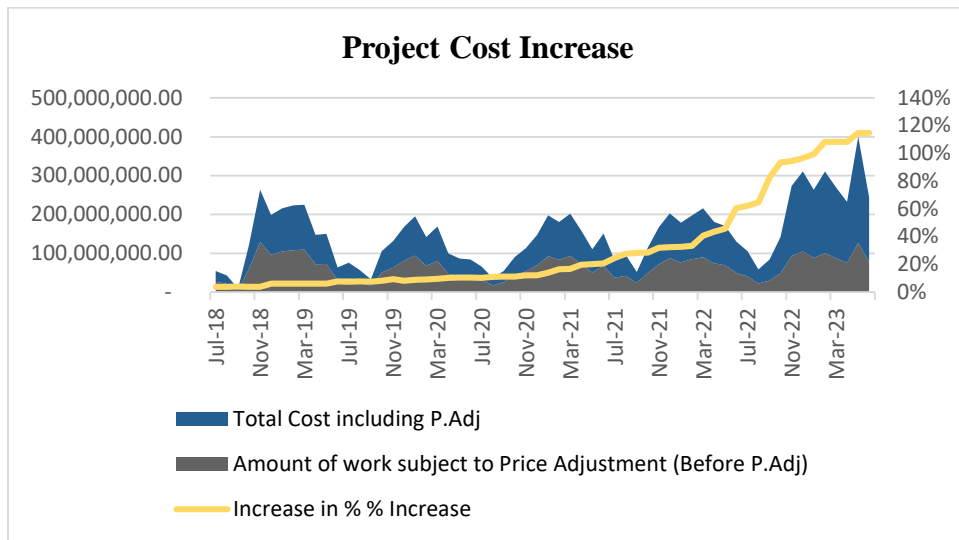


Figure 4.2-5 Amount of Work and Price Adjustment

Source – ERA 2018 – 2023, Secondary Data, 2024

In the above figure, it can be noted the impact of the cost fluctuation of the major construction materials (Fuel, Cement, Steel and Bitumen) on the monthly project Cost. It can be noted that from the period of July 2018 to June 2021 (the first three years), the increment in the cost of the project due to the increment of the price of the construction materials was up to a maximum of 20%. However, in the fourth year the increment of the cost raised to an average 38% (*ranging from a min. 24% to max. 61%*). Even more in the fifth year (*July 2022 to June 2023*), the increment of the cost raised to an average 96% (*ranging from a min. 62% to max. 115%*). This produced a cost overrun, an unforeseen adjustment to the project budget that increases the project's ultimate cost. There are three primary reasons why it could happen as per the experts and managers of ERA in interview sessions: economic factors resulting from mistakes in the project's budget or scope and technical reasons, like imprecise data collection techniques or estimation errors.

Due to the exceptional price increment trend for construction inputs, contractors may seek payment for increased costs that were unpredictable during the bidding process. This data demonstrates that there is variation in the quantity of work that is really subject to price adjustments, both in terms of the amount adjusted before and throughout the time. Furthermore, nearly every ERA project was unable to finish on time, making it necessary to extend the deadline for project completion.

Regarding this, the Ethiopian Civil Code, specifically Article 3183 sub-articles 1 and 2, states that the party entering into a contract with the administrative body will make every effort to carry out his obligations in the event of unforeseen circumstances. However, the administrative body will share the losses resulting from these circumstances with the contracting party in order to help them overcome the obstacles that arise. Therefore, when viewed in accordance with the Works Contract provision of risk allocation and pertinent provisions of the law of the country, the contract price adjustment on the contract provision is found to be an unfair and unbalanced risk/reward allocation mechanism between ERA and the Contractor as it is no longer providing the required compensation to the Contractor for the price fluctuation of construction materials.

4.2.3. Price Adjustment from Payment Certificates

This research has used the data from Monthly Progress Reports, Monthly Interim Payment Certificates (*Five Year Data*), ERA Annual Budget for Projects (*Five Year Data*), Contractors' payment certificate, Contract Agreements, Variation Orders, and other relevant documents to assess the impact of cost fluctuation of construction materials on the construction cost. To clearly show the impact of the price fluctuation of the construction materials it is assessed from the undermentioned angles.

- *Impact of Cost fluctuation of Construction materials in regards to the Price Adjustment*
- *Impact of cost fluctuation of Construction materials in regards to ERA budget for the projects*
- *Claims raised by the Contractors in regards to the Price Adjustment Weightage*

4.2.3.1. Impact of Cost fluctuation of Construction materials in regards to the Price Adjustment

The research analyzed the Monthly Payment Certificate of the Eight (08) projects under the study and identified the value of the impact of the price adjustment of Fuel, Cement, Bitumen and Reinforcement Bar on the monthly project cost.

As discussed in the previous sections of the research, the price of each aforementioned construction materials have been recorded in the monthly Payment Certificate and the monthly price increase of the same is used to calculate the cost adjustment for each month. The same can be summarized in the undermentioned formula:

Monthly Project Cost of the Road = Cost for the work executed + Price Adjustment for the Price fluctuation of the Construction materials

Accordingly, the cost of the works (on a monthly basis) has been summarized for each of the eight projects and also the additional cost that is due to the price adjustment of the construction material is calculated using the Price Adjustment formula

$$P_n = A + \frac{bL_n}{L_o} + \frac{cM_n}{M_o} + \frac{dE_n}{E_o} + \dots etc$$

Where:

***P_n** is a price adjustment factor to be applied to the amount for the payment of the work carried out in each month excluding Design and Employer's Representative Facilities;*

A is a constant, specified on the Contractor's bid, representing the non-adjustable portion in Contractual payments;

***b, c, d etc.,** are weightings or coefficient representing the estimated proportion of each cost element (labour, material, equipment etc) in the works or sections thereof, as specified in the Contractor's bid; the sum of A, b, c, d etc..., shall be one;*

***L_o, M_o, E_o etc.,** are the base cost indices or reference prices of the cost elements at the date 28 days prior to the deadline for bid submission*

Therefore, in the undermentioned sections of the research the specific impact of the price fluctuation of each construction material on the project cost for a period of Five years as of July 2018 is discussed.

4.2.3.2. Impact of Fuel Price Fluctuation on the Project Cost

The Price of Fuel at the start of July 2018 is 17.10 Birr /Lit and during the course of the five years, the same has raised to 71.13 Birr /Lit. Accordingly, the impact of the same on each of the eight projects over the period of the Five (05) years can be shown in the table here-below:

Table 4.2-1 The Impact of Fuel Price Fluctuation on the Project Cost for Five years

Project Name	Cost for the Construction of the Works in ETB (A)	Amount of Price Adj. for the price Fluctuation of Fuel in ETB (B)	Total Project Cost in ETB (C=A+B)	Comparison of P.Adj to Project Cost in ETB (D=B/A,%)	% of the Price Adj. of Fuel from the Total Project Cost of the Project in ETB (E=B/C)
Project A	800,649,101.42	207,206,095.81	1,007,855,197.23	25.88%	20.56%
Project B	477,009,726.41	50,431,008.09	527,440,734.50	10.57%	9.56%
Project C	267,809,109.64	21,968,255.14	289,777,364.79	8.20%	7.58%
Project D	419,357,684.80	32,609,233.36	451,966,918.17	7.78%	7.21%
Project E	308,737,463.95	45,620,288.25	354,357,752.19	14.78%	12.87%
Project F	652,778,045.13	121,490,531.32	774,268,576.45	18.61%	15.69%
Project G	628,872,880.27	117,317,882.39	746,190,762.66	18.66%	15.72%
Project H	274,015,206.96	35,777,138.74	309,792,345.69	13.06%	11.55%
Total	3,829,229,218.58	632,420,433.10	4,461,649,651.68	16.52%	14.17%

As it can be seen from the above table, the total cost of Price adjustment due to the fluctuation of fuel price amounts around 16.52% of the net cost of the works and a 14.17% of the total cost due to the Contractor. The same is shown in above table as from the total cost of the projects that is due to the Contractor for the five-year duration, ETB: **4,461,649,651.68**, 14.17% of the same i.e. ETB: **4,461,649,651.68** is due to the adjustment done for fuel price fluctuation.

4.2.3.3. Impact of Cement Price Fluctuation on the Project Cost

The Price of Cement at the start of July 2018 is 190 Birr /Qtl and during the course of the five years, the same has raised to 755.40 Birr/Qtl. Accordingly, the impact of the same on each of the eight projects over the period of the Five (05) years can be shown in the table here-below:

Table 4.2-2 The Impact of Cement Price Fluctuation on the Project Cost for Five years

Project Name	Cost for the Construction of the Works in ETB (A)	Amount of Price Adj. for the price Fluctuation of Cement in ETB (B)	Total Project Cost in ETB (C=A+B)	Comparison of P.Adj to Project Cost in ETB (D=B/A,%)	% of the Price Adj. of Cement from the Total Project Cost of the Project in ETB (E=B/C)
Project A	800,649,101.42	57,960,565.40	858,609,666.82	7.24%	6.75%
Project B	477,009,726.41	16,845,319.55	493,855,045.97	3.53%	3.41%
Project C	267,809,109.64	7,179,364.33	274,988,473.97	2.68%	2.61%
Project D	419,357,684.80	11,459,822.98	430,817,507.78	2.73%	2.66%
Project E	308,737,463.95	13,771,862.86	322,509,326.81	4.46%	4.27%
Project F	652,778,045.13	35,669,683.41	688,447,728.55	5.46%	5.18%
Project G	628,872,880.27	35,590,822.66	664,463,702.92	5.66%	5.36%
Project H	274,015,206.96	10,615,907.96	284,631,114.92	3.87%	3.73%
Total	3,829,229,218.58	189,093,349.15	4,018,322,567.74	4.94%	4.71%

As it can be seen from the above table, the total cost of Price adjustment due to the fluctuation of cement price amounts around 4.94% of the net cost of the works and a 4.71% of the total cost due to the Contractor. The same is shown in above table as from the total cost of the projects that is due to the Contractor for the five-year duration, ETB: **4,018,322,567.74**, 4.71% of the same i.e. ETB: **189,093,349.15** is due to the adjustment done for cement price fluctuation.

