Review on Price Adjustment Valuation Practices in Ethiopian Federal Road Construction Projects

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Addis Ababa University
Addis Ababa Institute of Technology
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Author's Declaration

I, the undersigned, hereby declare that this thesis entitled "REVIEW ON PRICE ADJUSTMENT VALUATION PRACTICES IN ETHIOPIAN FEDERAL ROAD CONSTRUCTION PROJECTS" is my original work and has not been presented for any other university and is not concurrently submitted in candidature of any other degree, and that all sources of material used for the thesis have been duly acknowledged.

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Abstract

In developing countries with deficit in infrastructure facilities, like Ethiopia, the role of road network expansion programs are fundamental. In line with this logic, Ethiopia is engaging in a number of road construction projects under regional and federal level by implementing consecutive Road Sector Development Programs (RSDP).

Nevertheless, due to the fact that most road construction projects take over a year for completion on one hand and the cost of materials, equipment and labor often increase on the other; projects face an increase in contract price which leads to major problems in administration of the contract and completing the project within allocated budget. In contracts, the risk and uncertainty caused by fluctuations in cost of construction materials, labors and equipments, have been managed by providing price adjustment provisions usually by using a formula method. However, the implementation of these provisions encores different challenges regarding to determination of permissible weightings and coefficients as well as getting the price indices/price which reflects the actual market conditions.

Therefore this research aims to explore and analyze the current price adjustment valuation methods in Ethiopian federal road construction projects and evaluate their capability in depicting the reality on the ground. To achieve the research aim specific objectives are set and case study method is used as research instrument. Accordingly, probing questions and themes are prepared and meticulously analyzed against the international practices evolved from literature review.

The research result shows that the price adjustment practices observed on all selected cases are different on the subject of the non-adjustable portion, permissible weighting ranges as well as the source of index and prices.

Based on the analysis of the cases, the establishment of permissible weighting ranges and non-adjustable factors are found to be inconsistent from the logically acceptable international practices. Besides, the question of the reliability and reputability of price indices/prices is identified as point of controversy between contracting parties.

Lastly, by comparing the current price adjustment valuation practices with the logically acceptable international practices, Ethiopian Roads Authority (ERA) is recommended to prepare a guideline that the design consultant follows in proposing the permissible weighting ranges and non-adjustable factors. Furthermore, the researcher insists on establishment of producers' price index (PPI) or publishing average selling prices for the key construction materials.

Key Words: Non-adjustable portion, Price Adjustment, Source of index and prices Weighting Coefficients,

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List of Abbreviations

AA	Addis Ababa
AAiT	Addis Ababa Institute of Technology
AAU	Addis Ababa University
AC:	Asphalt Cement
BaTCoDA:	Building and Transport Construction Design Authority
BCIS	Building Cost Information Service
BLS:	Bureau of Labour and Statistics
BOQ:	Bill of Quantity
CIDB:	Construction Industry Development Board
CoPA:	Conditions of Particular Application
CPI:	Consumers Price Index
DB:	Design and Build
DBB:	Design, Bid and Built
DTC:	Design to Cost
EEA:	Ethiopian Economic Association
EFFORT:	Endowment Fund for Rehabilitation of Tigray
E.g :	Example
EPSE:	Ethiopian Petroleum Supply Enterprise
ERA:	Ethiopian Roads Authority
FIDIC:	Fédération Internationale des Ingénieurs Conseils
GDP:	Gross domestic product
ICB:	International Competitive Bidding
IPC:	Interim Payment Certificate
MAP:	Mobilization Advance Payment
MC:	Medium Curing
MoFED:	Ministry of Finance and Economic Development
MoWUD:	Ministry of Works and Urban Development

MSc :	Masters of Science
NCB:	National Competitive Bidding
NDOT:	Nevada Department of Transport
OECD:	Organization for Economic Co-operation and Development
PMBOK:	Project Management Body of Knowledge
PPA:	Public procurement Agency
PPI:	Producers Price Index
ROW :	Right of way
RSDP:	Road Sector Development Program
SAFCEC:	South African Federation of Engineering Contractors
SAICE:	South African Institution of Civil Engineering
UK:	United Kingdom
USA:	United States of America
WBS:	work breakdown structure

CHAPTER ONE

1. Introduction

1.1 Background

Construction industry has a great impact on the economy of all countries (Leibing, 2001). It is one of the sectors that provide crucial ingredients for the development of an economy. According to Chitkara (2004), the construction industry in many countries accounts for 6-9 % of the Gross Domestic Product (GDP); and according to Bhimaraya (2001), it reaches up to 10 % of the GDP of most countries. In Ethiopia its percentage of GDP amount ranges from 4.5% in 2009/2010 to 8.5% in 2014/2015 (AfDB,UNDP, 2016).

Therefore, the construction industry is a vital element of the economy and has a significant effect on the efficiency and productivity of other industry sectors. However, due to the economic risks and uncertainty the costs of material, labor and equipment often changes which in turn makes estimating, bidding and financing the construction projects challenging for both the contractor and the employer.

Consequently, the risk and uncertainty caused by the economic factor such as fluctuations in cost of construction materials, labors and equipments, have been managed by providing price adjustment provisions in the contract which calls for an adjustment in price in the event of an increase or decrease in certain cost beyond the control of either party in contract.

Therefore, this research will focus on finding methods to both quantify and manage price adjustment on road construction project by making in-depth investigations on cause and effects of price adjustments on project's budget and schedule.

On the other hand, as per Ethiopian Roads Authority's often used contract provision, price adjustment amounts have been calculated by using formulae with different coefficients and weightings for different projects without correlating the contractor's master work program, material on-site payment and advance payment received by the contractor.

In consequence, this research will try to point out the prevailing problems on price adjustment administration and valuation so as to recommend the concerned bodies by thoroughly reviewing the international practices.

1.2 Motivation to Research

On prevailing volatile material, labor and equipment market estimating, bidding and financing the construction projects are challenging for both the contractor and the employer. Hence, the risk on this trembling market price could be exhaustively researched, and fair estimation method should be recommended to protect the contractor from losses or erosion of anticipated profits and/or preventing the contractor from getting a windfall profit.

In view of that, the causes and effects of price adjustments had been comprehensively researched by different post graduate students as listed hereunder but most of the researchers had focused only on the general causes and effects of price escalation;

Yadessa Dinsa (2015). Assessment of the Causes and Effects of Price Escalation of Federal Road Contracts in Ethiopia; Addis Ababa University, MSc Thesis on Construction Technology and Management.

Mohammed Gashaw Mossa (2013). *Assessment of Price Escalation and Adjustment Problems on Federal Road Construction Projects*, Addis Ababa University MSc Thesis on Construction Technology and Management.

Asteway Yigezu (2008). *Study on the Effects of Unpredictable Price Fluctuation on the Capacity of Construction Contractors*. Addis Ababa University MSc Thesis on Construction Technology and Management.

There are also other related research works through which price adjustment had been researched from different perspectives such as:

Behailu Tadesse (2015). *Study on the Impact of Inflation on Building Construction Projects*. Addis Ababa University MSc Thesis on Construction Technology and Management.

Hewan Desta (2015). *Assessment of Risk Management in Federal Road Projects*. Addis Ababa University, Degree of Master of Engineering in Civil and Environmental Engineering on Construction Technology and Management.

Therefore, I strongly believe that the effects of price changes both on contractors, and employers should be examined thoroughly and further revision on current estimation techniques should be made against the international practice so as to derive a fair estimation technique for compensating the price changes.

Likewise, the total compensate-able amount as price adjustment should be assessed in-depth against the contractor's master work program as well as settled advance payment and material on site payments.

1.3 Definition of Terms

Cost Estimation: is one of the most important steps in project management. It establishes the base line of the project cost at different stages of development of the project. Cost estimation at a given stage of the project development represents a prediction provided by the cost engineer or estimator on the basis of available data (Hendrickson, 2008).

Project Forecasting is a process of taking the project status information and extrapolating the current project performance to the end of the project. Forecast can be done with respect to project duration, overall project cost, performance/quality level of project deliverables, or any combination of these. The key elements in forecasting are to review the risk events that occurred and remaining risk triggers (Hyndman, 2013).

Construction Risk can be defined as an uncertain event or condition that if it occurs, has a positive or negative effect on a project's objectives any exposure to possible loss (PMI, 2008). Because every construction project is different, each offers a multitude of varying risks. To ensure the success of a project, a contractor starting on a construction project must be able to recognize and assess those risks (www.SuretyLearn.org, accessed on 03/02/16, 10:20 AM).

Cost adjustment of construction projects is one of the construction risks which depart the final project costs (after construction) from the initial budget estimates and/or forecasted project cost. This can be caused by a number of factors ranging from design changes to high cost of materials, machinery and labor (That is, more than initially anticipated) (Dawood *et al*, 2001).

Construction Contract: is a mutual or legally binding agreement between two parties based on policies and conditions recorded in document form. The purpose of the construction contract is to:

1. Allocate the duties between the parties;
2. Recognize and allocate the risk to the different parties, and
3. Reduce the uncertainty surrounding the project and allow the parties to plan for the project and the future (Fortney, 2016).

Price Adjustment: is the process of allocating risks between the two contracting parties. Price escalation/fluctuation can generally be defined as the rise or fall of price of goods, materials and services on the markets. Price fluctuation can occur at any market, i.e at international markets, local market and/or at the labor market (Stukhart, 1982).

An escalation clause is a clause in a contract that guarantees a change in the contract price once a particular factor beyond the control of the either part results in an increase or decrease in the contractor's costs. It is also referred to as "Rise and Fall" which indicates that if the price of certain costs fall then the contract price will be adjusted in the client's favor.

1.4 Research Question

In view of the fact that most of the construction projects take over a year for completion, most projects usually will not be completed at the estimated costs unless and otherwise a very fair project cost forecasting is done.

On the other hands, due to risks and uncertainty in the price of material, labor and equipment market estimating, bidding and financing the construction projects are challenging for both the contractor and the employer. Theoretically,

- If price Adjustment provisions are provided in the contract, the contractor might offer lower bid-price and the employer can benefit from the same. However, the risk related to price adjustment will be transferred to the employer. Therefore, the question of fair valuation of price adjustment comes to picture.

- On the other hand, if price adjustment clauses are not provided in the contract, the risk associated with price escalation will be totally transferred to the contractor and the contractor might offer a higher bid price by adding a premium to the bid price for the possible cost increase during construction.

  On the contrary, a contractor might disregard the price escalation during preparation of bid as a consequence; the contractor might face losses or erosion of anticipated profits.

In line with the above, for developing countries like Ethiopia, the market trends are unpredictable. As a result, the issue regarding price adjustment should be exhaustively researched including:

- How is price adjustment calculated in the Federal Road Construction Projects?
- Do the prices/price indexes utilized on price adjustment valuations reflect the reality on the ground?
- Does price adjustment calculation have correlation with contractor's master work program and previously settled advance payment and material on-site payments?

1.5 Research Aims and Objectives

1.5.1 Aim

The aim of the research is to explore and analyze the current price adjustment valuation methods in Ethiopian federal road construction projects and evaluate their capability in calculating price adjustment.

1.5.2. Research Objectives

The objectives of the study are;

- To identify price adjustment methods commonly used in Ethiopian federal road constructions projects and analyze the advantages and drawbacks of same;
- To analyze key resources [fuel, bitumen, reinforcement, cement, labor and equipment] prices/price indexes used in price adjustment clauses in the sector and compare same with the market prices/price indexes;
- To evaluate and correlate price adjustments with contractor's maser work program, advance payment and material on sites payments;
- To recommend ways of improving the current price adjustment valuation methods by reviewing against the international practices;

1.6 Significance of the Research

The major stakeholders who benefit from the outcomes of this research would be the road construction contractors participating on federal road construction projects and the ERA as shown below:

- Since the research will identify and analyze advantages and drawbacks of the current price adjustment methods commonly used in Ethiopian federal road constructions projects, both contractors and ERA will be benefited from same;
- By analyzing key resources [fuel, bitumen, reinforcement, cement, labor and equipment] prices/price indexes used in price adjustment clauses in the sector and compare same with the market prices/price indexes, a fair price adjustment techniques will be recommended;
- By reviewing the current price adjustment valuation methods against the international practices, the employer will be equipped with the best method of compensation for price changes.

1.7 Scope and Limitation of the Research

The scope of the research has been limited to the asphalt projects with total project period greater than 18 months and executed by local contractors by using design bid built contract delivery method within RSDP IV program.

While its concepts on general approaches might be used for other sectors as well, the research primarily focuses on the road sector. Particularly, it focuses on the Ethiopian Roads Authority's practices in price adjustment during the delivery of its projects.

1.8. Organization of the Thesis

The thesis is organized in five chapters.

- **Chapter one:** presents the basic research information as an introduction part of the research. It provides background to the problem statement, posses the key probing questions the research is set to answer and presents the objectives of the research. The chapter also presents the significance of the study as well as its scope and limitation.
- **Chapter two:** deals with a critical and in-depth evaluation of previous research as well as books, scholarly articles, and any other sources relevant to the research. Accordingly, it begins with introduction and extends to the basic principles of risks and uncertainty. The chapter illustrates the type of project cost estimation and forecasting methods as well as the risk allocation through construction contracts. It also deals with the basic concepts behind price escalations like definition and causes of price escalation as well as its management strategy in addition to price escalation valuation techniques. Moreover, the current ERA Practices in dealing Price Adjustment together with applicable contract provisions regarding price adjustments in Ethiopia are presented in this chapter.
- **Chapter three:** as part of the research design, presents the research methods adopted and its justifications, methods of data collections, data analysis and interpretation together with means for assuring the research quality.
- **Chapter four:** encompasses the analysis of findings and discussions part. The analysis pulls out from general description of cases and extends to price adjustment formulae (i.e. coefficients and weightings) and sources of prices/indexes even further to other issues related to price adjustments like advance payment, material on site and master work program.

  Chapter five: is the last chapter and comprises the conclusions made and recommendations forwarded based on the major findings of the study.

CHAPTER TWO

2. Literature Review

In line with the research problems and objectives discussed in the previous chapter, this chapter presents the critical and in-depth evaluation of literature in the following outline:

- Risks and uncertainty in the construction industry.
- Cost estimation techniques
- Price forecasting techniques
- Contracting between two parties
- Price escalation and adjustment practices

From the above outline, emphasis will be given to price escalation and adjustment practices starting from the definitions of price escalation and causes of price escalation up to its management techniques and practices.

2.1 Risks and Uncertainty

2.1.1 Introduction

According to PMBOK ® Guide (PMI, 2008), Risk is an uncertain event or condition that if it occurs, has a positive or negative effect on a project's objectives. Mark (2004) describes the “treat” aspect of a risk as the potential for complications and problems with respect to the completion of a project and the achievement of a project goal and as an uncertain future event or condition with the occurrence rate of greater than 0% but less than 100% that has an effect on at least one of project objectives (i.e., scope, schedule, cost, or quality, etc).

Furthermore, risks have been mathematically defined by different scholars and the definitions fall into two major categories:

i. Single case scenario (traditional engineering definition): it defines risk as the ‘probability times consequence’ (Wilson & Crouch, 1982). This definition will equate a low-probability high-damage scenario with a high probability low-damage scenario – which is clearly not the same thing.

ii. Multiple case scenarios: defines risks as a set of triplets as described in Eq. 2.1 (Garrick, 1981)

$R = \text{Function}(S_i, P_i, X_i)$, i=1,2,...,N. ……..Equation (2.1)

Where S_i is the is a scenario identification or descript ion;

P_i is the probability of that scenario; and

X_i is the consequence or evaluation measure of that scenario,

Whereas scholars like Kaplan argues that this definition to be inconsistent and proposes instead, in keeping with the set of triplets idea, that 'risk is probability times consequence'.

$R = f(P,C)$ ……...Equation (2.2)

Where, P=probability of occurrence &

C= Consequence

Peter (2013) state that uncertainty really reflects unknowns. This view of uncertainty as a state of unknowing is consistent with the dictionary definition of uncertainty as "not able to be relied on; not known or definite" (Oxford English Dictionary). Besides, both Chapman & Ward (2011) and Cleden (2009) echo this conceptualization of uncertainty in their respective definitions of uncertainty as sum of the unknown and unknowable aspects of the project, the consequences of which may threaten the achievement of one or more project goals.

When reviewing the literature, some disagreement regarding the distinction between risk and uncertainty can be found.

- On one hand, there are those who consider risk and uncertainty as distinct concepts. This distinction can be found in the way that a risk can be measured in terms of its impacts and their probabilities, while uncertainty is hard to measure objectively, especially in terms of probability issues.
- On the other hand, others regard to risk and uncertainty as so strongly related to each other as to be synonymous. Newton (1992) states that the counter argument to

the dissimilarity of risk and uncertainty recognizes that they are inevitably defined in terms of one another, and to distinguish them might even be unhelpful.