4.2.3.4. Impact of Reinforcement Bar Price Fluctuation on the Project Cost

The Price of Reinforcement Bar (dia. 16) at the start of July 2018 is ETB: 18.50 and during the course of the five years, the same has raised to ETB: 130. Accordingly, the impact of the same on each of the eight projects over the period of the Five (05) years can be shown in the table here-below:

Table 4.2-3 The Impact of Reinforcement Bar Price Fluctuation on the Project Cost for Five years

Project Name	Cost for the Construction of the Works in ETB (A)	Amount of Price Adj. for the price Fluctuation of R. Bar in ETB (B)	Total Project Cost in ETB (C=A+B)	Comparison of P. Adj to Project Cost in ETB (D=B/A,%)	% of the Price Adj. of R. Bar from the Total Project Cost of the Project in ETB (E=B/C)
Project A	800,649,101.42	51,316,307.94	851,965,409.35	6.41%	6.02%
Project B	477,009,726.41	19,695,850.73	496,705,577.14	4.13%	3.97%
Project C	267,809,109.64	9,499,575.04	277,308,684.68	3.55%	3.43%
Project D	419,357,684.80	14,814,891.85	434,172,576.66	3.53%	3.41%
Project E	308,737,463.95	14,283,747.29	323,021,211.24	4.63%	4.42%
Project F	652,778,045.13	33,307,381.52	686,085,426.65	5.10%	4.85%
Project G	628,872,880.27	34,068,207.71	662,941,087.98	5.42%	5.14%
Project H	274,015,206.96	11,336,360.00	285,351,566.96	4.14%	3.97%
Total	3,829,229,218.58	188,322,322.08	4,017,551,540.66	4.92%	4.69%

As it can be seen from the above table, the total cost of Price adjustment due to the fluctuation of R. Bar price amounts around 4.92% of the net cost of the works and a 4.69% of the total cost due to the Contractor. The same is shown in above table as from the total cost of the projects that is due to the Contractor for the five-year duration, ETB: **4,017,551,540.66**, 4.69% of the same i.e. ETB: **188,322,322.08** is due to the adjustment done for R. Bar price fluctuation.

4.2.3.5. Impact of Bitumen Price Fluctuation on the Project Cost

The Price of Bitumen at the start of July 2018 is ETB: 29,285.00 and during the course of the five years, the same has raised to ETB: 100,924. Accordingly, the impact of the same on each of the eight projects over the period of the Five (05) years can be shown in the table here-below:

Table 4.2-4 The Impact of Bitumen Price Fluctuation on the Project Cost for Five years

Project Name	Cost for the Construction of the Works in ETB (A)	Amount of Price Adj. for the price Fluctuation of Bitumen in ETB (B)	Total Project Cost in ETB (C=A+B)	Comparison of P. Adj to Project Cost in ETB (D=B/A,%)	% of the Price Adj. of Bitumen from the Total Project Cost of the Project in ETB (E=B/C)
Project A	800,649,101.42	112,626,060.20	913,275,161.62	14.07%	12.33%
Project B	477,009,726.41	36,440,948.96	513,450,675.37	7.64%	7.10%
Project C	267,809,109.64	14,483,389.17	282,292,498.81	5.41%	5.13%
Project D	419,357,684.80	26,116,374.44	445,474,059.24	6.23%	5.86%
Project E	308,737,463.95	27,929,097.63	336,666,561.58	9.05%	8.30%
Project F	652,778,045.13	73,902,474.37	726,680,519.50	11.32%	10.17%
Project G	628,872,880.27	74,073,584.18	702,946,464.45	11.78%	10.54%
Project H	274,015,206.96	21,523,404.58	295,538,611.54	7.85%	7.28%
Total	3,829,229,218.58	387,095,333.53	4,216,324,552.11	10.11%	9.18%

As it can be seen from the above table, the total cost of Price adjustment due to the fluctuation of Bitumen price amounts around 10.11% of the net cost of the works and a 9.18% of the total cost due to the Contractor. The same is shown in above table as from the total cost of the projects that is due to the Contractor for the five-year duration, ETB: **4,216,324,552.11**, 9.18% of the same i.e. ETB: **387,095,333.53** is due to the adjustment done for Bitumen price fluctuation.

4.2.3.6. Total Impact of the Construction Materials Price Fluctuation on the Project Cost

As it is discussed in the previous sections of the research it is clearly noted that the cost of construction materials has increased significantly over the past few years and its without say that the same had an impact on the different sectors of the country and the road construction is no exception.

However, the price fluctuation of the construction materials over the past few years has caused a more significant challenge than the previous fluctuations noted in the past 10 years in the road sector. This can be noted in the undermentioned scenarios created:

4.2.3.6.1. Price Adjustment Clause and Contract Administration

There is a noted and reported difficulty by ERA in the administration of the price Adjustment as per the agreed terms of the Contract, as the fluctuation surpassed the conditions set in the contract. One of the basic principles of Contract is fairness. In accordance, the proper management of risk is one key principles that ERA tries to implement in its Contracts. Accordingly, the Contracts incorporate a price adjustment clause for the reason of sharing risk between the Employer and Contractor that might occur if the price of construction materials fluctuates higher or lower than the original assumption during the signing of the contract with the specified contract amount/cost.

In this regard, ERA has set a limit (i.e. *20% of the Contract Price*) on the price adjustment of materials, equipment and labour price fluctuations. Over the past years of contract administration of road projects, it was noted that only few projects surpassed this limit before finalization of the majority of the construction works. In connection

However, as shown in the previous sections of the report, in the past few years it is noted that the significant fluctuation of material prices has caused the Cost of the project to surpass this price adjustment limit set by ERA on the Contracts (i.e. *20% of the Contract Price*). In addition, the Contractors, as an experienced contractor, are expected to have a risk margin amount allocated as a contingency in their price calculation during the bidding stage of the project due for any unanticipated risks that might occur during the implementation of the project. Similar to the limit

set by ERA, the risk margins set by Contractor's (*i.e. approximately 5%*) have also been surpassed because of the unanticipated price fluctuation of Construction materials over the past few years.

The aforementioned impact of unanticipated price fluctuation can be noted in the eight (08) projects under review by this research as shown in the table below.

Table 4.2-5 Impact of Price Fluctuation of Construction Materials on Project Cost

Project Name	Cost for the Construction of the Works in ETB	Amount of Price Adj. for the price Fluctuation of all Materials in ETB (B)	Total Project Cost in ETB	Comparison of P. Adj to Project Cost in ETB (D=B/A,%)	% of the Price Adj. of materials from the Total Project Cost of the Project in ETB (E=B/C)
	(A)		(C=A+B)		
Project A	800,649,101.42	429,109,029.35	1,229,758,130.77	53.60%	34.89%
Project B	477,009,726.41	123,413,127.33	600,422,853.74	25.87%	20.55%
Project C	267,809,109.64	53,130,583.68	320,939,693.32	19.84%	16.55%
Project D	419,357,684.80	85,000,322.63	504,358,007.43	20.27%	16.85%
Project E	308,737,463.95	101,604,996.03	410,342,459.98	32.91%	24.76%
Project F	652,778,045.13	264,370,070.62	917,148,115.75	40.50%	28.83%
Project G	628,872,880.27	261,050,496.94	889,923,377.21	41.51%	29.33%
Project H	274,015,206.96	79,252,811.28	353,268,018.24	28.92%	22.43%
Total	3,829,229,218.58	1,396,931,437.86	5,226,160,656.44	36.48%	26.73%

As it can be seen from the above table, the total cost of Price adjustment due to the fluctuation of construction material (*Fuel, Cement, Reinforcement Bar and Bitumen*) price amounts around 36.48% of the net cost of the works in the Eight Projects and a 26.73% of the total cost due to the Contractor, which is more than the CAP limit on the Contracts. The same is shown in above table as from the total cost of the projects that is due to the Contractor for the five-year duration in the Eight Projects, ETB: **5,226,160,656.44**, 26.73% of the same i.e. ETB: **1,396,931,437.86** is due to the adjustment done for material price fluctuation.

In addition, from the total cost that is due to fluctuation (ETB: **1,396,931,437.86**) the percentage contribution of each material is as shown in the graph here-below.

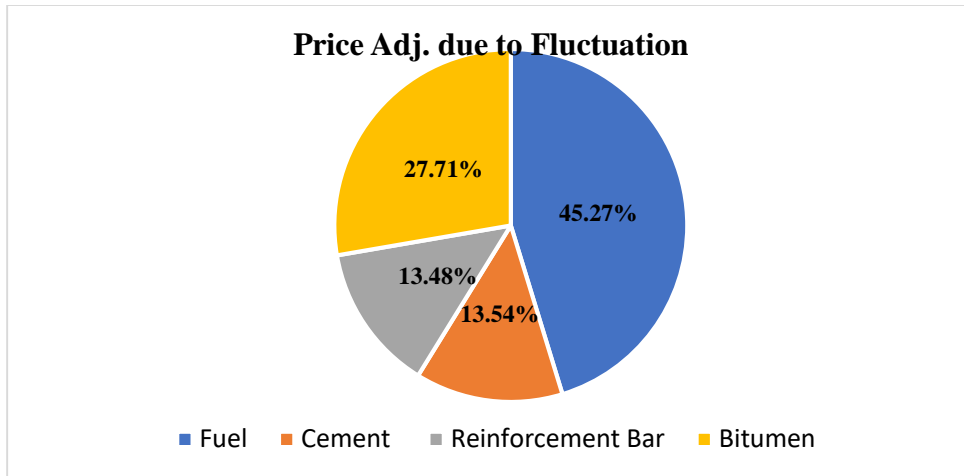


Figure 4.2-6 Price Adj. due to Fluctuation
 Source – ERA-Payment Certificate- Secondary Data, 2024

As shown in the above table, it is noted that from the four construction materials, the material with significant contribution to the cost of the project due to the construction material is firstly Fuel, followed by Bitumen, Cement and reinforcement bar.