Risk preference refers to the attitude of the company/people toward risks (Fenghua *et al*, 2014). For any set of conditions, the risk preferences could be classified under three distinct classes of individual risk preferences namely:

1. Risk-averse: Where a party places a higher value to the risk that the expected monetary value.
2. Risk-neutral: Where a party places a value to the risk equal to the expected monetary value.
3. Risk taker or gambler: Where a party places a lower value to the risk than the expected monetary value.

2.1.2 Risk Management

In view of the fact that most of the construction projects take over a year for completion and the cost of materials, equipment, and labor often increase, which leads to major problems in the administration of the contract and completing the project within allocated budget and time due to the economic risks and uncertainty.

According to Flanagan and Norman (1993), the construction industry is subject to more risks than other industries. In construction projects, risks and uncertainties will involve a possible range of financial outcomes that could be better or worse than predicted.

Therefore, risk management is an important step in project success and it includes the process of identifying, classifying, quantifying and responding of inherent risks in a project. Due to the nature of the construction projects which consists of many related and none-related operations, many risk factors will contribute to a project. To have an effective risk management plan, at first step the key risk factors which have the most effect on project objectives should be identified and classified (Rezakhani, 2012).

A researcher like Weidman *et al* (2010) underscores that in the commercial construction industry, the problem of price volatility as it pertains to materials and labor is a consistent problem. The changing instability of market conditions presents a challenge for construction companies to accurately estimate and complete projects within budget. This

volatility can lead to higher costs and more risk to suppliers, contractors, and owners which can cause financial distress for all parties involved in the construction process.

Therefore, underlining that risk management is one of the key knowledge areas of Project Management[1], will play a key role in managing the project cost during cost estimation and cost forecasting so as to make a balanced project cost.

That said, the effect of price fluctuation could be managed as risk, and the value of the amount paid by the owner as price adjustment depends on the attitudes towards risk of the various parties to the contract because the party that bears the risk is largely determined by the terms of the contract. The manner in which the risk is shared or borne will significantly affect the contract sum and the final construction costs. The employer ultimately pays the price of construction including inherent risks, since, even in fixed price contracts, the contractor's price includes an amount to cover escalation of costs (Andrew, 1990). Therefore, the amount paid, however, may be optimized by judicious allocation of escalation risk and could be entertained (borne, shared or transferred) by providing price adjustment clauses.

2.2 Cost Estimations

As defined by the PMBOK Guide (PMI, 2008), cost estimation is the iterative process of developing an approximation of the monetary resources needed to complete the project activities. Therefore, in estimate cost process, the cost of each activity is determined, including the cost of human hours, the cost of equipment, and the cost of materials used as well as the contingency cost (i.e. the cost to cover the identified risks).

According to NDOT, Risk Management and Risk-Based Cost estimation Guidelines, cost estimating is not an exact science; a cost estimate is only an approximation of the costs and is made up of many elements that may not be completely or equally defined at the time the estimate is prepared. As a result, there is variability or uncertainty associated with any

[1] Key knowledge areas of Project Management could be classified into nine categories such as Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communication Management, **Project Risk Management** and Project Procurement Management.

estimate. When applied to the project estimate, this uncertainty establishes the range of costs the base cost could fall within.

Estimating construction cost is one of the essential tasks in the budget development phase of any project lifecycle. However, it is carried out under conditions of uncertainty. The preparation and accuracy of any type of cost estimate will depend heavily on the amount of information available and tools used during different project phases.

There are different types of project cost estimation tools ranging from software estimation to the estimation based on forecasted costs. These methods have different needs and goals based on the desires of the estimator. The primary goal of any estimate is to generate a good prediction of the cost and time to complete a project using as few resources as possible. Because of the large range of estimation tools available, they can typically be characterized as falling into one of the following categories: (Ramanath, *et al*, 2008)

i. "Top-down" and "Bottom-up":

These two general categories approach estimation differently as implied by the name. The "top-down" approach is a more of an analogous model whereas the "bottom-up" approach is more in line with the ideals of industrial engineering.

Generally, a work statement and set of drawings or specifications are used to "take off[2]" material quantities required to perform each discrete task performed in accomplishing a given operation. From these quantities, direct labor, equipment, and overhead costs are derived and added (Lawrence B, 2006).

The first approach is generally used when there is not as much information on a product and the second approach is used as more historical information becomes available as the product matures. A Top-Down estimation method consists of high-level breakdown that is then refined into smaller tasks. This often involves generating a work breakdown structure (WBS) that is then assigned an amount of resources to each stage of the program often referred to as phase distribution. (Stewart, R. D., 1991)

[2]Take off (sometimes spelled as "Take-off" or "takeoff") in its most essential form, is a count of how much material will be needed to go into the project.

Bottom-Up approaches start from the most detailed breakdown of the project and then estimate in detail the cost of each activity. Activity-Based Costing falls into this category as the division of each activity is broken down and then estimated to support the overall estimation. This approach can be time-consuming, but also can yield better results if done properly. Similar to Top-Down estimation, Bottom-Up estimations require a detailed WBS in order to estimate the cost. This makes the importance of providing sufficient detail to the WBS important as forgotten tasks can lead to the resulting estimate being too low.

ii. Estimation by Analogy, Past History:

This requires the estimator to have some form of knowledge about a similar system or systems in order to provide that prior knowledge for the purpose of estimation improvements (NASA, 1995). Similar to some of the strengths of top-down estimation provided in the previous section, estimation by analogy can provide a good estimate based on past performance with little experience from the estimator. An extension of analogy based estimation is the estimation of particular types of systems or article based estimation.

The primary drawback to this approach is the need for a detailed database of projects in order to create these "similar-to" estimates. First, this method requires an organization to keep careful timekeeping records to the task level for each project knowing that later there may be a similar project that can be better understood by the use of past data.

iii. Expert Judgment/Guest mates:

As it implies, is founded primarily upon the expert judgment of key staff on an estimation team. The experts, in this case, are relying on their personal past experience, which may go beyond experience accessible from their current employer.

The benefits of expert judgment range from the speed at which good estimates can be generated to the estimation of complex efforts that involve the integration of multiple disciplines and/or subsystems.

The negative components of expert judgment are related to the repeatability of results and the subjective nature of human decision-making.

iv. Design to Cost (DTC)

The premise of design to cost (DTC) is that cost should be included in the entire design cycle based upon the assertion that design should converge on cost as opposed to cost converging upon a design (Michaels, *et al*, 1989).

This approach can be considered more of a concept that should be followed as opposed to a method.

v. Parametric Models:

Parametric models are mathematical equations that have been developed to describe a system and these models allow the estimator to predict the cost of a particular development. The model becomes a series of cost estimation relationships parameters to characterize a particular system.

The models are based upon analogous cost data and formalized into models that allow estimators to make quick decisions without going through the exercise of generating a detailed bottom-up estimate (Carmargo *et al*, 2003).

Similar to the drawbacks from estimations based on historical data, these types of estimates require the capture of metrics from similar systems as well as the availability of a comprehensive database of information.

Since project cost estimation is required at all stages of a project with varying amounts of available information and, as a result, several methods have evolved as depicted above. However, the relationship between methods, information available, project stage, and estimate accuracy must be always kept in perspective by the user.

According to Hira (1998), estimated costs are based on a combination of historical data and price quotations (i.e. the price at the base date). As a result, several influences contribute to the uncertainty, including the method of gathering the historical data, the conditions under which the project will be executed are unique and on top of this, the

estimating process by itself needs a forecast of the future which in turn makes the process risky.

Therefore, cost estimation errors are always a concern, but can be minimized with good procedures. It also could be managed by providing the following provisions (Hira, 1998):

i. **Contingency:** which is the "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that, statistically, unforeseeable events which will increase costs are likely to occur". (Cook, 1997)

ii. **Allowance/ Prime Cost Sums:** Occasionally the bidder is asked to include a specified sum of money for known items which have not been adequately defined so that an accurate estimate can be made.

iii. **Price Escalation allowance:** is an allowance allocated for future increases in cost (for material and labor) that are likely to occur due to the difference in time between design of a project and the procurement or construction of its component (Hira, 1998).

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2.3 Project Cost Forecasting

According to Kim (2013), who explained on his post-doctorial research on forecasting project progress and early warning of project overruns with probabilistic methods, reliable forecasting is a critical component of project planning, controlling, and risk management. When at-completion of the project, duration and cost are forecasted before the start of a project, the process is carried out as a part of project planning and its results provide the baseline plan intended to complete the project on time and within budget. Once a project gets started, actual performance is monitored and analyzed to revise the estimates of the remaining work. The major purpose of execution phase forecasting is to obtain an early warning signal so that corrective or preventive actions may be taken in a timely manner. Such predictions need to be revised and compared with the scheduled completion time and the available budget. Therefore, the effectiveness of project controls relies on the capability of project managers to forecast final cost and completion time in a timely manner.

Empirical studies have shown that there are no single best forecasting methods applicable to all situations (Goodrich, 1989). To decide which forecasting method is best for a given situation, it is necessary to critically examine the available data. This and an understanding of the fundamentals of the various forecasting procedures are prerequisites for obtaining good forecast.

Ligtvoet (2017) underlined to the following cost forecasting techniques on his Earned value management research which are:

1. **Management Estimate**

   The Management Estimate is the first and most commonly used estimation method, also known as the expert opinion. For internal projects, this can be easily applied and embodies a very accurate approach when punctually executed. The expert will estimate the remaining work, bottom-up, and adds this up to the Actual Cost to date by keeping the revised direct and overhead rates, material cost, contract amendments etc in mind (Ligtvoet,2017).

The management estimation could also be done based on the under list techniques (Andrew, 1990):

i. **Genius Forecasting:** It is a combination of intuition, insight, and luck. The weakness in genius forecasting is that it's impossible to recognize a good forecast until the forecast has come to pass

ii. **Delphi Method:** a panel of experts is interrogated by a sequence of questionnaires in which the responses to one questionnaire are used to produce the next questionnaire. Any set of information available to some experts and not others thus pass on to the others, enabling all the experts to have access to all the information for forecasting.

iii. **Market Research:** it is the systematic, formal and conscious procedure for evolving and testing the hypothesis about the real markets.

iv. **Panel Consensus:** this method is based on the assumption that several experts can arrive at a better forecast than one person. There is no secrecy, and communication is encouraged. The forecasts are sometimes influenced by social factors, and may not reflect a true consensus.

v. **Historical Analogy:** this is a comparative analysis of the introduction and growth of similar new products that bases the forecast on similarity patterns**.**

The problem of this approach might be that the forecast is calculated based on (wishful) estimates rather than on factual data.

2. Current variance is typical for the work to come (Time Series Analysis & Projection)

It assumes that the measured performance to be typical to the project or work package and extrapolate this performance to the work to come. By doing this, estimation for the remaining work to be executed would be done at the same cost performance index as the actual work performed (Ligtvoet, 2017).

This also includes statistical techniques used when several years' data for a product or product line are available and when relationships and trends are both clear and relatively stable (Andrew, 1990).

i. **Moving Average:** Each point of a moving average of a time series is arithmetic or weighted average of a number of consecutive points of the series, where the number of data points is chosen so that the effects of seasonal or irregularity or both are eliminated**.**

ii. **Exponential Smoothing:** this technique is similar to the moving average, except that more recent data are given more weight. Descriptively, the new forecast is equal to the old forecast plus some proportion of the past error**.**

iii. **Box-Jenkins:** the time series is fitted with a mathematical model that is optimal in the sense that it assigns smaller errors to history than any other model.

iv. **X-11:** developed by Julius Shiskin of Census Bureau, this technique decomposes a time series into seasonal, trend cycles, and irregular elements.

v. **Trend Projections:** this technique fits a trend line to the mathematical equation and then projects it into the future by means of this equation**.**

3. **Acceleration of remaining work**

When the project is behind of (or ahead of) schedule and the aim is to reach the ultimate project deadline with extra (or less) resources to reach this deadline, then the estimation could be done by incorporating the standard performance index into the estimation to completion (Ligtvoet,2017).

4. Variance is not recurring

When the estimator identified that the variance cannot be recurring, for example, when the future type of work is totally different from the work performed, or a major issue has occurred, then the estimator can decide not to extrapolate the positive or negative variance (Ligtvoet, 2017).

In this case, the estimator will develop the most sophisticated kind of forecasting tool by applying mathematical expression between the relevant causal relationships and market survey information into a time series analysis (Andrew, 1990).

i. **Regression Model:** this functionally relates sales to other economic, competitive, or internal variables and estimates an equation using the least-squares technique.

ii. **Economic Model:** it is a system of interdependent regression equations that describe some sector of economic sales or profit activity. The parameters of the regression equations are usually estimated simultaneously.

iii. **Diffusion Index:** the percentage of a group of economic indicators that are going up or down, this percentage then becoming the index.

iv. **Leading Indicator:** a time series of an economic activity whose movement in a given direction precedes the movement of some other time series in the same direction is a leading indicator.

v. **Life-Cycle Analysis:** this is an analysis and forecasting of new product growth rates based on S-curve.

vi. **Decision trees:** Decision trees originally evolved as graphical devices to help illustrate the structural relationships between alternative choices. Utility theory is often used in conjunction with decision theory to improve the decision-making process. It recognizes that values are not the only consideration in the decision process. Other factors, such as risk, are also considered.

However, it seems clear that no forecasting technique is appropriate for all situations. There is substantial evidence to demonstrate that combining individual forecasts produces gains in forecasting accuracy. There is also evidence that adding quantitative forecasts to qualitative forecasts reduces accuracy. Research has not yet revealed the conditions or methods for the optimal combinations of forecasts.

Therefore, combining forecasts provides us with a way to compensate for deficiencies in a forecasting technique. By selecting complementary methods, the shortcomings of one technique can be offset by the advantages of another.

2.4 Construction Contract

2.4.1 Definition of Construction Contract

Different authors have tried to formulate a universally accepted definition of construction contracts. Generally speaking, a construction contract is one type of ordinary contracts; it's only difference from ordinary contracts is that it deals with the construction of various infrastructures.

Duncan et al define a construction contract as "an agreement under which a person, called variously the builder or contractor, undertakes for the reward to carry out for another person, variously referred to as the building owner of an employer, works of a building or civil engineering character."

Likewise, Article 2610 of the Civil Code (1960) of Ethiopia defines a construction contract as

> *a contract of work and labor is a contract whereby one party, the contractor, undertakes to produce a given result, under his own responsibility, in consideration of a remuneration that the other party, the client, undertakes to pay him.*

Furthermore, Article 2876 elaborate that

> *a contract whereby one of the parties undertakes to deliver to the other party a house, a flat or another building which does not yet exist, is a contract of work and labor relating to immovable and not a contract of sale.*

According to Bryan and Shapiro, in the construction industry, contracts define the roles, relationships, rights and obligations of the parties to one another, and can be used as an innovative tool to foresee likely problems inherent to particular project types and to provide formulae for the resolution of those problems. Accordingly, contracts provide a rare means by which construction claims, disputes and issues may be significantly reduced and defused through the negotiation of risk transfer terms and conditions.

2.4.2 Types of Construction Contracts

There are a several types of construction contracts used in the industry, but there are certain types of construction contracts preferred by construction professionals. construction contract types are usually defined by the way the disbursement is going to be made and specifies other specific terms, like duration, quality, specifications and several other items.(Fisher, 2015)

The most common types of construction contracts used in the construction industry include:

1. **Lump sum Contract:** is a type of contract normally used in the construction industry to reduce design and contract administration costs whereby the contractor is required to submit a total and global price instead of bidding on individual items.

2. **Unit Price Contract:** is a type of contract which is based on estimated quantities of work items and unit price for each of these work items. The engineer/architect estimates quantities in the Bills of Quantities for each work items and the contractor enter unit prices against the estimated quantities of work. Payment is made on the basis of units of work actually done and measured in the field multiplied by the unit prices.

3. **Schedules of Rates Contract:** is a type of contract which is usually used for repair and maintenance works or under conditions of urgency. The descriptions of items and the units of measurement are similar to those used in a normal BOQ, but no quantities are given (or inaccurate quantities; possibly with upper and lower probable limits) is prepared by the owner and /or architect/engineer to be rated by the contractor. It usually comprises of separate rates for labor, plant, and materials.

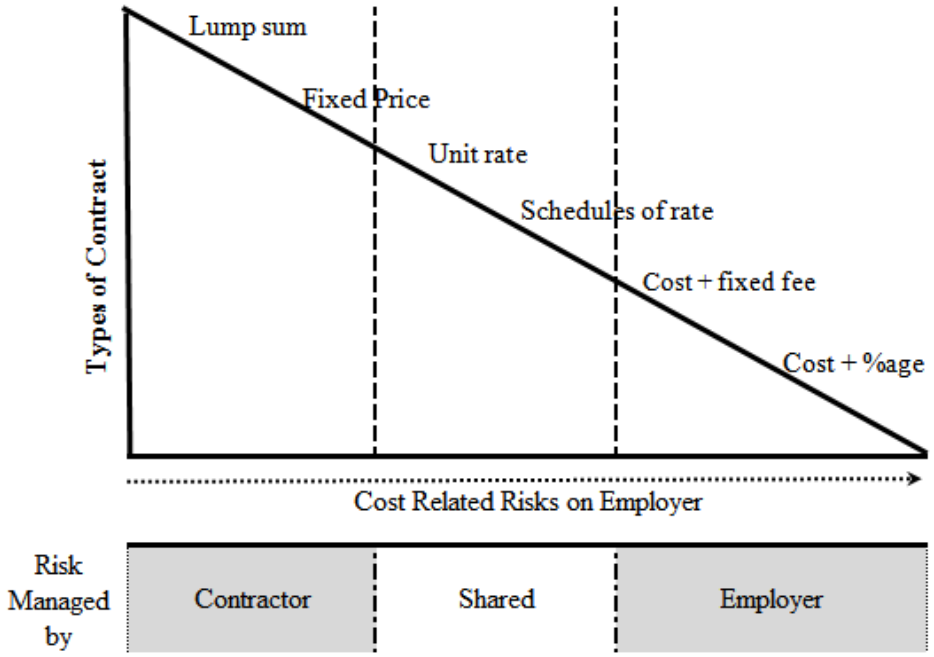
4. **Cost plus Percentage Contract:** is a type of contract where the contractor is reimbursed for all his costs with a fixed % age of costs to cover his services.

5. **Cost plus Fee Contract:** is a type of contract where the owner pays all costs of construction with a fixed sum of money which does not fluctuate with the actual cost of the project.

6. **Package deal type Contract:** is a type of contract where the owner undertakes to pay a lump sum amount for the firm who is assigned to tender all in service from inception to completion stage of the project. Such firm shall be responsible for taking brief from client, selecting a site, developing a sketch scheme, pricing it, carrying out construction and finally they handover the completed building and settle the final account.

In line with the above advantages and disadvantages of different types of contract delivery systems together as well as employer's risk preference decision; the employer will select a specific contract delivery method. Garth Ward (2014) elaborates the employer's risk preference strategy in selecting the type of contract delivery system as follows:

Figure 2.1: Type of contract with cost related risks



2.4.3 Risk Allocation through Construction Contracts

Strickland (2016) stipulates that the purpose of the construction contract is to allocate the duties between the parties, recognize and allocate the risk to the different parties, and reduce the uncertainty surrounding the project and allow the parties to plan for the project

and the future. Thus Contracts could be considered as an early opportunity to anticipate, define and deal with potential issues and thereby avoid disputes.

Others like Bryan (2015) underscores that once the initial project review, risk identification and definition phase has been completed, critical decisions require to be made regarding allocation of risks to one party or the other in the construction contract. These risk allocation decisions will have a dramatic effect on the cost of the project, the construction methods employed to build it and the efficiency of the entire construction process, from commencement of the work through to completion.

According to Bryan (2015), although not always the best way to proceed, the stronger party will often allocate risk that it does not want to bear to the weaker party. This scenario does not necessarily provide the most effective and efficient risk management process. Therefore, allocation of risk to the party best able to manage it efficiently, inexpensively and easily will generally result in a more successful and profitable project and will benefit all of the parties concerned. That said, the risks could be allocated based on the following main conditions (Bryan, 2015):-

1. Who can manage the risk most cheaply, efficiently and easily?
2. Who benefits most from its management?
3. Who has the greatest incentive to manage it?

Consequently, in the current volatile global market the price of material, labor and equipment become challenging for both the contractor and the employer in estimating, bidding and financing the construction projects. Hence, the risk on this trembling market price could be allocated by selecting the project delivery method as well as by introducing price adjustment provisions in the contract document.

2.5 Price Escalation

2.5.1 Definition of Price Escalation

Webster English dictionary defines to escalate as: "to gradually increase; to raise and go up ... " Escalation in construction costs is the increase in the cost of any of the construction elements required for original contract works occurring during construction.

Besides, different scholars defined price escalation in the construction industry in their works and some of them are outlined as follow:

> *Escalation is an increase in cost due to upward changes in prices due to changes in market conditions. Because costs typically increase over time, escalation rates must be developed for future forecasting purposes. Though less common, escalation rates can be negative as well, reflecting decreases in one or more prices* (Cost Escalation Rate Study for Caltrans District 4 Projects, 2009).

> *Price escalation/fluctuation can generally be defined as the rise or fall of the price of goods, materials, and services on the markets. Price fluctuation can occur at any market, i.e at international markets, local market and/or at the labor market.* (Stukhart 1982).

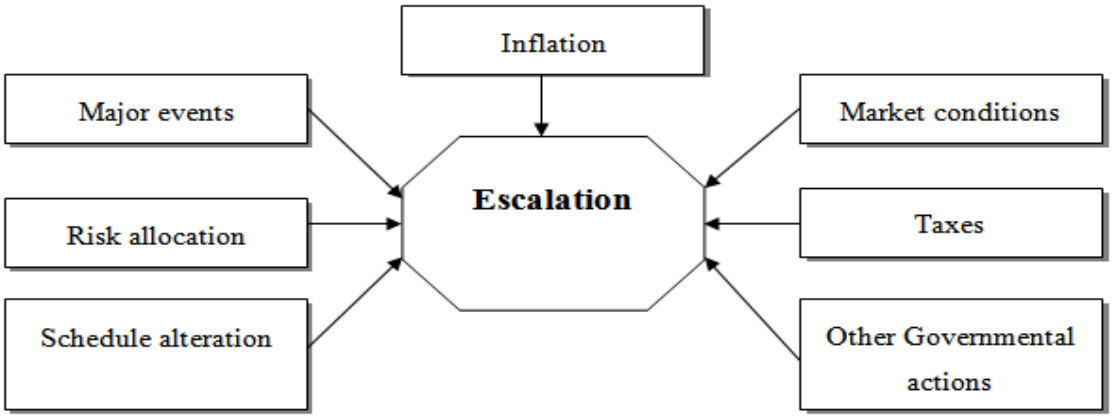
> *Cost escalation of construction projects can be defined as the departure of final project costs (after construction) from the initial budget estimates. This can be caused by a number of factors ranging from design changes to the high cost of materials, machinery, and labor (i.e. more than initially anticipated)* (Dawood *et al*, 2001).

For the purposes of this study, escalation is defined as the increase in the cost of construction elements (labor, equipment, and materials especially fuel, cement, reinforcement bar and bitumen) required for original contract works occurring during construction.

2.5.2 Causes of Price Escalation

The causes of escalation differ from project to project because of the diversity of required construction cost elements and differing conditions and methods of construction. Nonetheless, the principal causes of escalation for most construction projects are all shown in Figure 2.2 and outlined below (Andrew, 1990).

Fig 2.2: Principal causes of escalation



According to Anderson *et. al*, 2007, the factors that lead to project cost escalation have been identified through a large number of studies and research projects. These factors can be distilled into 18 fundamental cost escalation factors, which could be broadly grouped into two groups as internal factor and external factors.

A. Internal Factors

i. **Bias:** it is a systematic tendency to be overly optimistic about key project parameters. It is often viewed as the purposeful underestimation of project costs to ensure that a project remains in the construction program.

ii. **Delivery[3] and Procurement Approach[4]:** it causes price escalation when allocating risks between the clients and the contractor. When risk is shifted to a party that is unable to control it, the project cost will likely increase. The decision regarding which project delivery approach (E.g Design-Bid-Build, Design-Build or Build-Operate-transfer) and procurement methodology (E.g Low Bid, Best Value, or Qualifications-Based selection) affect the transfer of project risks.

iii. **Project Schedule Changes:** particularly extensions, caused by budget constraints, a timing of fund allocations, environmental impacts, or design challenges can result in unanticipated increases in project overhead and/or inflation.

[3] Project Delivery system/Approach is the type of Contract in which the project is going to be delivered

[4] Procurement approach is the approaches that the Project Owners together with Project Regulators and Financiers determine the assignment of responsibilities to Project Stakeholders along the Construction Process.

Schedule extension may be necessary if any required construction elements are delayed for unforeseen reasons. Schedule extension can be caused by a multitude of other factors such as change orders, abnormal weather conditions, strikes, and poor management. Any extension of contract schedule ultimately increases construction costs (Andrew, 1990).

iv. **Engineering and Construction Complexities:** caused by project's location or purpose can make early design work very challenging and lead to internal coordination errors between project components. Internal coordination errors can include conflicts or problems between the various disciplines involved in the planning and design of a project. Constructability problems that need to be addressed may also be encountered as the project develops. If these issues are not addressed, cost increases are likely to occur.

v. **Scope Changes:** which should be controllable by the clients, but which still happen, can lead to project cost escalation. Such changes may include additions to or deductions from the project scope.

vi. **Scope Creep[5]:** is the tendency for the accumulation of many minor scope changes to increase project cost. While individual scope changes have only minimal cost effects, the accumulation of these minor changes, which are often not essential to the intended function of the facility, can result in a significant cost increase over time. Projects seem too often grow naturally as the project progresses from inception through development to construction. These changes can often be attributed to highway projects to the changing needs for environmental compliance in the area being served.

vii. **Poor Estimation:** can also lead to underestimation, which subsequently translates into increases in project cost as errors and omissions are exposed. Estimation documentation must be in a form that can be understood, checked, verified, and corrected. The foundation of the good estimate is the formats, procedures, and processes used to arrive at the cost. Poor estimation includes general errors and omissions relating to plan details and project quantities as well as general

[5] Scope Creep = (Summation of Scope Changes)

inadequacies and poor performance in planning and estimation procedures and techniques. Errors can be made not only in the volume of material and services needed for project completion but also in the cost of acquiring such resources.

viii. **Inconsistent Application of Contingencies:** causes confusion as to exactly what is included in the line items of an estimate and what is covered by contingency amounts. Contingency funds are typically meant to cover a variety of possible events and problems that are not specifically identified or to account for a lack of project definition during the preparation of planning estimates. Misuse and failure to define what costs contingency amounts cover can lead to estimation problems. In many cases, it is assumed that contingency amount can be used to cover added scope, and planners seem to forget that the purpose of the contingency amounts in the estimate is lack of design definition.

On the other hand, there are scholars (like Taylor, 1979 and Cook, 1978.) who put clear demarcation between contingency and escalation. Thus the application of contingency does not affect the price escalation.

ix. **Faulty Execution by the project owner's in managing a project** is one factor that can lead to project cost overruns. This factor can include the inability of the employer's Representatives to make timely decisions or actions, to provide information relative to the project, and to appreciate design and construction difficulties caused by coordination of connecting work or work responsibilities.

x. **Ambiguous Contract Provisions:** dilute responsibility and cause misunderstanding between the employer and other contractual parties, including design consultants and/or project contractor, providing too little information in the project documents can lead to cost overruns during the execution of the contract. When the core assumptions underlying estimation are confused by ambiguous contract provisions, forecast accuracy cannot be achieved.

xi. **Contract Document Conflicts** lead to errors and confusion when preparing an estimate and cause change orders and rework during project construction.

B. External Factor

i. **Local Concerns and Requirements:** typically result in mitigation efforts to minimize project effects and negotiated scope changes or additions. Action by the employer is often required to alleviate perceived negative impacts of construction on the local societal environment, as well as on the natural environment. Local government concerns and requirements can affect the project cost during any project development phase, especially as legislatures seek to add specific scope to a project. Similar to the effects of the planning phase, mitigation actions imposed by the local government, neighborhoods, and businesses as well as local and national environmental groups during the construction of a project can extend the project duration, thereby affecting inflation allowances, employer can be plagued by project cost increases.

ii. **Effects of Inflation:** Economists argued that there are many definitions of inflation, but for most practical purposes inflation can be considered as the "decrease in the purchasing power of the nation's money."

In simple terms, inflation is caused by an increase in the stock of money that is available for spending while the quantity of goods available for purchase does not increase by a proportionate amount.

Therefore, the cost of construction elements increases with inflation and thus inflation causes construction cost escalation when the time value of money can adversely affect project when

- The project estimation is not communicated in year-of-construction costs;
- The project completion is delayed, and, therefore, the cost is subject to inflation over a longer duration that anticipated; and/or
- The rate of inflation is greater than anticipated in the estimate.

iii. **Scope Changes** which are not controllable by the employer can lead to underestimation of project cost escalation, similar to internal scope changes.

iv. **Scope Creep Changes from external causes** is similar to scope creep from internal causes, however, the former category is usually the accumulation of minor scope changes from the external participants.

v. **Market Conditions or changes in the Macro environment** can affect the costs of a project, particularly large projects. The size of the project affects competition for a project and the number of bids that the employer receives for the work. Inaccurate assessment of the market conditions can lead to incorrect project cost estimation. Changing market conditions during the development of a project can reduce the number of bidders, affect the available labor force, or result in increased commodity prices.

   Besides, shortages of any given material or labor as well as any increase in demand for construction elements due to the level of construction activities will also cause an escalation of construction costs (Andrew,1990).

vi. **Unforeseen Events** are unanticipated occurrences that are not controllable by the Clients, such as floods, hurricanes, tornadoes or other weather-related incidents. Typically, these events are called "acts of god". These acts can bring construction to the standstill and have been known to destroy work, thereby creating the need for extensive rework or repair.

   Sometimes, even events that could be controlled by third parties are also considered as unforeseen like terrorism, strike and sudden changes in financial or commodity markets. These actions can have a devastating impact on projects and projects cost.

vii. **Unforeseen Conditions** are notorious for causing project cost overruns. Unknown soil condition can effect excavation, compaction, and structure foundations. Contaminated soils may be present, thereby resulting in the need for special mitigation works. Utilities are often present that are not described or are described incorrectly on existing drawings. There is a multitude of problems that are simply unknown during the early project phases and that can increase project cost when they become apparent during construction.

2.5.3 Managing Price Escalation/Fluctuation

According to the Guidance for Cost Estimation and Management for Highway projects by National Cooperative Highway Research Program, the methodology used to develop the potential list of strategies, methods, and tools focused on the causes of cost escalation and potential strategies that would address these causes (Anderson *et.al*, 2007).

According to Microsoft Encarta, 2009, the strategy is a carefully devised plan of action to achieve a goal or the art of developing or carrying out such a plan. Many scholars argued that there are seven overarching or global strategies that can affect the accuracy and consistency of project estimates and escalation (Anderson *et.al*, 2007).

1. **Management Strategy:** manage the estimation process and costs through all stages of project development;
2. **Off-prism strategy:** use proactive methods for engaging external participants and assessing the macro environmental conditions that can influence project cost;
3. **Risk Strategy:** identify risks, quantify their impact on cost, and take actions to mitigate the impact of risks as the project scope is developed;
4. **Delivery and procurement Strategy:** apply appropriate delivery methods to better manage cost because project delivery influences both project risk and cost;
5. **Document Quality Strategy:** promote cost estimate accuracy and consistency through improved project documents;
6. **Estimate Quality Strategy:** used qualified personnel and uniform approaches to achieve improved estimate consistency and accuracy; and
7. **Integrity Strategy**: ensure that checks and balances are in place to maintain estimate accuracy and to minimize the impact of outside pressures that can optimistic biases in estimates.

2.5.4 Price Escalation Valuation Techniques

Empirical studies have shown that there is no single best price escalation valuation method. However, three types of adjustment clauses are generally considered and used (Barthet, 2010);

2.6.1. Invoice method: This requires the contractor to produce documentation reflecting any increase in materials costs which may have occurred between the time the contract was signed and the time that the materials were actually purchased, passing same on to the owner.

2.6.2. Index method: Under this sort of price adjustment clause, certain material costs are tied to an index for that applicable commodity, allowing the contract price to fluctuate in accordance with any regional or local changes to the price index for that commodity. Contractors should be aware that unlike the invoice method (which passes on increases in costs), the index method can result in a loss when the cost of materials decreases.

2.6.3. Hybrid method: This combines the invoice and index methods and is based on a certified bid cost where the contractor certifies its estimate of the costs of certain materials or fuel, based on current supplier prices or an index price listing. If the certified bid cost changes by a pre-set percentage, the contract can be adjusted accordingly.

2.5.5 Price Escalation and Advance Payment

According to Rameezdeen (2012) on his research entitled Financing Contractors in Developing Countries: Impact of Mobilization Advance Payment, mobilization advance is a monetary payment made by the client to the contractor for initial expenditure in respect of site mobilization, and a fair proportion of job overheads or preliminaries.