In addition, as discussed in section 4.2.5 of this research and depicted in the graph here-below, it can also be noted that a significant rise in the price adjustment cost was observed as of the year of 2022. Starting from 2022, the rise of material cost spiked starting from 50% to 115% of the cost of the works due that period.

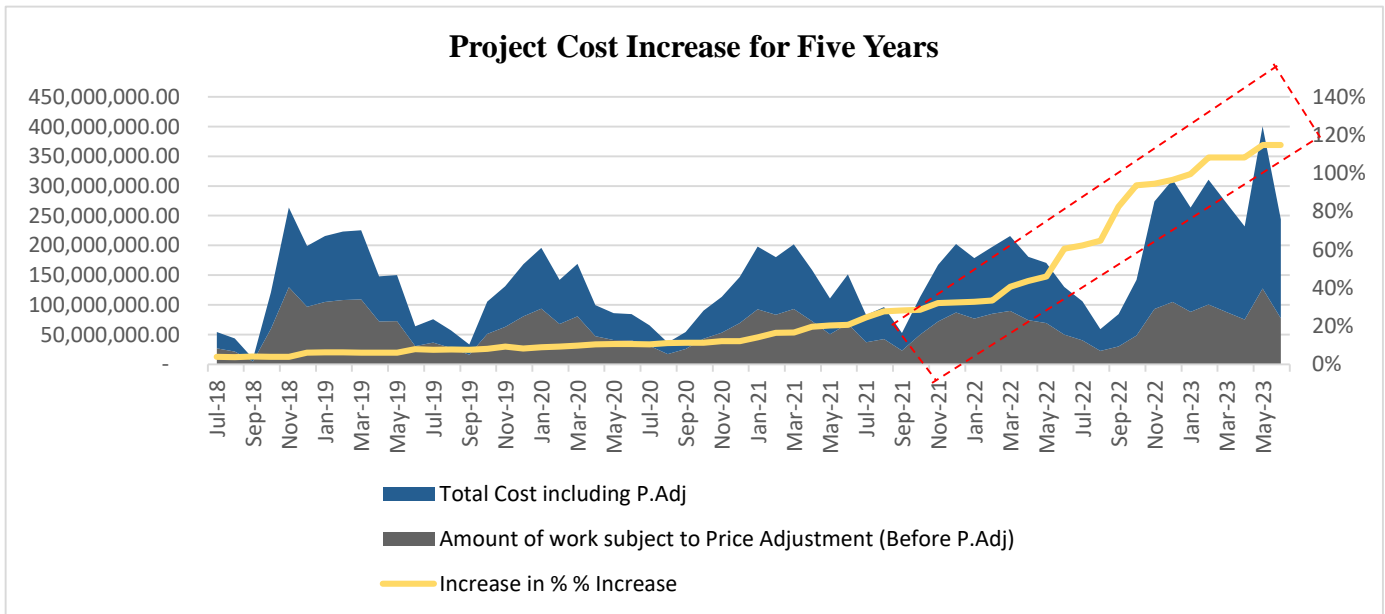


Figure 4.2-7 Amount of Work and Price Adjustment
 Source – ERA 2018 – 2023, Secondary Data, 2024

4.2.3.6.2. Claims by Contractors

As discussed in the previous sections of the research, ERA has Price Adjustment clauses in its contracts in order to share the risks associated with the fluctuation of construction material prices, labour & equipment and accordingly in addition to the cost for the construction of the works, by using the price adjustment formula, the price of fluctuation of the construction materials is adjusted and added on the net construction cost of that period. However, as per the records in ERA, it is noted that the Contractors of the projects are submitting a claim in regard to the request for modification of the price adjustment formula.

The Contractors have claimed that the price adjustment formula is no longer compensating the cost that is endured by them, as the fluctuation is beyond the anticipated assumptions and hence, the revision of the price index on the formula is requested.

The price Adjustment formula, as shown here-below, has a fixed non- adjustable portion of 30% in all the contracts. In addition, the formula as designated by *b,c,d....* has weightings of Coefficients representing the estimated proportion of each cost element (*labour, material, equipment etc*) in the works. The element of the formula is set by ERA and incorporated in the contracts. The Proportion of the non-adjustable factor and the portion of the indexes was not an issue for either the Contractors or the Employer five years earlier, however over the past few years in consequence to the spiking fluctuation (*more than the anticipation*), the price adjustment formula has not fully compensated the cost incurred by the contractors for the purchase and utilization of construction materials. Accordingly, the submitted claims by contractors implicate the request for the reduction in the 30% non-adjustable portion and revision of the weightage of each adjustable element (*Construction materials, labour and Equipment*). The claims by the contractors indicated that for the reason of the price adjustment not clearly compensating the cost they incurred for the purchase and utilization of the construction materials, they have faced serious cash flow problems that has forced them to minimize the progress of the projects and stated that if situations continue as is, the Contractors are forced to suspend the project.

$$P_n = A + \frac{bL_n}{L_o} + \frac{cM_n}{M_o} + \frac{DE_n}{E_o} + \dots etc$$

Where:

***P_n** is a price adjustment factor to be applied to the amount for the payment of the work carried out in each month excluding Design and Employer's Representative Facilities;*

***A**-is a constant (30%), specified on the Contractor's bid, representing the non-adjustable portion in Contractual payments;*

***b,c,d etc.**, are weightings or coefficient representing the estimated proportion of each cost element (labour , material, equipment etc) in the works or sections thereof, as specified in the Contractor's bid; the sum of A,b,c,d etc..., shall be one;*

***Lo,Mo,Eo etc.**, are the base cost indices or reference prices of the cost elements at the date 28 days prior to the deadline for bid submission*

4.2.3.7. Impact of Fluctuation on the Budget allocated by ERA

As a government organization, the Ministry of Finance allocates budget for ERA for the administration of its projects. Accordingly, ERA disburses the allocated projects to the different sectors or department in the administration.

In a recent assessment of its projects, The Ethiopian Road Administration prepared an internal report by the identifying the critical issues of the sector. Accordingly, different internal and external sectoral challenges were identified by ERA. One of the critical challenges identified as a hindrance to the performance of Contractors as well as a challenge for ERA, is the unanticipated price fluctuation of construction materials. In the report, it was stated that the overall ERA budget utilization analysis indicate that a budget deficit has occurred on most projects. One of the reason for the same is unanticipated price fluctuation. The report summarized the impact of the material price fluctuation as summarized in the table here-below:

Table 4.2-6 ERA’s Report on the Impact of Cost Fluctuation of Construction Material on the Budget Allocated for Projects

No.	Budget Year (E.C)	Project No	The Budget that was supposed to be allocated to finalize the projects in the Contract Duration in ETB (10 ⁶)	The allocated budget	Difference	
					In ETB (10 ⁶)	In %
1	2010	318	77,363.00	45,532.18	31,830.82	58.9%
2	2011	317	78,280.02	38,287.31	39,992.71	48.9%
3	2012	373	72,333.00	46,365.86	25,967.14	64.1%
4	2013	413	69,201.00	58,080.20	11,120.80	83.9%
5	2014	408	73,447.00	66,641.00	6,806.00	90.7%
Total			680,722.38	482,213.91	198,508.47	70.8%

Source: ERA- 2024 - Internal Report on Sectoral Challenges

As it can be noted above, the budget allocation for the projects under ERA have been affected due to the unanticipated price fluctuation of construction materials. Evaluating the price fluctuation and noting the impact it has caused, it was noted that the allocated budget for projects was inadequate for the construction of the projects by an average of 70.8%. The total required Budget for the five-year duration was supposed to be ETB: 680,722.38 (in millions) however, the allocated

budget was ETB: 482,213.91 (in millions), this indicates that there is a shortage of ETB: 198,508.47 (in millions) which is 70.8%.

So, it can be noted from the above that the unanticipated price fluctuation of construction materials (*specifically for the past five years*) has caused impact on the Employer, as it has placed the Employer (ERA) in a difficult position in regards to its budget and Contract administrations.

4.3. Using Primary Data (60 Respondents)

The detailed comments and ratings from the respondents are summarized in the table below. According to the results of this study, it attained 86 % of response rate as 60 professionals answered the questionnaires: 19 project engineers (32%), 27 project sites (45 %), and the rest 14 contractors, consultants, and clients (23%). The dependability of the returned questionnaires was checked prior to survey analysis. Out of the 70 questionnaires issued, 86% of respondents answered the questionnaires after it was found that two of the contractor's and one of the employers were incomplete and shouldn't have been further investigated. To make the data analysis process easier to utilize, the questionnaire replies were also coded.

Of all respondents, 60 % of professionals' work for companies that have been around for more than 15 years, and 36 % have from 5 to 15 years of professional experience in the road construction industry. In contrast, few (4 %) were employed by companies that have been around for less than 5 years. Furthermore, 54% of the professionals have an MSC and are qualified to work as civil engineers, whereas 46% have a BSc and are qualified to work in other capacities. The respondents' qualifications and educational background are displayed in the table below.

Table 4.3-1 Analysis of Questionnaire Respondents

Items	Mean	SD
Responses on Cement cost fluctuation	4.05	.945
Cost Fluctuation of Fuel	4.25	.910
Cost Fluctuation of Reinforcement Bar	4.00	.978
Cost Fluctuation of Bitumen	3.83	.991
Actual Cost (Project Cost)	3.91	.969

Source – ERA 2018 – 2023, Primary Data, 2024

Understanding the cost incremental trend of construction inputs requires an understanding of the general respondents' perceptions of the project cost fluctuation and its allocation practice, the challenges faced during project implementation, and the current ERA price adjustment practice in works contract implementation. The responses on the cost fluctuation of cement had a grand mean value of 4.05, while the responses on the cost fluctuation of fuel, bitumen, and actual cost (project cost) had grand mean values of 4.00, 3.83, and 3.91, respectively, and were all evaluated as very good. This indicates that the majority of respondents believe there is significant variance in or extremely high price inflation for construction materials during the bid proposal process. However, only a small number of specialists agreed that, depending on the strategy, price inflation of building inputs is both fair and undesirable. This leads to a number of challenges during project implementation, such as subpar work and inefficiency, delays in project development or time extensions, and cost overruns.