In the construction industry, getting working capital, which is the sum of money available for conducting the day-to–day operations of a project for the period between the point at which cash begins to be expended on the project and the collection of cash from client, will make a successful completion of the project (Speed,1997). One of the most common sources of financing for working capital in developing countries is mobilization advance payment which ranges from 10-30%.

However, there are two different school of thought regarding advance payment these are:

1. Advance payment is an overpayment from the point of view of the employer, and would possibly exist until the end of the contract depending on the terms of recovery without adding interest rate. Therefore, advance payments are not preferred by the employer (Tang, 2010).
2. Advance payment is one of the most common sources of financing working capital and further considered as informal security given by the client and motivator (Rameezdeen, 2012).

However, to commence the construction of the main work the contractor should secure a working capital since the payment will be paid after execution of the works. Therefore, if the contractor is not provided with an advance payment with free of interest due to the terms on his contract then he might secure the initial working capital by borrowing money from bank with the prevailing interest rate as a result the project cost will automatically rise up (Rameezdeen, 2012).

2.5.6 Price Escalation and Material on site Payment

Materials on site or unfixed materials on site are materials and goods delivered to or adjacent to the works site for use thereon. Tang (2010) advises that materials and goods should be delivered to site earlier than one month in advance of the time required for use. He further underlines to the following reasons which are for the contractor's own benefit and convenience would not be acceptable:

- Larger quantities which are delivered to site to secure earlier payment
- Larger quantities which are delivered to secure the cheaper supply price
- Larger quantities which are delivered to reduce off-site storage cost.

However, sub-Clause 60.3 of the Conditions of Particular Application (CoPA) of contracts (please note that, ERA had used a harmonized contract provisions regarding material on site) the contractors are at liberty to receive a certain percentage of the works (60% up to 80%) as an advance when they mobilize the material in advance.

On the other hand, the directive issued by Ministry of Finance and Economic Development for amending the PPA directive (2014), declares that in whatsoever circumstance the contractor will not be entitled for material on site payment.

2.5.7 Price Escalation and Master Work Program

As discussed in the previous sub chapters, the major causes of price escalation is the erratic market condition caused by micro and/or macro economical situations. Besides, emphasis also been given on the point that cost escalation/fluctuation is highly dependent on time.

Further to the above, the employer will analyze the risk related to cost escalation/fluctuation in selecting the contract delivery system as well as providing price adjustment clauses. In doing so, the risk analysis will be considered up to the planned project completion date. Therefore, failure to complete the project within the intended contract completion period will impose additional risk both on the contractor and employer.

2.6 Current Ethiopian Practices

2.6.1 Public/Government Construction Contract in Ethiopia

Government contract placing is not left to the whim of the individual power holders at the various hierarchies of the government structure. What officials of the government do with the public expenditure should be transparent, and those wielding the power should be accountable to the general public for each and every activity that they do and have it done on behalf of the public. The constitution of the federal democratic republic of Ethiopia, under Article 12, titled as the conduct and accountability of government", provides thus:

The Conduct of affairs of Government shall be transparent.

Any public official or an elected representative is accountable for any failure in official duties.

In Ethiopia, administrative contracts law is governed by the Civil Code provisions of Articles 3131-3306 (Title XIX). These rules, peculiarly put under the civil code provisions, were introduced to the Ethiopian legal system by David in 1960. These are public service concession contracts, contracts of public works, and government supply contracts. The applicability of the administrative contracts law regime in civil code has been defined under article 3131. That provides:

1. *Contracts concluded by the State or other administrative authorities shall be governed by the provisions of this Code which relate to contracts in general or special contracts.*

   The provisions of this Title shall supplement or replace such provisions where the contract is in the nature of an administrative contract.

2.6.2 Government Procurement Policy

Ethiopian federal public procurement agency is established under the MoFED by virtue of the federal public procurement proclamation No.430/1997, and it is mandated, among other things, to supervise and audit whether all federal procurements are carried out in accordance with the public procurement proclamation and the directives.

Accordingly, the agency prepared and distributed manuals, guidelines and conditions of contract to manage and supervise public procurements in the country. Regarding price adjustment, it underscores to the point that

> ***Art 13.5 of Instruction to Bidders:*** *The rates and prices (or in the case of a lump sum contract, the lump sum price) quoted by the bidder shall be subjected to adjustment during the performance of the Contract if provided for in Clause 47 of the Condition of the Contract. The bidder shall submit with the bid all the information required under Clause 47 of the Conditions of the Contract.*
>
> ***Clause 47.1 of the General Conditions of the Contract:*** *Prices shall be adjusted for fluctuations in the cost of inputs only if provided for in the Special Conditions of Contract. If so provided, the amounts certified in each payment certificate, after deducting for Advance Payment, shall be adjusted by applying the respective price adjustment factor to the payment amounts due.....*
>
> ***User's Guide for Standard Bidding Documents:*** *The Contract [insert "is" or "is not"] subject to price adjustment in accordance with Clause 47 of the Conditions of Contract.*
>
> *[Price adjustment is recommended for contracts which provide for the time of completion exceeding 18 months. Bidders are required to propose the weightings for each cost element (labour, materials, equipment etc) and the sources of indices. These are subject to approval by the Engineer and should be carefully analysed by the Procuring Entity, prior to acceptance of the Bid].*

2.6.3 Price Escalation provisions applicable in Ethiopia

In most case price escalations is administered in Ethiopia by using the following contractual clauses. These are:

i. BATCoDA 1987 Contract Form

Clause 70: Changes in Cost and Legislation, Sub-clause (1) Increase or Decrease of Costs

The only adjustments to be allowed are on the difference between the basic prices and market prices of the materials and goods listed in the appendix to the bill of quantities after the bid pricing date.

ii. MoWUD 1994 Contract Form

Clause 70, Sub-clause (1) Changes in Cost and Legislation

The contract price in the priced Bill of Quantities is based upon the rates of wages and other emoluments and expenses applicable at the site date of bid pricing. And if the said rates of wages and other emoluments and expenses are increased or decreased by any Act, Statute, Decree, Regulation and the like after the said date of bid pricing, then the net amount of the increased or decreased of the emoluments and expenses shall, after due consultation with the Employer and the contractor, be determined by the Engineer and shall form an addition or deduction as the case may be to or from the Contract Price and be paid to or allowed by the Contractor accordingly.

iii. PPA 2006 Contract Form

Clause 47: Price Adjustments

Prices shall be adjusted for fluctuations in the cost of inputs by using the under listed empirical formula Eq. 2.3 after deducting for Advance Payment:

$$\text{Price Adjustment Factor (pn)} = A + b\frac{Ln}{Lo} + c\frac{Mn}{Mo} + d\frac{En}{Eo} + etc\ . \quad \text{…Equation 2.3}$$

Where:

- **A** is a constant, the nonadjustable portion in contractual payments**;**
- **b, c, d,** etc., are weightings representing the estimated proportion of each cost element (labor, materials, equipment usage, etc.) in the Works.
- **Ln, Mn, En,** etc., are the current cost indices; and
- **Lo, Mo, Eo,** etc., are the base cost indices

iv. FIDIC 1987 (Reprinted 1992) Contract Form

Clause 70: Changes in Cost and Legislation, Sub clause (1): Increase or Decrease of Cost

There shall be added to or deducted from the contract Price such sums in respect of rise or fall in the cost of labor and/or materials or any other matters affecting the cost of the execution of the Works as may be determined in accordance with Part II of these conditions.

2.7 Ethiopian Roads Authority Practices in dealing Price Adjustment

2.7.1 Applicable Provisions

Due to the fact that ERA had implemented a harmonized contract provisions, this clause (Clause 70) with the under listed sub-clauses had been provided to all the selected cases with a minor modification discussed hereunder:

- **Sub-Clause 70.1 (Price Adjustment) :** The amount payable to the Contractor shall be adjusted in respect of the rise or fall in the cost of labour, Contractor's Equipment, Plant, material and other inputs to the works, by applying to such amounts the formulae prescribes in this clause.
- **Sub-Clause 70.2 (Other changes in Cost):** To the extent that full compensation for any rise or fall in costs to the Contractor is not covered by the provisions of this or other Clauses in the Contract, the unit rates and prices included in the contract shall be deemed to include amounts to cover the contingency of such other rises or fall of costs.

- **Sub-Clause 70.3 (Adjustment Formulae):** the adjustment to the Interim Payment Certificates in respect of changes in cost and legislation shall be determined from separate formulae for each of the types of construction works to be performed and plant to be supplied. The formulae will be of the following general type as shown in Eq. 2.4:

$$Pn = a + b\frac{En}{Eo} + c\frac{Fn}{Fo} + d\frac{Cn}{Co} + e\frac{Sn}{So} + f\frac{Bn}{Bo}. \quad \ldots \text{Equation 2.4}$$

If a price adjustment factor is applied to payments made in a currency other than the currency of the source of the index for a particular indexed input, a correction factor Zo/Zn will be applied to the respective component factor of Pn for the formula of the relevant currency.

The formula for price adjustment to the local portion of the contract will not include the local labour factor. The contractor is therefore advised to take this into accounts when preparing his bid.

If during the execution of the contract the engineer discovers that the base cost indices or prices given by the contractor were incorrect, he shall amend them to the correct figures.

- **Sub-Clause 70.4 (Sources of Indices and Weightings):** The sources of indices shall be those listed in the Appendix to Bid which shall be subjected to approval by the Engineer.

The contractor shall not sign the agreement before he submits the base indices from the approved sources.

If the contractor desires to order materials from a supplier other than from whom he obtained his original quotations or indices because the original supplier ceases to exist, the engineer will look into the trend of increment of the material cost of the new supplier and compare it with the trend of the original supplier, and determine a cost with a trend which could fairly represent the original increment trend.

However, if the original supplier exists and the contractor proposes a new supplier for any reason, the engineer will look into the current quotations or indices of the original supplier and the newly proposed supplier, and will use the quotations or indices favorable to the employer.

- **Sub-Clause 70.5 (Base, Current and Provisional Indices):** The base cost indices or prices shall be those prevailing on the 28 days prior to the latest date for submission of bids. The current indices or prices shall be those prevailing on the 28 days prior to the last date of the period to which a particular interim payment certificates (IPC) is related. If at any time the current indices are not available, provisional indices as determined by the Engineer will be used, subject to subsequent correction of the amounts paid to the Contractor when the current indices become available.

- **Sub-Clause 70.6 (Adjustment after Completion):** If the Contractor fails to complete the works within the time for completion prescribed under Clause 43[6], adjustment of prices thereafter until the date of completion of the works shall be made using either the indices or prices relating to the prescribed time for completion or the current indices or prices, whichever is more favorable to the Employer, provided that if an extension of time is granted pursuant to Clause 44[7], the above provision shall apply only to adjustments made after the expiry of such extension of time.

- **Sub-Clause 70.7 (Weightages):** The weightages for each of the factors of cost given in the appendix to Bid shall be adjusted if, in the opinion of the Engineer, they have been rendered unreasonable, unbalanced or inapplicable as a result of varied or additional work already executed or instructed under Clause 51 or any other reason.

[6]**Clause 43 (Time for Completion)** stipulates that the whole of the Works and, if applicable, any Section required to be completed within a particular time as stated in the Appendix to Tender….

[7]**Clause 44 (Extension of Time for Completion)** stipulates that in the event of…….. and other special circumstances which may occur, other than through a default of or breach of contract by the Contractor or for which he is responsible, being such as fairly to entitle the Contractor to an extension of the Time for Completion of the Works, …..

2.7.2 Change in Legislation

In spite of the fact that price adjustment and change in legislations is a separate concept with some overlap in current Ethiopian market scenarios (like the price of fuel is fixed by legislation), they are treated under the same umbrella in clause 70. Price adjustment has been explicitly explained from sub-clause 70.1 up to 70.7 while change in legislation cited under sub clause 70.8 as follows:

Sub-Clause 70.8 (Change in Legislation) : If, after the date 28 days prior to the latest date for submission of bids for the Contract, there occur in the country in which the works are being or are to be executed changes to any National or State Statute, Ordinance, Decree, or other Law or any regulation or by-law of any local or other duly constituted authority, or the introduction of any such state statute, ordinance, decree, law, regulation or by-law which causes of this clause, in the execution of the Contract, such additional or reduced cost shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be added to or reduced from the Contract price and the Engineer shall notify the Contractor accordingly, with a copy to the Employer. Notwithstanding the foregoing, such additional or reduced cost shall not be separately paid or credited if the same shall already have been taken into account in the indexing of any inputs to the Price Adjustment Formulae in accordance with the provisions of Sub-Clauses 70.1 to 70.7.

2.7.3 Non Adjustable Factor

This is defined by the UK Institution of Civil Engineers as the portion of the inflation risk the owner wants the contractor to share. It can also be viewed as the share of overheads and profits, deemed to be unaffected by inflation. There are different views on the appropriate value of Non Adjustable Factor depending on whether it considered the contractor's risk or his profit. In the UK, BCIS Highways Term Maintenance Price Adjustment Formula for highway maintenance works has it fixed at 10%.

Likewise, South African Institution of Civil Engineering (SAICE) together with Construction Industry Development Board (CIDB) and South African Federation of Engineering Contractors (SAFCEC) had considered 10% as non-adjustable portion.

On contrary, Pakistan Engineering Council had published a guidelines and formula for calculating Price Adjustment through which it declares that the non-adjustable portion of the Contract shall generally be fixed between 45% to 65% depending on the nature of the project and discretion of the employer.

Furthermore, scholars like Lucas Bowles, underscored that most countries like China, china, and India have set it at 15% for non-adjustable portion but the reason behind this figure is not well defined. Nevertheless, on his article regarding unraveling the 15% non-adjustable element; he puts the theories for fixing 15% for non-adjustable portion as:

- The 15% represents that part of the project which is not affected by cost fluctuations.
- The 15% is the profit margin which would be sustained throughout the contract period.
- The 15% non-adjustable element of the formula represents the portion of the works for which the contractor carries the risk of inflation.

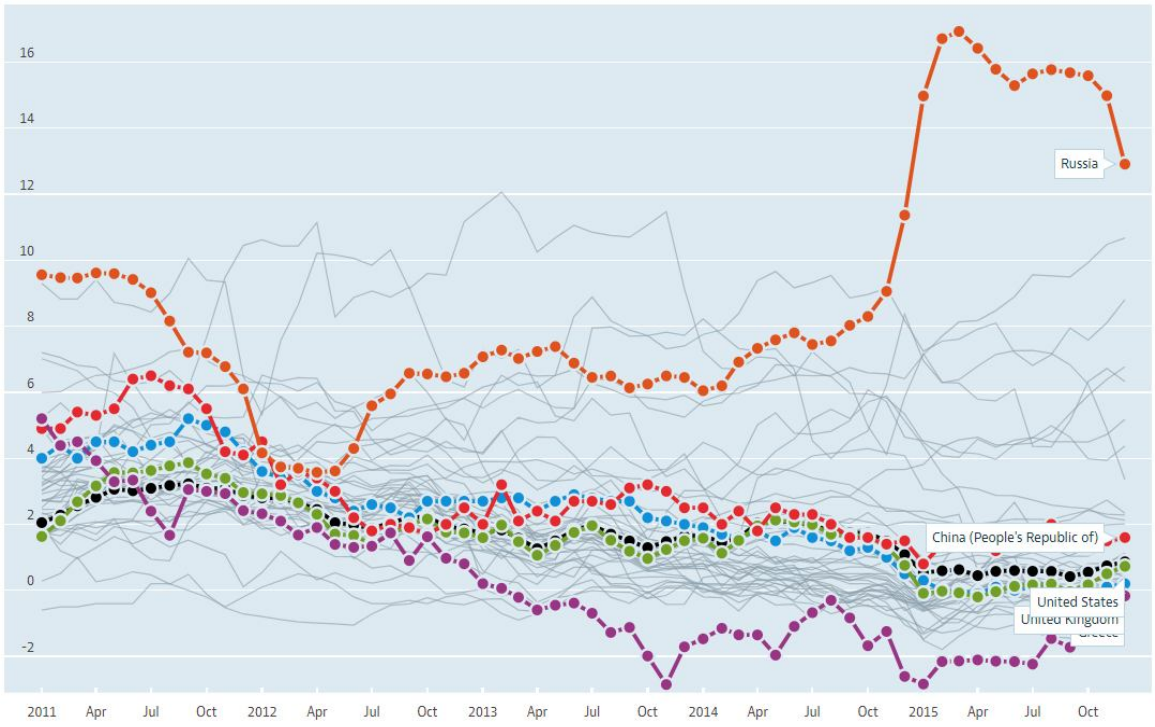
Similarly, ERA had applied different portions for the non-adjustable portion of the Contract between 12% and 50% (usually 15%) depending on the nature of the project, nature of the work (type of bill item), engineer's recommendations and discretion of the employer. However, in recent construction contracts, ERA is demanding the design consultant to come up with the analysis of weightings and it will be analyzed against the range assigned by ERA which is 30%.

2.7.4 Sources of Indices and Prices

Ethiopian Roads Authority (ERA) would consider price adjustment only for fuel, bitumen, cement, reinforcement bar and construction equipments. In view of that, the sources of prices and indices would be determined and fixed by the contractor as per Sub-Clause 70.4. But knowing that market prices would be used for all adjustable elements except construction equipment for which the price index would be applicable and Ethiopian Central Statistics Authority or any responsible government bodies didn't produce the index, the problems have been observed in selecting the source of index for construction machinery and equipment.

Since, as per the Organization for Economic Co-operation and Development (OECD), as shown in the chart below, the rate of change of price index (particularly CPI) of one country differ from another. Therefore, for fair and reasonable evaluation of tender, the contractors/bidders should be guided for selection of price index or otherwise should be decided by the employer during preparation of tender document.

Fig 2.3: Comparison of CPI



Source: OECD (2017), Inflation (CPI) (indicator). doi: 10.1787/eee82e6e-en (Accessed on 19 September 2017)

Having said so, a reasonable source of index for construction equipment should be selected based on the country of origin of the machineries and/or country of purchasing of the machineries.

2.7.5 Price Adjustment CAP

Price Cap regulation was developed as a practical regulatory tool in the earliy 1980s in Britain. In 1983, the newly privatized British Telecom was regulated by price caps after the recommendations of a report by Stephen Littelchild (Mark A, 2002).

For recent contracts ERA had introduce an additional provision on Clause 70 as sub-clause 70.9 and declare that the cumulative total price adjustment amount which is going to be due to the contractor for the rise in the cost of the adjusted labor, contractor's equipment, plant, material inputs shall not be more than 20% of the revised contract price (excluding provisional sums, day works and price adjustment amounts). Accordingly, the contractor is advised to properly plan and execute the works so as to complete the works before such limits are surpassed. Besides, it is envisaged that the contractor considers appropriate allowance in his offer for such risks in cases where the price adjustment CAP surpasses as it will merely be the obligation of the contractor to absorb such risks.

2.8 Summary of Literature Review

After critical and in-depth evaluation of previous researches as well as books, scholarly articles, and other sources relevant to the researches regarding price adjustments against the current ERA practices in valuation of price adjustment and the following major gaps are identified:-

- As the international trend dictates, there are different kinds of price adjustment valuation techniques. Accordingly, price adjustment techniques employed by ERA including the type of formula used and employer's enquiries during pre contract award discussion should be assessed in-depth.
- Logically acceptable international best practices reflect the use of producer's price index (PPI) in calculating price adjustment. However, ERA had used prices/price indexes (not produced in Ethiopia). Therefore, assessment should be done to verify whether the prices/price indexes utilized on price adjustment valuations reflects the reality on ground or not?
- The correlation between price adjustment calculation and contractor's master work program as well as previously settled advance payment and material on-site payments should be intensively analyzed.

CHAPTER THREE

3. Research Methodology

3.1 Introduction

Research can be understood as the systematic and rigorous search for appropriate information on a specific subject. It involves articulation of the problem, developing a hypothesis, collecting and analyzing data and drawing conclusions, based on the facts and data collected. And to do so, the researcher uses research methods, during the course of conducting research.

In light of the research problem drawn and presented in chapter one, the analysis and conclusions presented in subsequent chapters, this chapter, as part of the research design, presents the research methods adopted and its justifications, methods of data collections, data analysis and interpretation together with means for assuring the research quality.

3.2 Selection of Research Methods and Analysis

3.2.1 Type of research

According to preparatory research module for AAU graduate programs, there are different ways of classifying research. It is really difficult to propose a single classification method that fits different disciplines and is acceptable by all. Besides, it should also be noted that there is no clear dividing line between one method and the other. There are always overlaps in a sense that one method somehow includes the other.

Accordingly, this research is designed to be:

- Descriptive and Explanatory since it aims to explore and analyze the current price Adjustment valuation methods in Ethiopian Federal Road Construction projects and evaluate their capability in depicting the reality on the ground.
- Applied since it is designed to solve practical problems than acquiring knowledge.
- In terms of the research approaches, it follows both qualitative and quantitative approaches.
- This research is designed to be non-experimental since the researcher does not have control of the events, situations, circumstances or experience of the participants.

- In view of the fact that this research utilizes both primary[8] data and Secondary[9] Data sources, this research could also be described as both Field/Primary research and Desk/Secondary Research.

3.2.2 Justification of Research Method used

In research design, one has to decide the methodological approach in finding solutions/answers to the research problem or research questions. According to Yin (2003), there are many different types of research methods/strategies to be adopted for scientific researches such as case study, survey, experiment, archival analysis, and history. He also underscore to the point that these strategies/ methods have peculiar advantage and disadvantages, depending on three conditions;

i. The type of research question;
ii. The control an investigator has over actual behavioral events; and
iii. The focus on contemporary as opposed to historical phenomena

In view of the above conditions on one hand and the research objectives on the other, case study strategy is the preferred strategy since the research question is "**How** does price adjustments calculated in the Federal Road Construction Projects" and the researcher has little control over events, besides, the research will focus on a contemporary phenomenon within some real-life context.

Spring (1997) explains that the Critics of the case study method believe that the study of a small number of cases can offer no grounds for establishing reliability or generality of findings. Others feel that the intense exposure to the study of the case biases the findings. Some dismiss case study research as useful only as an exploratory tool. Yet researchers continue to use the case study research method with success in carefully planned and crafted studies of real-life situations, issues, and problems.

[8] Primary data refers to the first-hand data gathered by the researcher himself by using Surveys, observations, experiments, questionnaire, personal interview, etc.

[9] Secondary data means data collected by someone else earlier by using Government publications, websites, books, journal articles, internal records etc.

3.2.3 Selection of Cases

Methodological guidelines for case selection differ between single and multiple case designs. Similarly, Yin (2003) also states that a primary distinction in designing case studies is between Single-and-Multiple-Case designs. This means the need for a decision, prior to any data collection, on whether a single case study or multiple cases are going to be addressing the research questions. He also pointed out that, the single-case study is an appropriate design under several circumstances such as Critical case, Extreme case or Unique case, Representative or Typical case, Revelatory case and Longitudinal cases.

In contrary to the above circumstances, this study mainly aimed at exploring and analyzing the current price adjustment valuation methods in Ethiopian Federal Road construction projects and evaluates their capability in depicting the reality on the ground. Therefore, multiple-cases design is preferred as a research method than the single-case study.

In light of the above and as stated on Yin (2003), each case must be carefully selected not using sampling logics but replication logics[10] so that it either (a) predicts similar results (a literal replication) or (b) predicts contrasting results but for predictable reasons (a theoretical replication)

3.2.4 Rationales for Selection of Cases

As explained in the above sub-topics, this study will use a multiple-case study strategy to meet its objective and careful selection of cases would be paramount for successful and reliable outcomes. As a result, the case sampling techniques would be the major tool to collect a representative and/or realistic evidence.

Furthermore, underlining to the point that Ethiopian Roads Authority has implemented a harmonized contract provisions, the difference between two projects are not that much significant. Nevertheless, to address constraints in the road sector, related to restricted

[10] Sampling Logics Vs Replication Logics: For sampling logics (commonly used in surveys) requires an operational enumeration of the entire universe or pool of potential respondents and then a statistical procedure for selecting a specific subset of respondents to be surveyed. As a result, the resulting data assumed to reflect the entire universe or pool. Whereas, replication logic is a purposeful sampling whose outcome could not represent the entire universe or pool. (Yin, 2003)

road network coverage and poor condition, ERA had formulated the Road Sector Development Program (RSDP) in 1997 as follows:

- RSDP I – Period from July 1997 to June 2002 (5 year plan), completed
- RSDP II – Period from July 2002 to June 2007 (5 year plan), completed
- RSDP III – Period from July 2007 to June 2010 (3 year plan), completed
- RSDP IV – Period from July 2010 to June 2015 (5 year plan), Completed
- RSDP V – Period from July 2015 to June 2020 (5 year plan), on-going

For the purpose of this research, emphasises will be given for RSDP IV since this program is recently completed with few on-going projects. Accordingly, the effect of price escalation could be seen in bold and the availability of project data would also make the program appropriate for this study.

Furthermore, the projects under RSDP IV could also be classified broadly as National Competitive Bidding (NCB) and International Competitive Bidding (ICB). By considering that experienced foreign contractors usually perform project cost estimation and forecasting with great care, the contractors will not suffer that much due to price escalation. As a consequence prominence will be given for NCB and local contractors.

Moreover, the above selected projects within RSDP IV and procured only for local contractors had been contracted using Design and Build (DB) and Design, Bid and Built (DBB) contract delivery system. Underlining to the very basic concept of DB, which is the employer don't have desire to accept additional costs, the DB form of contracts are disregarded in this research.

Further reference also been made to PPA special conditions of contract through which it advises to consider price escalation only for projects with project completion more than 18 months since it is believed that under the current market condition of Ethiopia, contractors could easily forecast the price of materials, labor and Equipment for a year and half. Even if the above point should be verified with a thorough research, for the purpose of this research projects with completion period less than 18 months are disregarded from the total cases.

Underscoring to the logics of replication (not the logic of sampling) for multiple case study approaches purposeful sampling techniques would be implemented to select typical projects from the reduced cases. In view of that only asphalt projects whose cost per kilometer is near the mean value and within standard deviation would be selected.

Once more, due to the fact that cross comparisons would be made against the cases, the detailed scope of the projects should be checked for its similarity.

3.2.5 Selection of Cases

Based on the rationales for selection of cases discussed above, the cases for this particular case study are selected

1. Reduced Cases
   - Total Projects under RSDP IV = 104 Road Construction Projects
   - Total NCB Projects =58Road Construction Projects
   - Total DBB Projects=54 Projects
   - Total Projects with projects completion greater than 18 months =43
   - Asphalt projects = 22
2. Calculating Cost/Km

22.54*	15.45	15.46	13.96	13.58	22.24*
14.23	19.47	8.97**	8.02**	8.05**	7.99**
7.62**	11.14	10.68	9.96	6.89**	6.77**
22.89*	22.45	10.83	7.14**		

NOTE: * Three cases exhibit higher average cost/km amounting to 22.89, 22.54 and 22.24. The main reason for exceptionally higher project cost is due to higher volume of cut to spoil especially rock excavations for the first two cases while rock fill embankment and structural works (retaining wall and bridges) accounts for the higher project cost for the third case.

** Seven projects display average cost/km lower than 9 million Birr since the projects were signed at the beginning of the RSDP IV as capacity building program for local contractors since they have lesser scope.

3. Calculating mean and Standard Deviation

Mean (μ) = 13.05 Million Birr/Km

Standard Deviation (σ) = 5.5

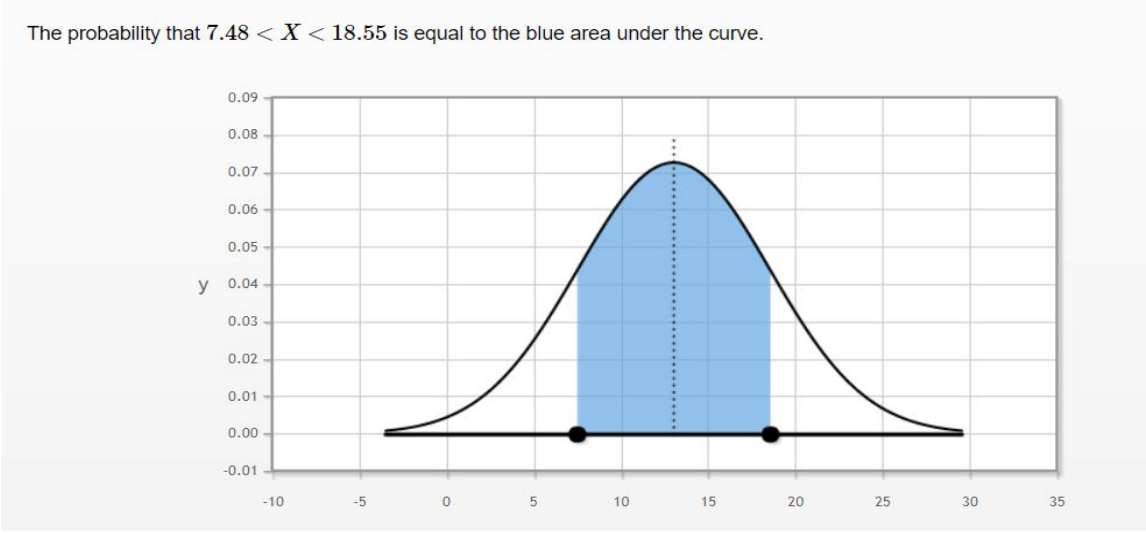
4. Selecting cases

For the purpose of this research, 6 cases would be selected near the mean but within standard deviation

Case should be $\mu \pm \sigma = (\mu - \sigma) \leq \text{Case} \leq (\mu + \sigma)$

7.48 Case ≤ 18.55

Fig 3.1: Normal distribution of the Cases



3.3 Methods of Data Collection

3.3.1 Method Adopted

For any study which extends beyond a review of theory and literature, a major issue is the collection of data. However, just because a researcher wishes to collect certain data does not ensure that those data will be available. Restrictions on collection of data apply for a variety of reasons– confidentiality, ease of collection or provision, cost, time etc. (Richard, 2008).

They further pointed out that despite the potential problems, it is helpful to determine what data are ideally required for the research, and then to modify those requirements, if necessary, to overcome practical difficulties. The objective is to obtain an appropriate set of data which will permit the research to proceed to test any hypothesis and to realize the objectives (to address the research question(s)) as rigorously as possible, given the dynamism of research and the practical considerations, with outputs reasonably close to the original intentions.

According to Yin (2003), evidence/data for a case study research may come from six sources namely Documents, Archival Records, Direct Observations, participant-observations and physical artifacts. In line with this, the researcher must know how to use these six sources, which call for knowing different methodological procedures.

More to the point, Yin (2003) also underscored to the point that there are some important overriding principles that a research should give attention in addition to the six sources. These include the use of (a) multiple sources of evidence (evidence from two or more sources, but converging on the same set of facts or findings) (b) a case study database (a formal assembly of evidence distinct from the final case study report), and (c) a chain of evidence (explicit links between the questions asked, the data collected and the conclusion drawn).

Having said so, for this research data/evidences are collected from documents, archival records, direct observations and interviews.

3.3.2 Access to key organizations

For this particular research the key organizations accessed through their official websites, publications, interviews, direct observations and/or any convenient methods of research instruments discussed above are:

- Ethiopian Roads Authority
- Ethiopian Trade and Industry
- Major Cement Factories in Ethiopia
- Major Reinforcement importers and producers

3.3.3 Establishing contacts

For the selected cases, communications would be made in the following sequence:

- ERA, Procurement and Regional Directors where the selected projects are located.
- ERA, Procurement and Regional Team Leaders of the particular Projects
- ERA, Counterpart Engineers
- The Resident Engineers of the projects, if applicable.
- The Project Managers of the projects, if applicable.

3.4 Data Analysis and Interpretation

3.4.1 Introduction

In analyzing data, especially a multiple case study research, Yin (2003) recommends a two-stage analysis: within-case analysis and cross-case analysis.

Within-case analysis entails analyzing the collected qualitative and quantitative data of each case study independently after which the researcher concludes the findings of the research issues for each individual case. .

Cross-case analysis includes three major cross-case analytic strategies. The first is to categories cases based on certain dimensions and then search for similarities and differences among the group of cases. The second is to choose two cases and list the similarities and differences between them. The final strategy is to break up the data by the

data source such as one researcher works on interview data, while other reviews questionnaire data.

In conclusion, within-case and cross-case analyses were carried out in analyzing the data of the current research. Further, the pattern or theme matching was compared with the emerged themes with patterns derived from the literature review.

3.4.2 Developing Themes and Probing Questions

The following themes and sub-themes are developed to analyze qualitative data:

Theme 1: Brief description of the cases, describing the basic contracting parties, contractual dates as well as financial data of the cases from works contract document, consultancy contract document, progress reports and the latest interim payment certificates.

Theme 2: Identifying the price adjustment techniques employed which includes type of formula used and looking for employer's Inquiries during Pre contract award discussion.

Theme 3: Closely examination of the non-adjustable factor and permissible weighting ranges fixed/proposed by ERA.