The majority of them indicate that low performance and inefficiency, delays in project progress or time extensions, and cost overruns if the contractor's risk allocation is awarded with inadequate consideration for the inflation of construction material prices are some of the difficulties faced during project implementation. The largest obstacles to project implementation, according to most of respondents, were delays in project progress or time extensions. These were followed by cost overruns, poor performance, and inefficiency with regard to the contractor's risk allocation practice regarding inflation of material, labor, and equipment.

Additionally, the respondents had the opinion that the contractor's poor risk allocation practices would cause them to go out of business, obstruct government plans to build more road networks, and extend project service times. However, most of respondents supported ERA's price adjustment procedure, which uses a formula approach with contributions from contractors, employers, and consultants in the amounts of 57%. Only few of respondents, meanwhile, strongly disagree with the current administration of the price adjustment management of ERA, as they have stipulated that the budget assigned by ERA for the projects is not in consideration of the significant price increment.

The entire project cost is impacted by the cost escalation of certain construction inputs, such as labor, materials, and equipment. They do not, however, all have an equal impact on the project's

overall cost, which is determined by their intake or contribution. The majority of respondents agreed that rising material prices had a significant impact on the project's overall cost. Numerous causes, such as poor performance and inefficiency, a shortage of construction inputs, and an increase in the cost of construction inputs, could cause the project price to rise.

4.4. Qualitative Analysis using Interview

In this study, the eight projects undertaken by the Ethiopian Roads Administration (ERA) were examined in depth with regard to the examination of the cost fluctuations of important building materials. We asked the majority of interviewees (80%) to explain how building material costs have changed over the previous five years. According to the comments, the cost fluctuations seen over the previous five years can only be characterized as unanticipated and unimaginable, meaning they cannot be lessened by risk-reduction strategies. Additionally, they highlighted the main issues with the price fluctuations of construction materials used in Ethiopian road construction. These include having negative impact on the contractor's ability to manage cash flow, delaying projects, encouraging needless claim development to lessen such difficulties, and causing projects to be abandoned without good reason.

They stated, in their perspective, what contracting parties should do to improve their project performance procedures while taking the variation in building material costs into account. First and foremost, it is imperative to review the award structure for procurement. Due to competition, projects are won at lower rates. However, when these cheap prices are combined with excessive fluctuation that cannot be reduced by changing the price, it will negatively affect the project's overall outcome. To reduce fluctuation, as much as feasible, research trends and include a risk margin. Employer should consider procedures for compensating for unanticipated changes that are not covered by the current contract, and contractors should use their advance carefully and buy volatile goods ahead of inflation.

The impact of fuel, bitumen, reinforcement bar, and cement price fluctuations on project costs in ERA road projects was a question posed to the responders. In the last five years, there has been a noticeable increase in prices, which can range from 200% to 300%. This is attributed to the inflation of cement, fuel, rebar, and bitumen, particularly in cases where contractors acquire these materials using local currency and bring in indices from the local market. These effects are hurting

the contractor's cash flow, causing delays in projects, and eventually turning into excuses for contract cancellation.

4.5. Impact of Variable by Inferential Analysis

Inferential analysis was used in this study to assess the hypothesis. To accomplish its objectives, the study combined explanatory and descriptive designs. Correlation analysis is one explanatory design that's utilized to find the relationship between independent and dependent variables.

4.6. Relationship among variables by means of Correlation Analysis

In the studied projects, the dependent variable (road construction projects cost) and the independent variables (described in the first chapter) were to be investigated. This section discusses the study's attempt to use Pearson's correlation to achieve its purpose.

Table 4.6-1 Correlation Test Result (N= 60)

		Correlations				
		Fuel	Steel	Cement	Bitumen	Project Cost
Fuel	Pearson Correlation	1	.423**	.502**	.391**	.652**
	Sig. (2-tailed)		.001	.000	.002	.000
	N	60	60	60	60	60
Steel	Pearson Correlation	.423**	1	.404**	.412**	.576**
	Sig. (2-tailed)	.001		.001	.001	.000
	N	60	60	60	60	60
Cement	Pearson Correlation	.502**	.404**	1	.388**	.633**
	Sig. (2-tailed)	.000	.001		.002	.000
	N	60	60	60	60	60
Bitumen	Pearson Correlation	.391**	.412**	.388**	1	.630**
	Sig. (2-tailed)	.002	.001	.002		.000
	N	60	60	60	60	60
Project Cost	Pearson Correlation	.652**	.576**	.633**	.630**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	60	60	60	60	60

** . Correlation is significant at the 0.01 level (2-tailed).

Source – Results of the Study, 2024

The Pearson correlation method is used to determine the relationship between the variables under the assumption that they have a linear relationship. With road construction project expenses acting

as the dependent variable, correlation analysis is one explanatory technique that looks for a relationship between independent factors and dependent variables. The relationship's strength (.30 to .07 moderate and above) is considered in this study. Its direction (-ve or +ve), strength of link, and significance level (P-value should be less than 0.05) are all present.

This study found a positive, moderate, and significant correlation ($r=.652$) between the fuel at the significance level of 0.0001. This implies that its existence is significantly improving the experience of road building projects expenses during the construction of public highways. Likewise, Similar to this, Suresh and Sivakumar (2019) found that they correlated favorably.

The correlation between steel ($r= .576$) and project cost of road project is positive, moderate and significant at significance level of 0.01. As well, Wondimagegn and Essubalew (2022) found it is positively and significantly related to project cost.

There is a positive, moderate and significant correlation between cement ($r=.633$) and the project cost in road projects. Additionally, Suresh and Sivakumar (2019) discovered a positive and significant relationship project costs management and it.

The perceived relationship between bitumen ($r=.630$) and the road project cost exhibits a positive, moderate and significant correlation, with a significance level of 0.01. Furthermore, Wondimagegn and Essubalew (2022) found a strong and positive correlation between the abilities of clients and road infrastructure project management.

4.7. Precise Impact on Project Cost Fluctuations by Regression Analysis

The elements influencing project cost changes in Ethiopian road construction projects were determined through this investigation. This analysis is used to test hypotheses. Using the regression method, the researcher was able to identify both general and specific objects. Regression analysis is performed using the multivariate linear regression approach. Every choice is taken at the significance level of 0.05. Modified R squared is used to summarize the model. F-statistics is used to do ANOVA analysis. The assumptions of the classical model were verified before the regression analysis was conducted

4.7.1. Assumptions Test Result

Normality Test

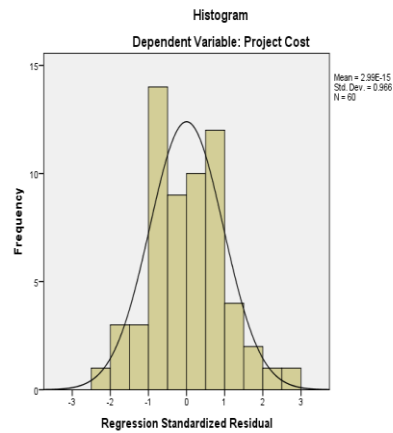


Figure 4.7-1 Normality Test Result (N=60)

Source – Results of the Study, 2024

One of the fundamental presumptions of traditional linear regression models is that the error term should either have a regularly distributed anticipated value or have an expected value of zero ($E(UT) = 0$). In order to determine the normal distribution of the residuals, the researcher used skewness and kurtosis. The outcome shows that the standard residuals are somewhat off the curve. The descriptive statistics of Kurtosis and Skewness statics computation are displayed in the above table. The range of values from -2 to 2 indicates that the distribution is normal, meaning the data is normally distributed and has a suitable variance for further investigation. This suggests that most scores fall somewhere in the middle of the distribution. Consequently, this suggests that the residuals.

Linearity

The fundamental concept of any normal probability plot is as follows: if the data have a mean and variance and a normal distribution, then a plot of the theoretical normal distribution percentiles against the observed sample percentiles should be roughly linear. To conclude that the data is nearly normally distributed, note that the points should approximate each other along the diagonal line.

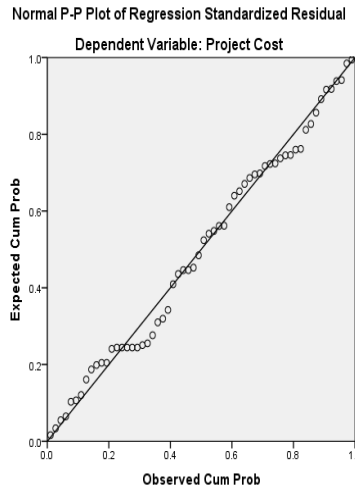


Figure 4.7-2 Linearity (N=60)
 Source – Results of the Study, 2024

In light of this, the investigation discovered a standard P-P plot in addition to a diagonal line and numerous little circles.

4.7.2. Regression Test Result

Table 4.7-1 Regression Results - Model Summary

Model Summary ^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.831 ^a	.691	.668	.477

a. Predictors: (Constant), Bitumen, Cement , Steel , Fuel

b. Dependent Variable: Project Cost

Source – Results of the Study, 2024

To determine how much the independent variable influences the dependent variable, the R² value is calculated. A linear regression with four independent variables and one dependent variable is shown and discussed below. The aforementioned table illustrates how the entire bundle of determinant elements from the three independent variables explained the dependent variable (project cost) (R² =.691). This suggests that additional unaccounted-for factors determine the remaining (100% - 69.1 %) of project costs, with the four independent variables accounting for 69.1% of the cost of road building projects.