Theme 4: Identification and examination of sources of index/prices and trend analysis

- **Sub-Theme 4.1:** Price of fuel
- **Sub-Theme 4.2:** Price of bitumen
- **Sub-Theme 4.3:** Price of cement
- **Sub-Theme 4.4:** Price of reinforcement bar
- **Sub-Theme 4.5:** Labour index
- **Sub-Theme 4.6:** Equipment index

Theme 5: In-depth exploration of relationship between price adjustment and:

- **Sub-Theme 5.1:** Mobilization advance payment (MAP)
- **Sub-Theme 5.2:** Material on site payment
- **Sub-Theme 5.3:** Master work program

3.5 Research Quality

3.5.1 Ethical Consideration

At design time of a case study, ethical considerations must be made (Singer and Vinson, 2002). Even though a research study first and foremost is built on trust between the researcher and the case, explicit measures must be taken to prevent problems. In this study, confidential information of contractors and Ethiopian Roads Authority will be dealt with. If it is not clear from the beginning how this kind of information is handled and who is responsible for accepting what information to publish, there may be problems later on.

Key ethical factors include informed consent, review board approval, confidentiality, handling of sensitive results and feedback (Runeson, 2009).

3.5.2 Measures to ascertain research quality

Yin (2003) underscored that the since the research design is supposed to represent a set of logical statements, the quality of any given design could be judged according to certain logical tests. These logical tests are:

- ***Construct validity:*** it includes the establishment of correct operational measures for the concept being studied. This, in turn, could be achieved by using multiple sources of evidence, establishing the chain of evidence and performing the key informative review of the draft case study report.

  Construct validity was fulfilled in the current thesis by:

  i. Designing case study protocol questions and asking questions during the interview sessions which effectively captured a comprehensive and rich understanding about the research main issue (Yin 2003),
  ii. Maintaining the chain of evidence through ensuring the accessibility of the field guide to data collection, the case study notes and providing adequate illustration in the case report to the evidence contained in the database (Bourgeois & Eisenhardt 1988; Yin 2003), and
  iii. Using multiple sources of evidence (triangulations) such as in-depth interviews, questionnaires, and documents (Al Qur'an 2010; Yin 2003).

- ***Internal Validity:*** it includes the establishment of the causal relationship, whereby certain conditions are shown to lead the other conditions, as distinguished from spurious relationships.

  Internal validity or creditability of this current thesis would be achieved by thoroughly conducting data analysis such as pattern-matching, explanation-building, addressing rival explanation and using the logic model.

- ***External Validity:*** it includes the establishment of the domain to which a study's findings can be generalized which could be achieved using theory in the single-case study and replication logics in multiple-case studies.

  Generalization/external validity/transferability refers to the extent to which the research's findings can be generalized beyond the immediate case study and applied to other cases of the research entire population (Yin 2003). Given that "the purpose of the case study is not to represent the world, but to represent the case" (Al Qur'an 2010), therefore, "analytical generalization[11]" is applied to case study research rather than "statistical generalization[12]" as in quantitative research which deals with the large randomly selected sample (Yin 2003).

  External validity or generalization was accomplished in the current study by:

  i. Using replication logic in the multiple case design
  ii. Adopting the purposeful sampling in selecting the case studies
  iii. Writing information-rich case study description or report of the data of each case study
  iv. By the multiple case study design itself in which all selected cases were firms from Ethiopian Roads Authority projects.

- ***Reliability/Dependability***: it includes the demonstration that the operation of the study can be repeated, with the same result. This could be achieved by using a case study protocol and developing a case study database.

[11] Analytical generalization means to what extent are the findings of the conducted case studies replicated and constant (Yin 2003).

[12] statistical generalization as in quantitative research which deals with large randomly selected sample

CHAPTER FOUR

4. Analysis and Interpretation

4.1 Introduction

As discussed in the previous chapters, there are six cases selected for in-depth evaluations. All the cases are Design Bid Build type delivery approaches floated for local contractors during RSDP IV. This chapter presents both the description of the cases and analysis and interpretation of the findings. However, for the confidentiality purposes, the project name, the name of the contractors as well as consulting firms are intentionally omitted, likewise, the contractual dates and financial data are rounded up.

The chapter first presents description of the cases and later presents detailed analysis and discussions of the cases.

4.2 General Description of the Cases

The selected cases are double surface treatment asphalt roads signed from August 2010 up to May 2013 with average cost per kilometer of 13.05 Million Birr and contract completion period around 3 years except for one case which is around two and half (2.5) years period. Currently, most the cases are under defect liability period i.e substantially completed and provisionally accepted by the employer except two cases with total progress of 94% and 81%.

From table 4.1 - 4.3 below present summary of the key variables of the cases under consideration:

	Case 1	Case 2
Contract Signing Date:	February, 2013	May, 2013
Commencement Date:	March, 2013	June, 2013
Original Contract:	ETB 700,000,000	ETB 1,300,000,000
Revised Contract:	ETB 800,000,000	ETB 1,100,000,000
Contract Duration	911 Calendar Days	1096 Calendar Days

	Case 1	Case 2
Original time of Completion:	September, 2015	June, 2016
EOT Granted:	593 Calendar days	129 Calendar days
Revised time of Comp.:	April, 2017	February, 2017
Progress (To date)	Substantially Completed	Substantially Completed
Total Certified Payment:	ETB 810,000,000	ETB 980,000,000
Total Price Adj. Certified :	ETB 50,000,000	ETB 70,000,000
Total Price Adj. Certified (%)	7%	8%

Table 4.1: Description of the cases (Continued)

	Case 3	Case 4
Contract Signing Date:	July , 2011	August , 2010
Commencement Date:	September, 2011	January, 2011
Original Contract:	ETB 800,000,000	ETB 650,000,000
Revised Contract:	ETB 800, 000,000	ETB 1 ,200,000,000
Contract Duration	1096 Calendar Days	1095 Calendar Days
Original time of Comp.:	September, 2014	January, 2014
EOT Granted:	534 Calendar days	534 Calendar days
Revised time of Comp.:	March, 2016	March, 2016
Progress (To date)	Substantially Completed	Substantially Completed
Total Certified Payment:	ETB 760,000,000	ETB 810,000,000
Total/to date PA Certified :	ETB 110,000,000	ETB 235,000,000
Total / to date PA Certified (% age)	17%	41%

Table 4.2: Description of the cases (Continued)

	Case 5	Case 6
Contract Signing Date:	August, 2011	February, 2013
Commencement Date:	September, 2011	May, 2013
Original Contract:	ETB 700,000,000	ETB 400,000,000
Revised Contract:	ETB 1,100,000,000	Under Evaluation
Contract Duration	36 Months	36 Months
Original time of Comp.:	September , 2014	May, 2016
EOT Granted:	978 calendar days	Under Assessment
Revised time of Comp.:	May, 2017	Under Assessment
Progress (To date)	94.04%	80.97%
Total Certified Payment:	ETB 960,000,000	ETB 270,000,000
Total Price Adjustment Certified :	ETB 130,000,000	ETB 17,000,000
Total Price Adjustment Certified (% age)	16%	7%

Table Error! No text of specified style in document.**.3: Description of the cases (Continued)**

4.2 Price Adjustment Techniques Employed

4.2.1 Type of formula used

As discussed in chapter 2, literature review, there are three types of price adjustment techniques namely invoice method (rise and fall method), formula method and hybrid method. On the selected cases all the price adjustments are carried out using formula method but with two types of techniques (i) by calculating adjustment factors for each Bill No[13] and (ii) by calculating an adjustment factor for aggregated Bill No(s).

Accordingly, from the selected cases only one case (Case 2) had used the second technique which is calculating an adjustment factor for grouped bill items as follows:

- One adjustment factor for site clearance, earthwork, base, sub base and gravel wearing course works (i.e. Bill 2000, Bill 4000 and Bill 5000)
- One adjustment factor for bituminous concrete and road base works (i.e. Bill 6000)
- one adjustment factor for drainage and structure works (i.e. Bill 3000 and Bill 8000)
- One adjustment factor for ancillary works (i.e. Bill 9000)

The distinction between the two techniques is being more specific and that of being generic. As the first technique strives for accuracy (specific case) while the other is more tenable for practical applicability (generic) based on assumption that it would be cumbersome and at times confusing if different factors were to be used for each work item.

However, by underlining to the fact that the scope of each bill items are diverse from one another, the amount of material used as well as the engagement of labor and equipment are different from one bill item to the other. Hence, it is advisable to treat each bill item separately.

[13] According to ERA's Technical Specification 2003, there are Nine main Bill items or series namely Bill 1000: General Provision, Bill 2000: Site Clearance, Bill 3000: Drainage, Bill 4000: Earthworks, Bill 5000: Base, Sub Base and Gravel wearing course, Bill 6000: Bituminous concrete and Road Base, Bill 7000: Rigid Pavements, Bill 8000: Structures and Bill 9000: Ancillary works.

In this regards, in the international practices, for example, the South African Federation of Engineering Contractors (SAFCEC) guidelines published in association with the Construction Industry Development Board of South Africa recommends different coefficients for each bill item. Even more specific, it recommends different coefficients for bulk earthwork and earthwork with culvert and drainage.

Merging or aggregating bill groups will not give a precise estimation of price adjustment. Therefore, by comparing the two techniques, the first technique (calculating separate adjustment factors for each bill items) estimate the price adjustment more precisely than the second. But the later will save time for bid evaluation and calculation of price adjustment.

4.2.2 Employer's inquiries during pre contract award discussion

As could be understood from the contract document of the selected cases, the employer (ERA) had intensively reviewed the availability of prices/ price indexes which is 28 days prior to the latest date of bid submission and also evaluates the reputability and reliability of the supplier, especially for reinforcement bar.

In view of that, during the analysis of the cases, it is found that ERA had questioned:

- Three contractors (Case 2, 5 and 6) to submit quotations/indices for fuel, bitumen and equipment for the date prevailing 28 days prior to the latest date for bid submission. Accordingly, the contractors had submitted same before the signing of the Contract.
- Two contractors (Case 2 and 3) about the reliability of the reinforcement bar supplier. Consequently, the contractors replied that their suppliers are reliable importers currently supplying reinforcement bars for different projects. Accordingly, the employer accepted the supplier (for Case 3) and provisionally accepted (for Case 2) by recommending for further assessment by the engineer during contract implementation.
- One contractor (Case 4) to describe the location for the source of cement and reinforcement bar. Accordingly, the contractor submitted same before signing of the contract.

Accordingly, as per bid document, the contractor will submit a valid prices/ indexes before the signing of the contract. However for the issues regarding the reputability and reliability of the supplier, the employer will not have the authority to force the contractor to change its supplier. Thus, based on the contractors justification about its supplier the employer either approves the supplier or forward the issue for supervision consultant for its review and approval during the implementation of the project.

In this perspective, for most countries in the world, the reputability and reliability of a single supplier would not be a big issue since they have produced their price index or otherwise average material prices compiled by the concerned government bodies.

4.3 Price Adjustment Formulae

4.3.1 Non-Adjustable Factor

The case study reflects that ERA had used different percentage for non-adjustable factor for each project as well as for each bill items as shown in the table below:

Table 4.4: Non Adjustable Factor

Non Adjustable Factor						
Bill items	**Case 1**	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**
2000	15%	15%	15%	20%	20%	25%
3000	15%	15%	15%	35%	30%	30%
4000	15%	15%	15%	19%	20%	25%
5000	15%	15%	15%	16%	40%	25%
6000	15%	15%	15%	12%	30%	20%
8000	15%	15%	15%	38%	40%	30%
9000	15%	15%	15%	41%	45%	50%

As could be observed from the case study data (Table 4.4) ERA had used different percentages in fixing the non-adjustable portion of the bill item ranging from a fixed (15% Portion) for all bill groups to different amount depending on the bill item and the nature of the works from (12% - 50%).

Furthermore, structured interviews had also been made with ERA procurement director and team leaders and found that ERA had strictly advised the designing consultants to come up with the proposed portion of non-adjustable factors during the preparation of tender document. Consequently, the engineer's recommended portion of the non-adjustable portion would be evaluated against ERA's general procurement guideline/weighting ranges (not published) which puts 30% as a minimum portion of non-adjustable factor unless and otherwise the design engineer's proposal is found to be justifiable and reasonable.

On the other hand, it is clear that the tendered rate of a single activity comprises the labor cost (both foreign and local), material cost (all construction materials whether their price escalation would be considered or not), equipment cost (operational and owning costs), overheads and profit.

Therefore, literally the non-adjustable portion, in the context of ERA contract provisions, means the portion of the unit rate excluding the adjustable portions (fuel, bitumen, reinforcement bar, cement and equipment). For that reason, the non-adjustable portion of the bill item should be determined based on its cost break down. As a result, each pay item will have different non-adjustable portion and by using a weighted average method a single non-adjustable portion could be calculated for the bill group.

4.3.2 Weightings

As could be understood from the case studies, ERA had advised the bidder to provide weightings from the permissible ranges. The permissible ranges for each of the cases are shown in Table 4.5 below:

Table 4.5: Permissible ranges of weightings

Bill items	permissible ranges of weightings						
		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
2000	F Labour	0 - 5%	0 - 5%	0 - 5%			
	Equipment	55 - 65%	40 - 60%	40 - 60%	50 – 60%	50-65%	55-60%
	Bitumen	-	-	-	-	-	-
	Fuel	15 - 25%	10 - 30%	10 - 30%	22-27%	10-30%	15-20%
	Rebar	-	-	-	-	-	-
	Cement	-	-	-	-	-	-
3000	F Labour	0 - 5%	0 - 5%				
	Equipment	25 - 35%	15 - 35%	15 - 35%	10-12%	4-6%	10-15%
	Bitumen	-	-	-	-	-	-
	Fuel	2 - 5%	5 - 15%	5 - 15%	4-5%	2-10%	5-10%
	Rebar	10 - 20%	15 - 25%	10 - 20%	18-23%	15-30%	5-10%
	Cement	30 - 40%	25 - 50%	30 - 40%	18-23%	25-30%	40-45%
4000	F Labour	0 - 5%	0 - 5%				
	Equipment	55 - 70%	40 - 60%	40 - 60%	55-65%	50-65%	55-60%
	Bitumen	-	-	-	-	-	-
	Fuel	15 - 25%	10 - 30%	15 - 35%	20-25%	10-30%	15-20%
	Rebar	-	-	-	-	-	-
	Cement	-	-	-	-	-	-
5000	F Labour	0 - 5%	0 - 5%				
	Equipment	50 - 60%	40 - 60%	50 - 60%	54-65%	33-37%	55-60%
	Bitumen	-	-	-	-	-	-
	Fuel	15 - 25%	10 - 30%	15 - 35%	22-27%	23-27%	15-20%
	Rebar	-	-	-	-	-	-
6000	F Labour	0 - 5%	0 - 5%				
	Equipment	50 - 60%	50 - 60%	10 - 15%	10-12%	5-10%	20-25%
	Bitumen	10 - 25%	10 - 25%	65-80%	65-80%	55-60%	40-50%

Bill items	permissible ranges of weightings						
		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
	Fuel	10 - 15%	10 - 15%	5-10%	5-6%	5-10%	10-20%
	Rebar	-	-	-	-	-	-
8000	F Labour	0 - 5%	0 - 5%				
	Equipment	25 - 35%	15 - 35%	5 - 10%	1-2%	3-8%	10-15%
	Bitumen	-	-	-	-	-	-
	Fuel	2 - 5%	5 - 15%	5 - 15%	0-1%	2-5%	5-10%
	Rebar	10 - 20%	15 - 25%	15 - 25%	40-48%	20-25%	5-10%
	Cement	30 - 40%	25 - 50%	30 - 50%	14-17%	15-22%	40-45%
9000	F Labour	0 - 15%	0 - 5%				
	Equipment	15 - 20%	5 - 25%	5 - 10%	27-32%	4-5%	10-15%
	Bitumen	-	-	-	-	-	-
	Fuel	2 - 5%	2 - 10%	5 - 10%	9-11%	2-10%	5-10%
	Rebar	30 - 40%	12 - 25%	5 - 10%	18-22%	10-20%	1-5%
	Cement	10 - 20%	25 - 50%	5 - 10%	0-1%	4-5%	15-20%

By thoroughly reviewing the above permissible ranges, one could identify the following:

- As discussed in the previous sections, the permissible weighting ranges should be proposed by the design consultant based on the engineering estimation and nature of the project and the type of bill item. Later on, the contractor will assign the weighting from the permissible ranges based on its methodology.

  However, as observed from the structured interviews made with ERA procurement director and team leaders, ERA had been utilized inconsistent permissible ranges on previous projects. Later on, starting from 2014, ERA had began to strictly advise the designing consultants to perform analysis and come up with their proposed permissible weightings ranges which would be further evaluated against ERA's general procurement guideline (unpublished document for in house evaluation and reference).

- The difference between the lower bound and the upper bound for some ranges is high. Like for instance, the ranges 25-50%, 40 - 60%, 15 -35% and 10 – 30% were given for the contractors. However, for balanced and fair evaluation of bids, it is advisable to narrow the permissible ranges.
- A range of 0- 5% had been assigned for foreign labour portion, but putting such amount for local contractors or national competitive bidding is pointless.
- When closely assessing the contractor's inclination toward the selection of coefficients (weightings):
    - Except Case 2 all the contractors fall to the outer boundary of the range for equipment and fuel.
    - Likewise, all contractors preferred the lower bound given for cement.

The contractor's preference would highlight the contractor's risk allocation strategy that is, transferring the maximum permissible risk related to price escalation caused by the macro economy and currency changes.

4.4 Source of Index/Price

There are two types of cost index/price in the contract namely base cost index or price which is the prevailing index/price 28 days prior to the latest date for submission of bids and the current index or price which is the prevailing index/price on the 28 days prior to the last date of the period to which a particular IPC is related. Besides, if at any time the current indices are not available, provisional indices as determined by the engineer will be used, subject to subsequent correction of the amounts paid to the contractor when the current indices become available.

For a stable and ideal market condition, the source of material price and the location where the price fixed do not have any impact on price adjustment calculation since price adjustment depends only on the rate of change of price. But this case study reflects that the price trend or the rates of growth of prices significantly differ from one case to another.

Table 4.6: Source of Material Price and Location

	Fuel	Bitumen	Cement	Reinforcement Bar	Equipment
Case 1	NOC, at AA	NOC, at AA	Muger, at Muger	Golagul Trading, at AA	BLS (USA)
Case 2	NOC, at AA	NOC, at AA	Muger, at Muger	Netsa Private Ltd. Co, at AA	BCIS (UK)
Case 3	NOC, at AA	NOC, at AA	Muger, at Muger	Dok Tok imp., at AA	BLS (USA)
Case 4	Gov. Price at Fincha	Cyrus Group, at AA	Messebo at AA	Guna Trading at AA	BLS (USA)
Case 5	Total, at AA	Cyrus Group, at AA	Muger, at Muger	Habesha Steel Mills, at AA	BLS (USA)
Case 6	NOC, at AA	NOC, at AA	Messebo at Mekele	Golagul Trading, at AA	BLS (USA)

As could be observed from the above summary of material sources and location where the price of the material is fixed, all the prices of fuel, reinforcement bar and bitumen (except fuel of Case 4) are is fixed at Addis Ababa. On the other hand, the prices of cement for all the cases are fixed at the factory except for case 4.

Even if, the price adjustment formulae considers only the change in the price of materials, the effect of place where the base price set will have significant effect due to additional escalation as a result of transportation, handling and insurance related costs. Therefore, the location of the base price should be fixed by the employer in order to make the bid evaluation process fair and easy.

4.4.1 Price of Fuel

Federal Democratic Republic of Ethiopian under Proclamation No 247/2001 as amended by Proclamation No 342/2003 had established Fuel Price Stabilization Fund which was initially aimed to stabilize fuel price by subsidizing the additional cost required due to escalation of fuel price in the international market.

This implies that the price of fuel in Ethiopia is not dictated by the international fuel market price due to the interference of the above said price stabilization fund. Accordingly, the Ethiopian Petroleum Supply Enterprise (EPSE) which is the sole government body for the importation of petroleum products together with the Ministry of Trade set retail petroleum prices upon the recommendations of the enterprise. And the savings or the deficits will be administered by Fuel Price Stabilization Fund.

However, as Kaleyesus (2016) elaborated, in keeping with different reports the global price of oil went down by 40% since the beginning of 2015 but Ethiopia decreased petroleum prices only by 12%. Therefore, the price of fuel is not dictated by the international market trend and the price adjustment relating to fuel will not be a problem since the government determine the selling prices and announce the users timely.

4.4.2 Price of Bitumen

The case study reflects the following points:

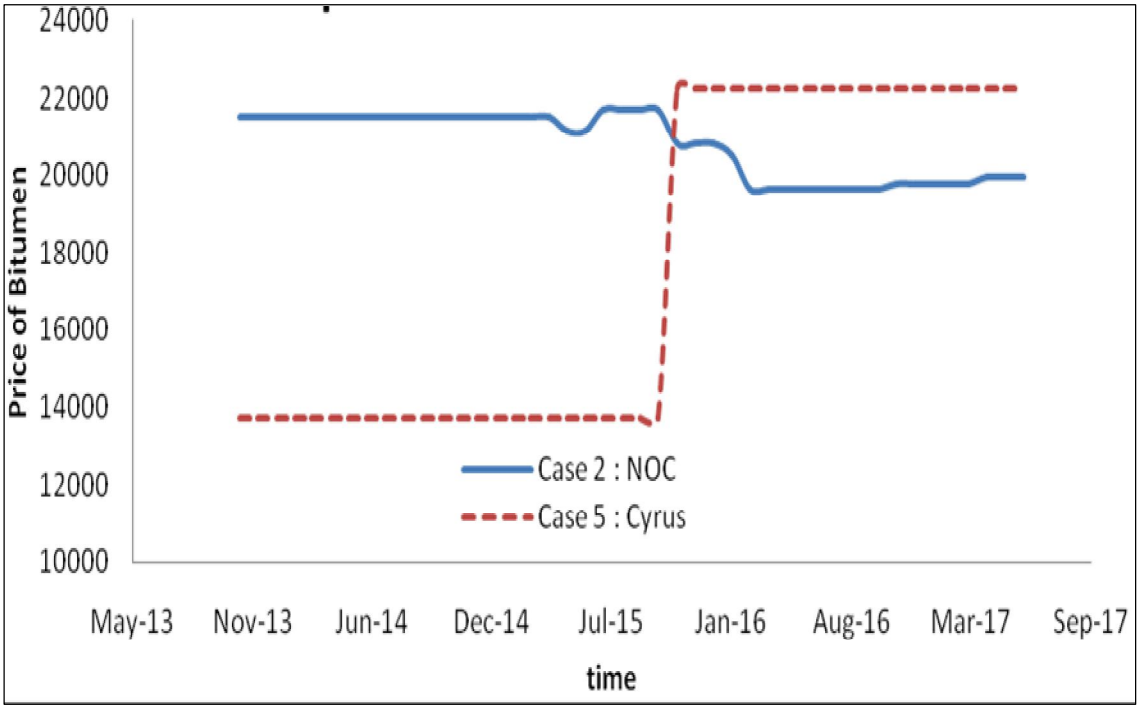
- There are few bitumen suppliers in Ethiopian construction industry as shown in the table 4.7 below;
- The penetration grades of the bitumen varies from one case to the other due to the climatic conditions and pavement design;
- The price of bitumen had not been updated monthly until the bituminous surfacing/paving works are commenced.

Table 4.7: Summary of bitumen source and base prices

No	Case	Bitumen Grade	Supplier	Base Date	Price at base date (Birr/barrel)
1	Case 1	MC 3000	NOC	April 2013	31,000
2	Case 2	AC 80/100	NOC	April 2013	21,500
3	Case 3	MC 3000	NOC	Feb 2010	23,000
4	Case 4	AC 60/70	Cyrus	Nov 2009	12,893.18
5	Case 5	AC 85/100	Cyrus	Feb 2011	13,739.13
6	Case 6	MC 3000	NOC	Aug 2012	29,500

Knowing that the actual selling prices of bitumen with penetration grades of 80/100 and 85/100 are more or less similar, the trend analysis of the price of NOC could be evaluated against the trend of the other supplier, Cyrus, as shown in the Figure below:

Chart 4.1: Comparison of Price Trend of NOC and Cyrus



As could be noticed from cross case comparison cited in the above chart, the price trends of the two bitumen suppliers are different since Case 2 has a decreasing trend whereas Case 5 exhibits an increasing trend.

For that reason, due to the change in price trend, the price adjustment calculated for the bituminous works will not be justifiable and fair as well as dependent on the choice of the supplier rather than the market conditions. Therefore, as the international best practices indicate, it is better to have an index for bitumen.

4.4.3 Price of Cement

The case study reflects that the main cement suppliers for ERA projects are Muger and Messebo cement factories, according to Access Capital Research, 2009, these two companies were "the largest producers and price setters". However, due to the introduction of Derba Cement Factory (February 2012) and Dangote Cement Factory (May 2015), Ethiopian cement market had become stable and competitive. (Official web site of dangote and derba cement factory, www.Dangotecement.com and www.dmc.com, accessed on September 25, 2017)

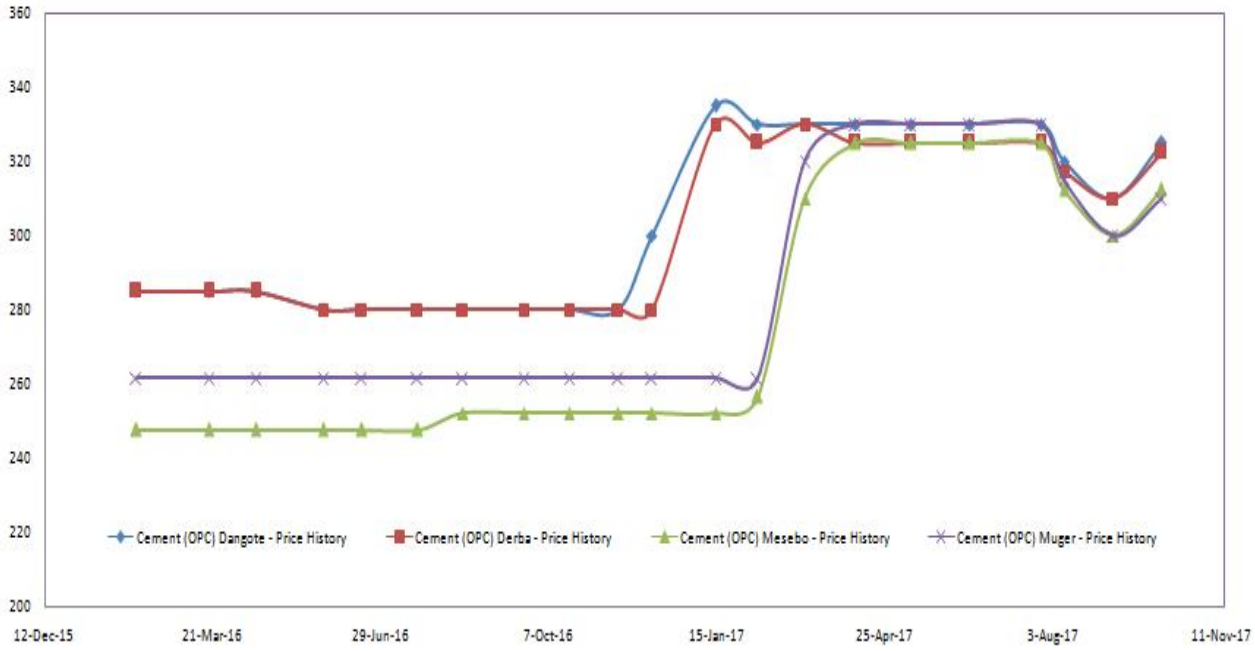
Table 4.8: Summary of Cement source and base prices

No	Case	Source of Cement	Location	Base Date	Price at base date
1	Case 1	Muger, OPC	Muger	April 2013	274.61
2	Case 2	Muger,OPC	Muger	April 2013	274.61
3	Case 3	Muger, OPC	Muger	Feb 2010	198.00
4	Case 4	Messebo,OPC	AA	Nov 2009	206.52
5	Case 5	Muger,OPC	Muger	Feb 2011	224.78
6	Case 6	Messebo,PPC	Mekele	Aug 2012	190.00

As could be understood from table 4.8, the prices of cement differ from one factory to the other but the price trend of them are more or less similar thus the quoted by the two companies could be considered as reputable and reliable.

Moreover, due to the introduction of the new cement price setters in Ethiopia (Dangote and Derba) the price of cement would further becomes more competitive and stable. This could be further shown on the chart 4.2 below:

Chart 4.2: Comparison of Price Trend of the Major Cement Producers



Further to the above, the introduction of new cement factories such as Habesha cement and National cement will also play a vital role in stabilizing the cement price in Ethiopian market.

4.4.4 Price of Reinforcement Bar

As could be understood from the cases, there are a number of reinforcement bar suppliers in Ethiopia, most of them are importers from Turkey. As a result selection of reinforcement bar supplier usually becomes the very first point of controversy between the employer and the contractor during tender evaluation period and between the contractor and the engineer during contract implementation period owing to the reputability and reliability of the supplier. Since both Ethiopian Public Procurement Agency (PPA) and ERA's procurement policy, allow the bidders to select their own supplier (whether importer or producer) and the employer could not intervene during the process except questioning the reliability and reputability of the quotation.

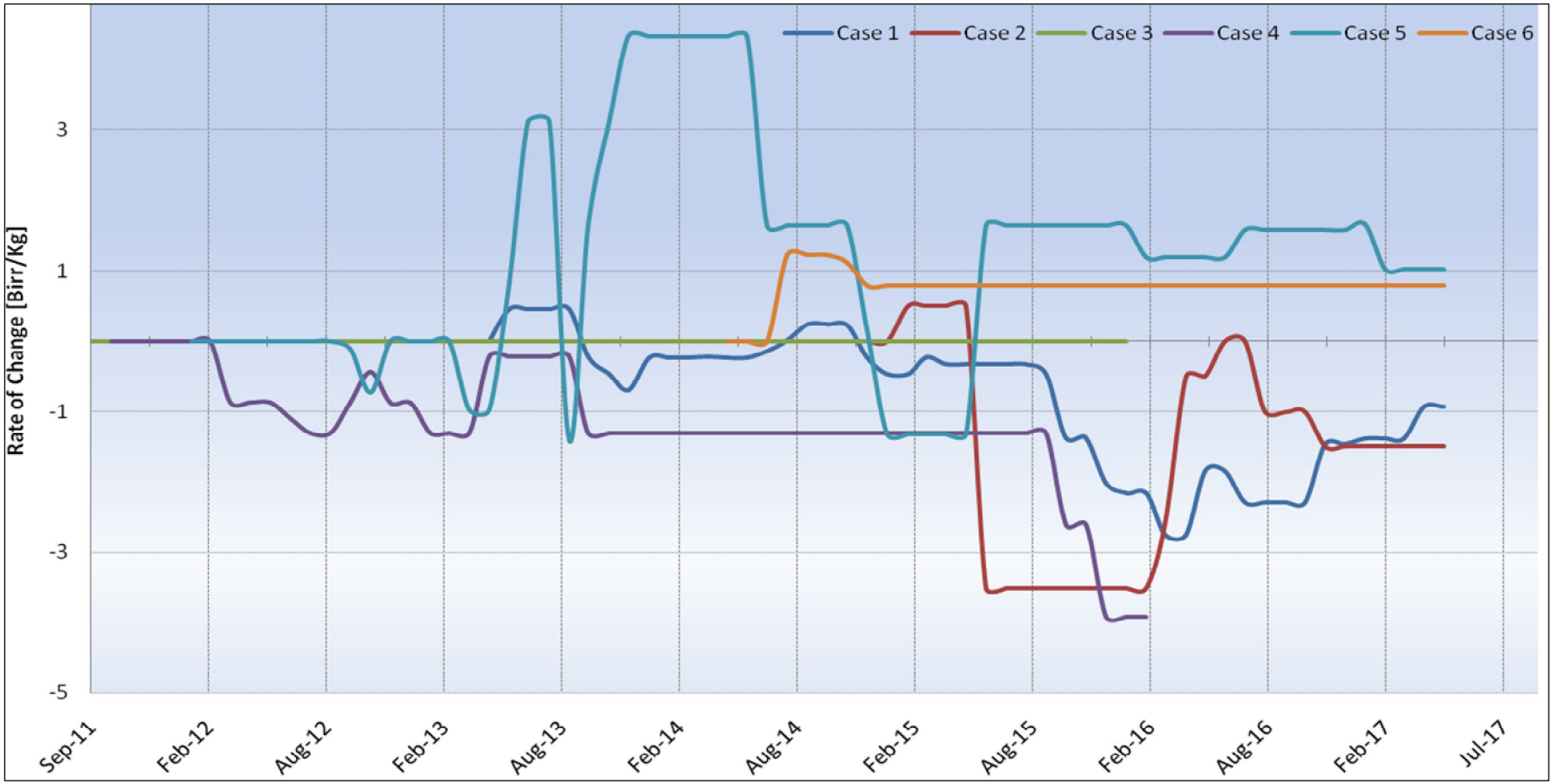
In this perspective, the case study reveals that, the reputability and reliability of the reinforcement bar suppliers had been questioned by the employer during pre-contract award meeting. But due to the free market policy of the country and the eligibility of most importers to sell reinforcement bar with free and equal market opportunity, the employer will not bound neither to select the supplier nor reject the submitted base price quotation.