Table 4.7-2 Regression Test Results ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27.940	4	6.985	30.727	.000 ^b
	Residual	12.503	55	.227		
	Total	40.443	59			

a. Dependent Variable: Project Cost

b. Predictors: (Constant), Bitumen, Cement , Steel , Fuel

Source – Results of the Study, 2024

It is feasible to get the statistically significant conclusion that the combination of determinant factors influences project cost as the second table shows the result $F= 30.727$. This investigation thus rejects the null hypothesis. Although the means are comparable, you may immediately ascertain which one deviates from the reference mean by consulting the p-value for each mean, as it suggests that a "overall" effect was evaluated.

Table 4.7-3 Analysis of Regression Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.534	.330		1.621	.111
	Fuel	.263	.080	.302	3.294	.002
	Steel	.157	.068	.205	2.326	.024
	Cement	.210	.070	.274	3.014	.004
	Bitumen	.268	.072	.321	3.705	.000

a. Dependent Variable: Project Cost

Source – Results of the Study, 2024

By calculating the beta value under the unstandardized coefficients, we can quickly examine the relative contributions of each of the several factors from the multiple regression table above. Bitumen has a bigger influence than other materials (.321) with more Standardized Coefficients, followed by fuel, cement, and steel, all of which have comparably similar effects. It shows the higher the beta value, the stronger the contribution of that construction material.

Using Unstandardized Coefficients, the study found that fuel (Beta= .263 and Sig. = .002) have a positive and significant effect on project cost. The result revealed that, a one-unit effort increase or positive change in fuel would lead to a 26.3 % unit increase in project cost. Concerning road construction project performance experience, Brownstein (2021) found that it affects road project cost.

The study of steel that affects the road construction project cost showed that there is a positive effect between it on and project cost existed (B= .157 and Sig = .024). In the same way, Rameezdeen et al., (2018) found that effective road project performance is positively affected by contractor's competency.

Moreover, cement (B= .210 and Sig =.004) has a positive and significant impacted on a road construction project cost. According to Brownstein (2021), the performance of road construction projects cost is positively and significantly impacted by it. Furthermore, the relationship between bitumen has a positive and significant effect on project cost (B=.268 and Sig =.0001). The relationship between it has a positive and significant impact on the performance of road construction projects on costs, according to Rameezdeen et al., (2018).

4.8. Direct (Straightforward) Impact of Price Fluctuation using Secondary Data and Simple Regression Analysis

Compared to conventional linear regression, multiple linear regression is a more precise computation. Simple linear regression may be able to accurately depict the relationship between the two variables in cases where it is straightforward (Creswell, 2014). Multiple linear regression is frequently preferable for more intricate interactions that need more thought. But this study offers a thorough comprehension of the link, which facilitates understanding of more complex processes. Furthermore, this study assessed the model's fit, determine the appropriate line to represent the relationship, and draw statistical conclusions with the use of simple linear regression.

4.8.1. Model Summary for Each Independent Variable by Simple Regression

Table 4.8-1 Simple Regression Results- Model Summary

Model Summary^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.730 ^a	.533	.525	4628934.652

a. Predictors: (Constant), **Fuel**

b. Dependent Variable: Project Cost

Model Summary^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.614 ^a	.377	.367	5346068.977

a. Predictors: (Constant), **Steel**

b. Dependent Variable: Project Cost

Model Summary^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.693 ^a	.481	.472	4882670.472

a. Predictors: (Constant), **Cement**

b. Dependent Variable: Project Cost

Model Summary^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.648 ^a	.420	.409	5162165.488

a. Predictors: (Constant), **Bitumen**

b. Dependent Variable: Project Cost

Understanding the following features of this table is crucial to comprehending the results: The R-value displays the correlation between the independent and dependent variables.. A value above 0.4 is selected for additional examination. The value for fuel .730, steel .614, cements .693 and bitumen .648, which are satisfactory for all variables.

The R-square shows the overall variation of the dependent variable that the independent factors may explain. A number between .1 to 0.5 indicates that the model's predictive power is sufficient to identify the relationship. The value fuel .525, steel .367, cement .472 and bitumen .409, which are favourable for all variables.

Table 4.8-2 Simple Regression Results- ANOVA

		ANOVA ^a				
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1419756170044213.500	1	1419756170044213.500	66.260	.000 ^b
	Residual	1242768088926500.000	58	21427036015974.137		
	Total	2662524258970713.500	59			

a. Dependent Variable: Project Cost

b. Predictors: (Constant), Fuel

		ANOVA ^a				
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1004857955638367.200	1	1004857955638367.200	35.159	.000 ^b
	Residual	1657666303332346.200	58	28580453505730.110		
	Total	2662524258970713.500	59			

a. Dependent Variable: Project Cost

b. Predictors: (Constant), Steel

		ANOVA ^a				
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1279776944495198.000	1	1279776944495198.000	53.681	.000 ^b
	Residual	1382747314475515.500	58	23840470939233.027		
	Total	2662524258970713.500	59			

a. Dependent Variable: Project Cost

b. Predictors: (Constant), Cement

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1116943012743283.2 00	1	1116943012743283.2 00	41.915	.000 ^b
	Residual	1545581246227430.2 00	58	26647952521162.590		
	Total	2662524258970713.5 00	59			

a. Dependent Variable: Project Cost

b. Predictors: (Constant), Bitumen

Source – Results of the Study, 2024

Understanding the following features of this table is crucial to comprehending the results: P-value/Sig value: Usually, a 95% confidence interval or a 5% significance level are selected by the study. The p-value should therefore be less than 0.05. In the table above, it is.000. As such, the result is remarkable. The F-ratio indicates the degree to which the model's intrinsic inaccuracy was taken into account while predicting the variable through model fitting.

The yield efficient model of F-ratio has a value larger than 1. The value of fuel 66.26, steel 35.159, cement 53.681 and bitumen 41.915 in the tables above are good. These findings suggest that since the ANOVA table's p-value is less than the acceptable significance level, the null hypothesis may be rejected upon further investigation.

The relationship's strength, or the variable's importance in the model and the degree to which it affects the dependent variable, is displayed in the table below. This analysis aids in carrying out a study's hypothesis testing.

Table 4.8-3 Simple Regression Results- Coefficients

		Coefficients^a						
		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	2253754.519	1217452.141		1.851	.069	-183240.719	4690749.756
	Fuel	298381.971	36656.141	.730	8.140	.000	225006.732	371757.210

a. Dependent Variable: Project Cost

		Coefficients^a						
		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	2310486.733	1602767.961		1.442	.155	-897801.917	5518775.383
	Steel	139810.073	23578.745	.614	5.929	.000	92612.087	187008.059

a. Dependent Variable: Project Cost

		Coefficients^a						
		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	1764198.420	1395707.990		1.264	.211	-1029614.666	4558011.506
	Cement	25641.493	3499.722	.693	7.327	.000	18636.038	32646.948

a. Dependent Variable: Project Cost

		Coefficients^a						
		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	1013682.766	1664408.089		.609	.545	-2317992.007	4345357.539
	Bitumen	175.778	27.151	.648	6.474	.000	121.430	230.126

a. Dependent Variable: Project Cost

Source – Results of the Study, 2024

Standard deviation units are used to measure the standardized coefficient. In this study the highest effect was found by fuel for the increment of project cost; A beta value of .730 for fuel means that the dependent variable or project cost increases by .730 or 73 % standard deviations for every standard deviation that the independent (fuel) variable increases. When variables are stated in multiple units or scales, standardized coefficients, sometimes referred to as beta coefficients, provide a means of determining the direction and strength of the link between them. We may make comparisons considerably simpler by bringing all the variables to a common scale by standardizing the coefficients.

The only value that is significant for interpretation is the Sig. value. The number should be less than the study's accepted significance level, or less than 0.05 in this case for the 95% confidence interval. The significant value determines if the null hypothesis is rejected or not. The null hypothesis is rejected when the significance level is less than 0.05. Should Sig. exceed 0.05, the null hypothesis is acknowledged. A null hypothesis that is rejected suggests that there is an impact. However, the acceptance of a null hypothesis implies the absence of any impact. In this case, the meaning will be as follows.

Table 4.8-4 Table of Coefficients

Variables	Unstandardized Coefficients	Sig.	Hypothesis Testing Result at 95% confidence interval	Interpretation
	B			
Fuel	298381.971	.000	Null Hypothesis Rejected (0.000 < 0.05)	Significant and helps to increase the project cost
Steel	139810.073	.000	Null Hypothesis Rejected (0.000 < 0.05)	Significant and assistances to increase the project cost
Cement	25641.493	.000	Null Hypothesis Rejected (0.000 < 0.05)	Significant and supports to increase the project cost
Bitumen	175.778	.000	Null Hypothesis Rejected (0.000 < 0.05)	Significant and reliefs to increase the project cost

Source – Results of the Study, 2024

The significant change in project cost due to fuel price activities, because of the Sig. value is 0.000, which is less than the acceptable value of 0.05. With a 1-unit increase in the fuel activities, the project cost will increase by 298381.971 (B value).

The significant change in project cost due to the steel price activities, because of the Sig. value is 0.000, which is less than the acceptable value of 0.05. With a 1-unit increase in the steel price activities, the project cost will increase by 139810.073 (B value).

The significant change in project cost due to the cement price activities, because of the Sig. value is 0.000, which is less than the acceptable value of 0.05. With a 1-unit increase in the cement price activities, the project cost will increase by 25641.493 (B value).

The significant change in project cost due to the bitumen price activities, because of the Sig. value is 0.000, which is less than the acceptable value of 0.05. With a 1-unit increase in the bitumen price activities, the project will increase by 175.778 (B value).

4.9. Discussions

4.9.1. Trend Analysis – Existing Practices of Price Fluctuations

This study examined the effects of variations in material costs on eight road projects that are administered under the Ethiopian Roads Administration. Over the previous five years, respondents stated that there have been notable and erratic price fluctuations for construction supplies, which have made cash flow management difficult and maybe resulted in project delays and abandonment. Procurement award mechanisms, including risk margins, were reviewed, and recommendations were made to improve project performance by making up for unanticipated changes. The report also emphasized how, during the previous five years, the prices of fuel, bitumen, reinforcing bar, and cement have significantly increased, placing a financial burden on contractors and delaying projects.

Fuel

At the significance level of 0.0001, this study discovered a positive, moderate, and significant correlation ($r=.652$) between the fuel. Furthermore, the analysis discovered that fuel has a favorable and significant impact on project cost (Beta=.263 and Sig. =.002). Using secondary data and simple regression analysis, the fuel price activities have resulted in a notable alteration in

project cost; the significance level (Sig.) is 0.000, below the permitted threshold of 0.05. A 1 unit increase in fuel-related activities will result in a 298381.971 increase in project cost (B value).

Brownstein (2021) discovered that experience with road construction projects has an impact on project costs. This suggests that the experience of road building projects expenses during the construction of public highways is greatly improved by its existence. In a similar vein, Suresh and Sivakumar (2019) discovered a positive correlation between them.

Steel

At a significance level of 0.01 the steel ($r=.576$) and project cost of the road project have a positive, moderate, and significant association. According to the study on steel's impact on road building project costs, there is a positive relationship between steel and project costs ($B=.157$ and $Sig =.024$). Because the Sig. value is 0.000, which is less than the permissible value of 0.05, there has been a considerable change in the project cost as a result of the steel pricing activities. The project cost will rise by 139810.073 (B value) with every 1 unit increase in steel pricing activities using secondary data and simple regression. Similarly, Rameezdeen et al. (2018) discovered that the competency of the contractor has a beneficial impact on the successful road project performance. Wondimagegn and Essubalew (2022) also discovered a positive and significant relationship with project cost.

Cement

In road projects, cement and project cost have a positive, moderate, and significant association ($r=.633$). Furthermore, the cost of a road construction project is positively and significantly impacted by cement ($B=.210$ and $Sig =.004$). Because the Sig. value is 0.000, which is less than the permitted value of 0.05, there has been a considerable change in the project cost as a result of the cement price activities. When the cement is increased by 1 unit, the project cost will increase by 25641.493 (B value). According to Brownstein (2021), it has a good and considerable impact on the cost performance of road construction projects. Furthermore, Suresh and Sivakumar (2019) found a strong and positive correlation between project costs management and it.

Bitumen

At a significance level of 0.01 the perceived association between bitumen ($r=.630$) and the cost of the road project shows a positive, moderate, and significant correlation. Additionally, bitumen and project cost are positively and significantly correlated ($B=.268$ and $Sig =.0001$). Further, using secondary data and simple regression analysis, Due to bitumen pricing activity, there has been a considerable change in project cost; nonetheless, the Sig. value is 0.000, which is less than the permissible value of 0.05. A 1unit increase in bitumen price activities will result in a 175.778 (B value) increase in the project. According to Rameezdeen et al. (2018), the relationship between it has a favorable and significant impact on the performance of road construction projects on costs. Additionally, Wondimagegn and Essubalew (2022) discovered a significant and favorable association between client competencies and project management for road infrastructure.

CHAPTER FIVE

SUMMARY OF MAJOR FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter gives an overview of the study's findings. It thoroughly developed the presentation and went into further detail on the main findings and analysis summary. The research study's summary and conclusion are followed by the researcher's possible recommendations and conclusions.

5.2 Summary of Major Findings

The overall attempt of this thesis was to evaluate the impact of price fluctuation on project cost in ERA. Using explanatory and descriptive research design, the study found that

- Objective One - The analysis of 8 road construction projects reveals that the cost of fuel has not consistently increased over time. The price of materials for these projects show significant rise in fuel prices can impact the overall cost of road construction projects, as expenses related to transporting materials and equipment may also increase. Additionally, the price of bitumen has fluctuated over time, with values higher ranging in various projects.
- Objective two, the amount of work subject to price adjustments varies, with most ERA projects experiencing delays and needing deadline extensions. Contractors can file claims for exceeding price increases if given more time to complete projects.
- Objective three- This study found a positive, moderate, and significant correlation between the fuel ($r=.652$), steel ($r=.576$), cement ($r=.633$) and bitumen ($r=.630$) and the cost of the road project exhibits a positive, moderate, and significant correlation at a significance level of 0.01.
- Objective four - fuel (Beta=.263 and Sig. =.002), steel (B=.157 and Sig =.024), cement (B=.210 and Sig =.004) and bitumen (B=.268 and Sig =.0001) have positive and significant impact on project cost, according to the analysis. Because the Sig. value is 0.000, which is

less than the permitted value of 0.05, there has been a considerable change in the project cost as a result of the fuel, steel, cement and bitumen price activities.

- In individual variable direct effect comparison, fuel 298,381.971 Steel 139,810.073, Cement 25,641.493 and Bitumen 175.778 has a positive as well as all have a significant effect on project cost; among them fuel has a greatest (B standardize = .730) effect on project cost.
- While the fluctuation in the prices of construction materials is not a new phenomenon, after reviewing the subject matter in the eight projects, this study has shown that the fluctuation over the past few years has been particularly significant, exceeding the anticipated trends of over ten years. Accordingly, this has impacted the management of the price fluctuation from the perspective of Price adjustment, contractual claims, disbursement beyond the allocated budget and hence, impacted the project cost.
- The Five-year price fluctuation analysis of the construction material indicate that the significant price increase from July 2018 till the end of the five-year period (*i.e. Fuel=315%, Cement=251%, Reinforcement Bar= 202% and Bitumen=227%*) has surpassed the compensation expected to be received from the Contract's Price adjustment.
- In addition, the adjusted amount due to the construction price fluctuation is a total of 36.48% of the total cost of the eight projects over the five-year duration, which indicates that it has exceeded the 20% limit on the Contracts.
- The unanticipated significant rise in the price of construction materials, has been the cause of the various claims (Time and Cost claims) by the Contractor's and hence has put ERA in a weak contractual position. Furthermore, the Contractors have claimed for the modification/revision of the price adjustment formula as it is no longer able to compensate the additional cost incurred by the Contractor for the rise in the price of materials.
- Over the past five years, the budget allocated by the Ethiopian Roads Authority (ERA) for its projects has shown a 30% shortage compared to what should have been allocated, taking into account the spiking price fluctuations of construction materials.

5.3 Conclusions

Understanding the increasing costs of construction materials requires knowledge of how respondents perceive fluctuations in project costs and how they are allocated, as well as the challenges faced during project implementation and the current practice of price adjustments in works contracts. Thus, this study concluded that the cost of materials has not consistently increased over time but generally there is the price of materials are significant rise that can impact the overall cost of road construction projects.

There is significant inflation in construction material prices, leading to challenges like delays, cost overruns, and inefficiencies during project implementation. It shows inadequate consideration for inflation in material prices can lead to poor project performance and potential business failure for contractors. However, many support the current price adjustment procedure, which involves contributions from contractors, employers, and consultants. Rising material prices have a significant impact on overall project costs, and various factors can contribute to cost escalation, such as inefficiencies and shortages in construction inputs. Therefore, based on the data, this study found that fuel, steel, cement, and bitumen had a favorable and significant impact on project cost.

5.4 Recommendations

Because of the uncertainty around changes in commodity prices in the construction industry, some developers may decide to postpone or cancel planned development projects. Those that move forward with projects in the current economic environment do so at their own risk—that is, more fluctuations may lead to increased construction costs, an extended construction schedule, and/or disputes with contractors and suppliers of building materials. These risks can be reduced sby including provisions in the contract that fairly share liability in a way that is agreeable to both parties.

The parties may take into consideration the following specific solutions by locating additional or substitute suppliers, such as those based in nearby states or cities; direct purchase to cut down on markup between the supplier and the owner; purchasing all necessary materials at the outset of the building project; securing space for extra materials to be stored in warehouses or lay-down yards

until their installation date; and offering alternatives or replacements for the materials called for in the design.

This research suggests that planning, monitoring, reporting, and adjusting are essential elements of cost control that ERA should take into account. These procedures indicate that the project's costs are accurately estimated, monitored in real time, shared with stakeholders, and proactively changed to avoid overruns. Additionally, contribution analysis, job evaluation, material control, market research, finance control, cost-benefit analysis, and labor and overhead management are some of the cost-cutting strategies that ERA must follow, according to this report.

5.5 Implications

For projects that are currently in progress, it is imperative that the involved parties initiate a conversation to investigate proactive measures to alleviate the effects of fluctuations in commodity prices or unavailability of materials on the project. Escalation is related to the shift in the value or rate of particular goods, materials, services, and other objects over time in an economy. Managers and policy makers may understand that increases in unit costs are taken into consideration while discussing inflationary changes in the economic system. It is the rise in costs associated with any construction-related aspects from the project's base price or initial contract that results from time. Cost control is crucial since it ensures that a project will remain profitable and financially viable. Efficient cost management ensures best use of resources, keeps project budgets under control, and keeps overruns at bay.

5.6 Directions for Future Studies

According to this thesis, future research may need to take into account more appropriate formulas for determining price escalation costs, and their impact should be examined prior to or on the basis of tendering, taking into account the total number of items and estimated quantities.