Having said so, the price as well as the price growth trend of the selected cases are analysed as follows but underscoring to the point that most contractors had failed to update the price of reinforcement bar monthly if they didn't executed structural works:

- The prices and price trends of reinforcement bar differ from one case to the other for the same month. Even a single supplier had quoted different price for two different projects on the same period (as could be noted on case 1 and Case 6).
- The price trend observed on case 3 is straight line meaning the price of reinforcement is constant. However, as could be understood from the rest cases as well as the global market condition, the price of reinforcement bar is dramatically changing. Therefore, the price quotations submitted by the contractors should be thoroughly evaluated before considering for price adjustment.
- As could be noticed on the chart 4.3 below, the price trend of case 5 (which is Habesha Steel Mills) is different from the other cases which are importers from Turkey (Golagul Trading, Netsa Private Ltd. Co, Dok Tok importer and Guna Trading). Since the price of producers are not that much affected by the global reinforcement price escalation.

Therefore, as per the logically acceptable international practice, it is advisable to establish price index for reinforcement bar or rely on the price of local reinforcement bar producers since their price will not be much affected by the macroeconomic situations.

Chart 4.3: Comparison of Price Trend of Reinforcement Bar



4.4.5 Labor Index

Contract Provisions regarding the price adjustment of labour are:

> **Sub-Clause 70.3:** The formula for price adjustment to the local portion of the contract will not include the local labour factor. The contractor is therefore advised to take this into accounts when preparing his bid.
>
> **Sub-Clause 70.8 (Change in Legislation) :** If, after the date 28 days prior to the latest date for submission of bids for the Contract, there occur in the country in which the works are being or are to be executed changes to any National or State Statute, Ordinance, Decree, or other Law or any regulation or by-law of any local or other duly constituted authority, or the introduction of any such state statute, ordinance, decree, law, regulation or by-law which causes of this clause, in the execution of the Contract, such additional or reduced cost shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be added to or reduced from the Contract price.

In light to the above provisions, it could be conclude that since ERA will not consider price adjustment for the local labour portion, the contractors are expected to take into consideration during the preparation of the bid. However, if the rate of labour affected due to change in legislation that an experienced contractor could not perceived might be entertained by Sub-Clause 70.8.

4.4.6 Equipment Index

The case study reflects all cases except Case 2 prefer the Construction Machinery and Equipment Indexes from US Bureau of Labour and Statistics (BLS).

However, as discussed on the previous chapter, a reasonable source of index for construction equipment should be selected based on the country of origin of the machineries and/or country of purchasing of the machineries. As could be observed from the monthly machinery mobilization report, most of the construction equipments mobilized in all cases is Caterpillars (i.e USA origin).

Therefore, the applicability of the BLS Equipment index for ERA projects is acceptable with further modification based on the detailed Producer Price Index (PPI) analysis published by BLS.

Accordingly to detailed BLS report, PPI for construction machinery and equipment, which also include heavy agricultural and mining machineries, are calculated as follows:-

Step 1: Categorizing all construction machineries into 6 (six) major groups as:

1. Tractors and attachments, ex. Parts
2. Power cranes, draglines & shovels (excavators) (incl. surface mining equipment) (excl. parts)
3. Mixers, pavers, and related equipment (excluding parts)
4. Off-highway, equipment, ex. parts
5. Misc. construction machinery and equipment
6. Parts for construction machinery and equipment, sold separately

Step 2: Calculating the Producers Price Index (PPI) of each groups separately

Step 3: Allocating relative importance[14] for each categories (as shown below).

Step 4: Calculating a weighted average index by using the relative importance

Table 4.9: Breakdown of Construction Machinery & Equipment with Relative Importance

Code	Description	Relative Importance
112A	Tractors and attachments, ex. parts	23%
112B	Power cranes, draglines, & shovels (excavators) (incl. surface mining equipment) (excl. parts)	25%
112C	Mixers, pavers, and related equipment (excluding parts)	5%
112D	Off-highway, equipment, ex. parts	10%
112J	Misc. construction machinery and equipment	27%
112K	Parts for construction machinery and equipment, sold separately	10%

[14] Relative importance of Construction Machinery and Equipment are established by United State Bureau of Census, every 5 Years.

By thoroughly reviewing the above proportions, one could highlight to the following points before adopting same for Ethiopian Road Construction Projects;

- It would be straightforward that the relevant importance of each categories differ from one country to another, therefore total adoption of product price index is generally unsupportable.
- The relative importance of miscellaneous Construction Machinery and Equipment like Winches, aerial work platforms and automotive wrecker hoists are very high in US economy. On the other hand, most of ERA's Road Construction projects did not need these winches, platforms and automotive wrecker hoists, the above cited machineries and equipment, the weighting for the subgroup should be reduced.
- Furthermore, the applicability of power cranes, draglines and shovels (surface mining equipment) in ERA's Road Construction projects can be argued to be insignificant. Therefore, the weighting/relative importance of this group should be reduced.
- Due to aging and lack of services, most of construction machineries and equipment used in ERA's Road Construction Projects need spare parts frequently. Therefore, the weighting/relative importance for this group could be increased.

In light of the above, adopting the index of US Bureau of Labor and Statistics as it is for Ethiopian Construction Projects may not advisable since it will not reflect the actual market conditions.

4.4 Other Issues Related to Price Adjustment

4.4.1 Mobilization Advance Payment (MAP)

As a separate contract provision the contractor will be given an interest free advance payment for the sole use of the project upon submission of advance guarantee bonds. Accordingly, the contractor will use the advance payment for the purchasing of material, equipment as well as production of materials like pipe, aggregates as well as materials for the pavement layer works. For which the price adjustment would be made during the execution of the works.

On the other hand, from the perspective of the civil code Article 1713 (consents of contract) the parties shall not only bounded by the terms of the contract but also by such

incidental effects as are attached to the obligations concerned by custom, equity and good faith, having regard to the nature of the contract.

Therefore, by underscoring to the basic definition of price adjustment, which is to compensate the additional costs encountered by the contracting parties (employer or contractor) and advance payment amount is purely the employer's money which had been given to contractor free of interest, an adjustment on items purchased by using an advance payment would not be considered as fair and the contractor will not be legitimate for same.

Furthermore, pursuance to Proclamation No 979/2016 of Federal Democratic Republic of Ethiopian, the profit that the contractor might get due to price escalation of an item purchased by using an advance payment could be considered as a windfall[15] profit.

On the other hand, as per the ERA procurement team leader underscored, during the interview, the purpose of mobilization advance payment is to provide the contractor a working capital based on free will of the employer. As a result, ERA will not consider mobilization advance payment as non-adjustable portion of the contract. Furthermore, if the employer decided not to facilitate mobilization advance payment, then the project cost might go up since contractors generate working capital from bank with high interest rate.

4.4. 2 Material on Site Payment

Pursuant to Sub-Clause 60.3 of the Conditions of Particular Application (CoPA) of the contracts (please note that, ERA had used a harmonized contract provisions regarding material on site) the contractors are at liberty to receive a certain percentage of the works (60% up to 80%) as an advance when they mobilize and/or produce the material in advance.

Accordingly, for the selected case study, the contractors had received the under listed material on site payment far before the execution/completion of the works mainly for the following items:

[15] "Windfall profit" is defined as a profit obtained by any person as a result of a change that occurs in local or international economic or political situations without its own effort.

- Precast concretes (RC pipes, ditch and manhole covers, curbs, tiles etc)
- Reinforcement steel
- Bitumen
- Cement
- Crushed aggregates and base courses

Table 4.10: Material on Site Payments

No	Case	Total Material On Site Payment	%age from Original Contract
1	Case 1	102,000,000	14%
2	Case 2	25,000,000	2%
3	Case 3	8,000,000	1%
4	Case 4	63,000,000	10%
5	Case 5	24,000,000	3%
6	Case 6	23,000,000	6%

In view of the very basic principle of price adjustment which is to compensate the actual rise or fall in price of some selected and previously agreed construction materials, equipment and labor, the compensation for material should be done based on the purchasing date of the material.

However, from the selected case study one could easily understood that the price adjustment had been calculated on the month where the work item is completed. Thus for highly fluctuating market conditions of Ethiopia (usually on positive side) the employer would pay additional sum of money as price adjustment for which the contactor did not acquire on actual condition.

4.4.3 Master Work Program

It is straight forward that all projects are planned to be executed within the original completion period defined by the employer. Accordingly, the contractor during preparation of unit rates will consider the completion period and submit its work program during bid submission.

However, due to different reasons (which could be broadly classified as Compensable Excusable Delay (employer related), Non-Compensable Excusable Delay (losses lie where they fall) and Non-Compensable Non-Excusable Delay (contractor related) the completion of the projects usually will not be materialized on targeted date. Likewise, all the projects on this case study were not-completed on the targeted original contract completion date, following this, the employer had granted extension of time for the completion of the project.

Consequently, because of the trembling market conditions both the contractor and the employer would be at financial risks due to price escalations. To elaborate same, the price trends of the adjustable elements are tabulated hereunder:

Table 4.11: Price Trends of Adjustable Elements

Cases	Price Trend						*Remark
	Fuel	Rebar	Bitumen	Cement	Equipment	Currency*	
Case 1	↓	↓	↓	↓	↑	↑	Dollar to Birr
Case 2	↓	↓	↑	↔	↑	↑	Dollar to Birr
Case 3	↓	↔	↑	↓	↓	↑	Pound to Birr
Case 4	↓	↓	↓	↑	↑	↑	Dollar to Birr
Case 5	↓	↑	↑	↓	↑	↑	Dollar to Birr
Case 6	↓	↔	↔	↔	↑	↑	Dollar to Birr

Further to the above price trends of adjustable elements, the financial impacts of the change in price of adjustable elements could be analysed as follows:

Assumptions:

- The backlog (the outstanding works on the original completion date) could be redistributed uniformly throughout the contract period so as to complete the project on the targeted date.
- The market condition/price will not be affected by an increase in demand of the projects due to the additional workloads.
- The market could able to supply all the required resources with the same price.

With the above assumptions in mind, the total saving of the projects if completed on the original contract completion would be calculated as shown in the table below.

		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Affected Amount	Up to original Compl.	270,263,736.13	610,809,144.29	179,796,511.57	446,088,263.19	274,242,972.17	143,655,130.05
	During Extended Period	291,419,628.41	141,654,207.04	561,488,086.17	501,861,454.32	327,948,390.56	34,489,475.56
Price Adjustment	Up to Original Compl.	22,422,524.66	50,263,879.85	37,967,450.51	89,555,122.18	53,051,895.62	12,784,080.77
	During Extended Period	28,011,763.04	16,905,492.05	73,671,777.62	145,360,659.38	74,394,449.57	4,008,941.14
Price Adjustment %age	Up to Original Compl.	8.30%	8.23%	21.12%	20.08%	19.34%	8.90%
	During Extended Period	9.61%	11.93%	13.12%	28.96%	22.68%	11.62%
Saving if Completed within Contract period		3,834,032.43	5,248,675.66	(44,897,103.06)*	44,608,706.08**	10,953,320.53	939,672.11

Table 4.12: Project cost after the original completion date

NOTE * Case 3: If the project had been completed within the original contract period, the employer would have paid an additional 44.9 million birr as price adjustment. But due to the decrease in the price of fuel, cement and equipment during the extended period, the actual price adjustment paid to the contractor is lower. In short, the employer had saved the above cited sum due to late completion of the project.

** For all Cases except Case 3: The employer will save 65.6 million birr from price adjustment if the projects had been completed on time.

CHAPTER FIVE

5. Conclusion and Recommendation

5.1 Introduction

This chapter presents the conclusions and recommendations of the research which are based on the results of data analysis and discussion made on the previous chapter. First and foremost it discusses and highlights the importance of some findings and contributions drawn during the elaboration of this thesis. Furthermore, this chapter presents some recommendations for the concerned bodies and future research.

Knowing that the research methodology used in performing this research is a multiple – case study the individual results found during the analysis will not be taken to the population, it simply reflects the individual cases and conclusions are drawn about the existence of such cases likewise recommendations to the concerned bodies to properly manage the observed scenarios.

5.2 Conclusion

To achieve the specific objectives of the research, case study method was used as research instrument and probing questions as well as themes were developed and thoroughly analyzed in the previous chapter against the international practices elaborated under literature review.

Based on the results from the analysis the following conclusions have been derived and summarized in accordance with the objectives of the research.

1. ERA uses formula method for the calculation of price adjustment with two different techniques, namely calculating adjustment factors for each Bill No and calculating an adjustment factor for aggregated Bill. As per the logically acceptable international practice, discussed in the previous chapters, the first technique to calculate price adjustment is preferable.
2. Reputability and reliability of contractor's supplier had been the very first point of controversy between the employer and the contractor during tender evaluation period. But international practice recommends the use of producers' price index

or otherwise average material prices compiled by the concerned government bodies.

3. The prices/price indexes of key resources [Fuel, Bitumen, Reinforcement, Cement, Labor and Equipment] were made and the result indicated that:
   - The price of fuel is determined by the government therefore the actual market fluctuation will be considered.
   - The price adjustment calculated for the bituminous works depends on the choice of the supplier rather than the actual market conditions as a result the adjustment is unfair and unjustifiable.
   - The price of cement is reliable and reputable as well as determined by the actual market conditions since the price trends of different cement suppliers are more or less similar.
   - Both the prices and price trends of reinforcement bar differ from one case to the other for the same month. Surprisingly, even a single supplier had quoted different price for two different projects on the same period.
   - ERA will not consider price adjustment for the local labour portion; it advises the contractors are expected to take into consideration during the preparation of the bid.
   - Adopting the index of US Bureau of Labor and Statistics for construction machineries and equipments as it is for Ethiopian construction projects is not advisable since it will not reflect the actual Ethiopian market conditions.

4. ERA had used different percentages in fixing the non-Adjustable portion of the bill item ranging from 12% - 50% depending on the bill item and the nature of the works. However, the non-adjustable portion of the bill item should be determined based on the cost break down. Likewise, the weightings should also be proposed based on the engineering estimation and analysis of the cost break down.

5. ERA had effected advance payment and material on site payments beforehand to support the contractor's cash flow by improving working capital. Besides, the completion of the project as per the contractor's maser work program will benefit both the contractor and the employer by reducing the risk of price fluctuations.

5.3 Recommendation

One of the objectives of this thesis was to recommend ways of improving the current price adjustment valuation methods by reviewing against the international practices. Therefore the recommendation will focus in addressing the major problems identified through the research processes and the under listed particular recommendations are forwarded to ERA.

1. ERA is recommended to apply formula methods by calculating adjustment factors for each bill item. This could in turn be applicable by producing a standard guideline/ manual to deal with price adjustment valuation.

2. As reflected on the case study, ERA's concern regarding reputability and reliability of contractor's suppliers before the signing of the contract is valued. And ERA is sincerely advised to facilitate the establishment of the price indices by communicating with the concerned bodies like Ethiopian Central Statistical Agency, professionals', consultants' and contractors' associations.

   But in the mean time, knowing that both Ethiopian Public Procurement Agency (PPA) and ERA's procurement policy will allow the contractor to freely select its own supplier ERA is advised to establish average selling price of materials and to request the purchasing invoice instead of the price quotations.

3. Since construction machineries and equipments index generated by US Bureau of Labor does not reflect the actual Ethiopian market condition, it is advisable to introduce a correction factor for same.

4. By communicating with the concerned bodies ERA is recommended to produce price indexes for the construction materials or provide a correlation factors to adopt previously produced indexes from the developed countries.

5. ERA is advised to request design engineer to perform non-adjustable portion and permissible weighting ranges analysis since these coefficients depends on the cost break down of activities and the nature/scope of the work. For that reason and for the uniformity of the projects, it is also advisable to prepare a guideline that the designing engineers use in proposing the coefficients as well as ERA will validate the engineer's proposal in accord.

6. Furthermore, after a thorough evaluation of correlation of price adjustment with mobilization advance payment, material on site payments and contractor's maser work program, ERA is cordially recommended as follows:

   - In this perspective and based on the findings on the interview, the Employer (ERA) is expected to focus on the major goal/objective which is the completion of the project within the planned cost, time and quality.
   - Further to the point, ERA had effected advance payments beforehand to support the contractor's cash flow by improving working capital.
   - ERA should provide a provision which prohibit material on site payment since the governing Ethiopian public procurement directive will not allow material on site payment.
   - Besides, the completion of the project as per the contractor's maser work program will benefit both the contractor and the employer, therefore, on today's volatile market condition it is advisable to complete the project at the earliest possible to reduce a risk of material, labor and equipment cost.

Recommendation for Further Study

1. Extending this research on Design and Build (DB) and International Competitive Biddings (ICB) projects.
2. Developing price indices for the major resources used in the road construction projects.
3. Meticulous assessment of correlation of price adjustment with the contractor master work program
4. Determination of non-adjustable portion of the contract based on the contractor's detailed cost break down.
5. Preparing guidelines for analysis and determination of permissible weighting ranges for price adjustment formula.

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