REFERENCE

- Andualem, Endris Yadeta. (2020). Critical Risks in Construction Projects In Ethiopia, *International Journal of Civil Engineering, Construction and Estate Management*, Vol.8, No.3, pp.30-40, September 2020, Published by ECRTD-UK
- Anjay, Kumar Mishra and Aithal, P. S. (2020). Operation of Price Adjustment in Construction Projects, Research Gate, Article in SSRN Electronic Journal · November 2020, DOI: 10.2139/ssrn.3732323
- Asnake, Getu Teshome. (2021). Investigation of Price Adjustment Problems in Ethiopian Construction Projects (The Case of Arsi Zone Public Building Projects), MA in Civil Engineering (Specialization in Construction Engineering and Management), Adama Science and Technology University
- Brownstein, Client Alert. (2021). Managing the Impacts of Material Price Fluctuations on Construction Projects, Insights Alerts-Articles, 2021
- Eleyan, Z. (2018). Factors Affecting Cost Escalation in Construction Project in Gaza Strip, *the Islamic University of Gaza Deanship*, 12pp
- Hanif Zaki M. (2018). Example of Price Adjustment as of FIDIC RED BOOK, National Procurement Authority (NPA), Standard Bidding Documents (SBD), Afghanistan
- Harold, Kerzner. (2017) *A Systems Approach to Planning, Scheduling, and Controlling*, John Wiley & Sons, Inc., Hoboken, New Jersey
- Haytham, Baraka. Mostafa, H Kotb. and Moustafa, Ismail Abu Dief. (2019). Risk in the Construction Industry, *Current Trends in Civil & Structural Engineering*, Volume 2-Issue 4
- Kerstin, K. Zander. Wouter ,J.W. Botzen. Elspeth, Oppermann. Tord, Kjellstrom. and Stephen, T. Garnett. (2015). Heat stress causes substantial labour productivity loss in Australia, *Nature Climate Change*, Vol 5, July 2015 | www.nature.com/natureclimatechang

- Kumar M. D. Sukumar and Rajesh, M. V. (2016). A study of various factors affecting labor productivity in road construction and suggestions to improve it [Journal]. - [s.l.]: international journal of scientific engineering research, 2016. - 4: Vol. 7
- Luke, A. Parsons. Drew, Shindell. Michelle, Tigchelaar. Yuqiang, Zhang. and June T. Spector. (2021). Increased labor losses and decreased adaptation potential in a warmer world, *Nature Communications* | (2021) 12:7286 | <https://doi.org/10.1038/s41467-021-27328-y>
- Mulugeta, S. (2018). Assessment of Conditions of Contract Problems in Ethiopian Construction Industry, *DSpace Institution*, 164pp
- Nuru, Gambo and Ilias, Said. (2014). An Assessment of the Impacts of Cost Factors Influencing Performance of Small Scale Local Government Contractors in Nigeria, *International Journal of Engineering Research & Technology (IJERT)*, Vol. 3 Issue 11, November-2014
- PMI (2017). *A guide to the Project Management Body of Knowledge*, (7th edition, Newton Square
- Rameezdeen, Hamdo et al. (2018). Financing Contractors In Developing Countries: Impact Of Mobilization Advance Payment, Department Of Building Economics, University Of Moratuwa, Sri Lanka In Association With Research Institute For The Built And Human Environment, University Of Sanford, U. In *Resource Allocation And Economic Policy* 363-373pp
- Shamble, Gebrehiwot Tadewos. (2018). Dixit Patel Factors influencing Time and Cost Overruns in Road Construction Projects: Addis Ababa, Ethiopian Scenario: review paper, *International Research Journal of Engineering and Technology (IRJET)*, 2018. - 01: Vol. 5
- Solomon, Kassa Gebeyehu. (2017). Review on Price Adjustment Valuation Practices in Ethiopian Federal Road Construction Projects, Master of Science (Construction Technology and Management), Addis Ababa University, Addis Ababa, Ethiopia
- Suresh, D. and Sivakumar, A. (2019). Impact of Schedule Management Plan on Project Management Effectiveness, *International Journal of Engineering and Advanced Technology*, (IJEAT) ISSN: 2249-8958 (Online), Volume-9 Issue-1

Vamsidhar, K., Eshwarswaroop, D. A., Ayyappapreamkrishna, K., & Gopinath, R. (2014). Study and Rate Analysis of Escalation in Construction industry. *IOSR Journal of Mechanical and Civil Engineering*, 11(2), 14–25. <https://doi.org/10.9790/1684-11251425>

Wondimagegn, Tadesse Borku. and Essubalew, TarkuYenialem. (2022). Assessing the Impact Of Cost Inflation On Building Construction Material: A Study In Wolaita Zone, Southern Ethiopia, *Journal of University of Shanghai for Science and Technology* ISSN: 1007-6735, Volume 24, Issue 1, January - 2022 Page-339

Annex

Appendix I –Questionnaire



(Survey)

Greetings, Dear

I am Biruhehiwot Zerihun, a post graduate student of Master of Business Administration, Addis Ababa University. I am carrying out a study on “*Impact of cost fluctuation of major construction materials on the project cost in case of Ethiopian Roads Administration (ERA)*”.

It will be of great value if you can share your wealth of knowledge by completing the attached questionnaire. Your answers will be handled with highest anonymity and confidentiality; this will be achieved by no indication of names. The general objective of this research is to assess the impact of cost fluctuation of major construction materials on the Project Cost in case of Ethiopian Roads Administration in Ethiopia.

Please kindly return the completed questionnaire to me. Your participation will be highly appreciated.

Yours Sincerely

Biruhehiwot Zerihun

Tel: 0913 923407

Part A: Personal Profile

Instruction – please tick appropriate answer you choose.

Age	Young adults (ages 18-35 years)	[]
	Middle-aged adults (ages 36-55 years)	[]
	Older adults (aged older than 55 years)	[]
Sex / Gender	Male	[]
	Female	[]
Education Status	Diploma and below	[]
	First Degree	[]
	Master and above	[]
Working experience in road construction project related activities	Below 5 years	[]
	6 to 10 years	[]
	11 to 15 years	[]
	Above 16 years	[]
Organization Type	Client	[]
	Project	[]
	Consultant	[]
	Contractor	[]
Your level of management	Government Office	[]
	Low	[]
	Medium	[]
	Top	[]

Section B: Cost Fluctuation Factors and Project Costs

- Please indicate the extent to which you agree or disagree with each statement and tick (√) in a box to the correspondent number. Note : - 5= Strongly Agree, 4= Agree, 3= Neutral, 2= Disagree, 1= Strongly Disagree

Variables	Items Dimensions	1	2	3	4	5
Cost Fluctuation of Major Construction Materials	Cement cost fluctuation positively affects project costs in road projects of ERA					
	Cost Fluctuation of Fuel positively affects project costs in road projects of ERA					
	Cost Fluctuation of Reinforcement Bar positively affects project costs in road projects of ERA					
	Cost Fluctuation of Bitumen positively affects project costs in road projects of ERA					
Management Methods	Poor estimation negatively affects project cost in road projects of ERA					
	I improper planning negatively affects project cost in road projects of ERA.					
	Improper implementation of proper planning negatively affects project cost in road projects of ERA					
	Project schedule changes negatively affects project cost in road projects of ERA					
	Material artificial shortage negatively affects project cost in road projects of ERA					
	Improper Accounting software utilization negatively affects project cost in road projects of ERA					
	Inappropriate utilization of market intelligence negatively affects project cost in road projects of ERA					

2. Please indicate the extent to you agree on project cost. Please record your answer by ticking in the spaces provided, by the scale indicator (1=not at all, 2=small extent, 3=moderate, 4=large extent, 5=very large extent)

Variables	Dimensions – Items	1	2	3	4	5
Project Cost	Road projects are finalized on expected project cost.					
	Road project costs and their associated activities are anticipated in road sector in Ethiopia.					
	Road Project costs are sequenced as per the expected controlling activities.					
	Road project costs can be effectively controlled in Ethiopia.					

Road projects have been planned as per a project cost requirement in Ethiopia.					
A quality assurance for the quality requirements are performed to ensure appropriate costs in road sector in Ethiopia.					
A cost control is performed to attain objective of project road project performance.					
The procurement process is consistently completed in project road project performance.					
Parties are concluded their road project contractual agreements.					
Payments are paid timely connection in determining the governing law of the contract.					

3. Could you describe the current situation of coat fluctuation and project costs in Ethiopia with couple of words?

Thank you for your cooperation!

Annex II - Interview

I am Biruhehiwot Zerihun, a postgraduate study of Addis Ababa University. I am conducting a study on ‘‘ *Impact of Cost Fluctuation of Major Construction Materials on the Project Cost In Case of Ethiopian Roads Administration (ERA)* ’’ with interrelated questions.

1. How would you describe project cost fluctuation in road constructions in Ethiopia?

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

2. What are the most significant problems in cost in road constructions in Ethiopia?

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

3. In your opinion, what should contracting parties do to enhance their project performance practices in Ethiopia?

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

4. Could you describe cement cost fluctuation, fuel, reinforcement bar and bitumen positively affects project costs in road projects of ERA?

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

Thank you for your cooperation!

Appendix III- Data

* Amount of work subject to Price Adjustment (Before P.Adj) ** Amount of price Adjustment for the Period

Year	Mon. Sta.	Fuel		Steel		Cement		Bitumen		Average for 8 Projects		
		Fn	Fo	Sn	So	Cn	Co	Bn	Bo	Amount of work subject to Price Adjustment (Before P.Adj)	Amount of price Adjustment for the Period	Total Cost including P.Adj
Year 1	Jul-18	17.10	17.06	43.00	18.50	215.00	190.00	30,772.60	29,285.00	3,330,437.49	128,601.85	3,459,039.34
	Aug-18	17.10	17.06	42.00	18.50	215.00	190.00	30,772.60	29,285.00	2,658,453.40	99,779.78	2,758,233.18
	Sep-18	17.10	17.06	42.00	18.50	215.00	190.00	31,369.60	29,285.00	583,502.73	23,090.14	606,592.87
	Oct-18	17.08	17.06	42.00	18.50	215.00	190.00	31,369.60	29,285.00	7,423,937.61	292,036.47	7,715,974.08
	Nov-18	17.08	17.06	42.00	18.50	215.00	190.00	31,369.60	29,285.00	16,169,376.56	636,057.02	16,805,433.58
	Dec-18	18.53	17.06	42.00	18.50	215.00	190.00	32,748.70	29,285.00	12,068,653.39	736,733.41	12,805,386.80
	Jan-19	18.53	17.06	42.00	18.50	215.00	190.00	32,847.30	29,285.00	13,092,772.31	803,659.17	13,896,431.49
	Feb-19	18.53	17.06	42.00	18.50	215.00	190.00	32,847.30	29,285.00	13,528,392.16	830,398.35	14,358,790.51
	Mar-19	18.81	17.06	38.00	18.50	215.00	190.00	33,135.70	29,285.00	13,665,883.30	838,059.03	14,503,942.33
	Apr-19	18.81	17.06	38.00	18.50	215.00	190.00	33,135.70	29,285.00	8,972,435.74	550,233.79	9,522,669.53
	May-19	18.81	17.06	38.00	18.50	215.00	190.00	33,135.70	29,285.00	9,088,675.79	557,362.20	9,646,037.99
	Jun-19	19.67	17.06	43.00	18.50	215.00	190.00	33,671.30	29,285.00	3,834,625.22	301,559.91	4,136,185.13

Year	Mon. Sta.	Fuel		Steel		Cement		Bitumen		Average for 8 Projects		
		F _n	F _o	S _n	S _o	C _n	C _o	B _n	B _o	Amount of work subject to Price Adjustment (Before P.Adj)	Amount of price Adjustment for the Period	Total Cost including P.Adj
Year 2	Jul-19	19.67	17.06	40.00	18.50	215.00	190.00	33,815.80	29,285.00	4,559,715.71	346,043.58	4,905,759.30
	Aug-19	19.67	17.06	40.00	18.50	215.00	190.00	33,982.40	29,285.00	3,416,026.97	261,190.70	3,677,217.67
	Sep-19	19.67	17.06	39.00	18.50	215.00	190.00	34,149.00	29,285.00	1,999,739.04	151,876.55	2,151,615.60
	Oct-19	19.67	17.06	39.00	18.50	225.00	190.00	34,984.20	29,285.00	6,339,278.99	516,218.49	6,855,497.48
	Nov-19	19.67	17.06	38.00	18.50	225.00	190.00	38,697.90	29,285.00	7,838,619.58	729,241.60	8,567,861.18
	Dec-19	19.63	17.06	38.00	18.50	225.00	190.00	35,604.80	29,285.00	10,105,680.99	828,674.89	10,934,355.87
	Jan-20	19.63	17.06	38.00	18.50	230.00	190.00	37,331.30	29,285.00	11,703,672.99	1,044,110.35	12,747,783.34
	Feb-20	19.67	17.06	38.00	18.50	230.00	190.00	38,014.60	29,285.00	8,468,855.05	779,256.65	9,248,111.70
	Mar-20	19.67	17.06	38.00	18.50	230.00	190.00	39,393.10	29,285.00	10,057,655.20	972,792.42	11,030,447.63
	Apr-20	19.67	17.06	38.00	18.50	245.00	190.00	40,268.90	29,285.00	5,911,190.10	612,751.42	6,523,941.52
	May-20	19.67	17.06	38.00	18.50	245.00	190.00	40,786.60	29,285.00	5,119,282.39	539,712.47	5,658,994.87
	Jun-20	19.65	17.06	38.00	18.50	245.00	190.00	40,786.60	29,285.00	4,996,109.26	525,555.23	5,521,664.49
Year 3	Jul-20	19.65	17.06	38.00	18.50	245.00	190.00	40,449.50	29,285.00	3,897,928.63	405,547.52	4,303,476.14
	Aug-20	19.63	17.06	38.00	18.50	245.00	190.00	42,561.00	29,285.00	2,147,184.28	238,375.05	2,385,559.33

Year	Mon. Sta.	Fuel		Steel		Cement		Bitumen		Average for 8 Projects		
		Fn	Fo	Sn	So	Cn	Co	Bn	Bo	Amount of work subject to Price Adjustment (Before P.Adj)	Amount of price Adjustment for the Period	Total Cost including P.Adj
	Sep-20	19.63	17.06	38.00	18.50	250.00	190.00	42,700.10	29,285.00	3,201,850.31	361,195.25	3,563,045.56
	Oct-20	19.63	17.06	38.00	18.50	250.00	190.00	42,700.10	29,285.00	5,348,959.30	603,406.94	5,952,366.23
	Nov-20	20.11	17.06	38.00	18.50	250.00	190.00	43,547.50	29,285.00	6,670,510.83	809,327.19	7,479,838.02
	Dec-20	20.11	17.06	38.00	18.50	250.00	190.00	43,547.50	29,285.00	8,644,537.38	1,048,834.09	9,693,371.47
	Jan-21	20.11	17.06	43.00	18.50	280.00	190.00	45,405.50	29,285.00	11,545,096.68	1,627,556.20	13,172,652.88
	Feb-21	21.01	17.06	51.00	18.50	280.00	190.00	46,609.30	29,285.00	10,409,074.55	1,710,045.30	12,119,119.85
	Mar-21	21.01	17.06	51.00	18.50	280.00	190.00	47,265.90	29,285.00	11,651,970.40	1,940,358.23	13,592,328.63
	Apr-21	23.16	17.06	51.00	18.50	280.00	190.00	48,819.30	29,285.00	9,034,338.67	1,780,087.88	10,814,426.55
	May-21	23.16	17.06	53.00	18.50	280.00	190.00	49,911.50	29,285.00	6,281,813.65	1,274,752.65	7,556,566.30
	Jun-21	23.16	17.06	53.00	18.50	280.00	190.00	51,074.80	29,285.00	8,547,047.80	1,768,382.71	10,315,430.51
Year 4	Jul-21	24.37	17.06	59.00	18.50	293.01	190.00	55,163.50	29,285.00	4,617,640.98	1,131,123.40	5,748,764.37
	Aug-21	24.37	17.06	72.00	18.50	347.01	190.00	56,113.30	29,285.00	5,288,637.41	1,462,122.40	6,750,759.82
	Sep-21	24.37	17.06	72.00	18.50	347.01	190.00	57,768.30	29,285.00	2,868,600.46	809,278.71	3,677,879.17
	Oct-21	24.37	17.06	69.00	18.50	347.01	190.00	59,732.70	29,285.00	6,217,268.23	1,775,532.72	7,992,800.95

Year	Mon. Sta.	Fuel		Steel		Cement		Bitumen		Average for 8 Projects		
		Fn	Fo	Sn	So	Cn	Co	Bn	Bo	Amount of work subject to Price Adjustment (Before P.Adj)	Amount of price Adjustment for the Period	Total Cost including P.Adj
	Nov-21	24.37	17.06	69.00	18.50	381.70	190.00	67,210.20	29,285.00	9,017,269.06	2,887,720.39	11,904,989.45
	Dec-21	24.37	17.06	69.00	18.50	381.70	190.00	68,433.10	29,285.00	10,885,369.89	3,531,423.00	14,416,792.88
	Jan-22	24.37	17.06	63.00	18.50	381.70	190.00	70,903.80	29,285.00	9,588,743.94	3,129,473.15	12,718,217.08
	Feb-22	24.37	17.06	63.00	18.50	393.00	190.00	72,135.90	29,285.00	10,590,345.25	3,532,414.04	14,122,759.30
	Mar-22	30.23	17.06	63.00	18.50	393.00	190.00	73,316.50	29,285.00	11,197,571.21	4,549,355.28	15,746,926.49
	Apr-22	30.23	17.06	63.00	18.50	440.00	190.00	78,182.90	29,285.00	9,286,260.44	4,041,996.61	13,328,257.05
	May-22	30.23	17.06	63.00	18.50	471.01	190.00	82,773.20	29,285.00	8,674,856.27	3,982,639.05	12,657,495.32
	Jun-22	37.41	17.06	112.00	18.50	493.01	190.00	83,665.00	29,285.00	6,241,179.57	3,776,429.43	10,017,609.00
Year 5	Jul-22	37.41	17.06	112.00	18.50	493.01	190.00	88,534.80	29,285.00	5,037,345.99	3,131,776.60	8,169,122.60
	Aug-22	37.41	17.06	112.00	18.50	581.75	190.00	88,920.70	29,285.00	2,783,526.62	1,799,221.52	4,582,748.14
	Sep-22	51.00	17.06	112.00	18.50	643.95	190.00	89,653.90	29,285.00	3,727,739.22	3,073,797.37	6,801,536.59
	Oct-22	59.88	17.06	100.00	18.50	643.95	190.00	95,777.90	29,285.00	6,040,564.00	5,657,689.28	11,698,253.28
	Nov-22	59.88	17.06	100.00	18.50	643.95	190.00	98,409.20	29,285.00	11,615,973.37	10,984,078.49	22,600,051.85
	Dec-22	59.99	17.06	115.00	18.50	643.95	190.00	99,089.10	29,285.00	13,091,908.61	12,639,303.78	25,731,212.39

Year	Mon. Sta.	Fuel		Steel		Cement		Bitumen		Average for 8 Projects		
		F _n	F _o	S _n	S _o	C _n	C _o	B _n	B _o	Amount of work subject to Price Adjustment (Before P.Adj)	Amount of price Adjustment for the Period	Total Cost including P.Adj
	Jan-23	59.99	17.06	111.00	18.50	755.70	190.00	100,444.20	29,285.00	11,010,187.43	10,956,672.57	21,966,859.99
	Feb-23	67.28	17.06	112.00	18.50	755.70	190.00	100,924.40	29,285.00	12,591,704.04	13,640,887.80	26,232,591.84
	Mar-23	67.28	17.06	112.00	18.50	755.70	190.00	100,924.40	29,285.00	10,968,227.53	11,882,137.70	22,850,365.23
	Apr-23	67.28	17.06	112.00	18.50	755.70	190.00	100,924.40	29,285.00	9,412,505.55	10,196,787.65	19,609,293.20
	May-23	71.13	17.06	130.00	18.50	755.70	190.00	100,924.40	29,285.00	15,912,676.95	18,266,443.39	34,179,120.34
	Jun-23	71.13	17.06	130.00	18.50	755.70	190.00	100,924.40	29,285.00	9,674,265.85	11,105,260.93	20,779,526.78