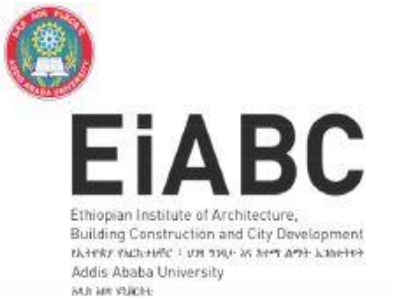

Ethiopia Institute of Architecture, Building Construction and City Development (EiABC)

Chair of Construction Management

Assessment of Price Adjustment Practice on Public Building Projects in Addis Ababa, The Case of Selected Projects.

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EiABC

Ethiopian Institute of Architecture,
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Assessment of Price Adjustment Practice on Public Building projects; The Case of Selected Projects in Addis Ababa.

A Thesis Submitted to Addis Ababa University (EiABC) Department of Infrastructure and Technology Management in Partial Fulfillment of the Requirement of the Degree of Master of Science in Construction Management.

By: Hamdu Nesru

The undersigned have examined the thesis entitled '**Assessment of Price Adjustment Practice on Public Building projects; The Case of Selected Projects in Addis Ababa** presented by **Hamdu Nesru,** a candidate for the degree of **Master of Science in Construction Management** and hereby certify that it is worthy of acceptance.

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I certify that research work titled **"Assessment of Price Adjustment Practice on Public Building projects; The Case of Selected Projects in Addis Ababa**." is my own work. The work has not been presented elsewhere for assessment. Where material has been used from other sources it has been properly acknowledged / referred.

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Abstract

The construction sector contributes significantly to a nation's GDP, which is crucial for economic growth and development in terms of the development of physical infrastructure. Ethiopia allocates a huge amount of budget for the development of public projects. Even though most public projects in Ethiopia face challenges to complete successfully within in planned budget and specified time frame. Ethiopia's building industry has faced difficulties due to market price fluctuations and inadequacies of the necessary construction inputs. The study looks into how Addis Ababa's public building projects are affected by price escalation in terms of project performance in terms of project cost and time overrun.

The study employed a case study methodology to investigate how escalation affects public construction projects. Systematic sampling techniques were applied for the selection of a few best-fit cases and focused on detailed contextual analysis. To measure the impact of price escalation on public building projects, construction material prices were investigated for a different period, and contract documents were reviewed and analyzed to explore the current price adjustment practice to overcome the risk of escalation by crosschecking the provision of different conditions of contract forms.

The research shows that the price adjustment practices observed in the selected cases were different on the subject of selected construction inputs for the price adjustment, non-adjustable portion, permissible weighting/ coefficient, and the source of price/index. The number of representative elements for the price adjustment component, fixing non-adjustable factor, and establishment of permissible weight/coefficient was not consistent in the selected cases in this study. On the other hand, Addis Ababa Construction Bureau implements price adjustment evaluation for projects having a duration of less than 18 months in setting a new unit rate in assessing the direct cost of each work item.

In conclusion, escalation is a major challenge facing the construction sector in Ethiopia. The high escalation rate on the price of construction materials, labor and other inputs made it difficult to complete public building projects on schedule within budget.

Key Words: Construction Projects, Price Escalation, Price Adjustment

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Abbreviations

AAU	_	Addis Ababa University
ADF	_	Africa Development Fund
ADB	_	Asia Development Bank
BCIS	–	Building Cost Information Service
CPI	–	Consumer Price Index
CPAP	_	Contract Price Adjustment Provision
DBB	_	Design Bid Build
ECSA	_	Ethiopia Central Statistics Agency
EEA	_	Ethiopian Economic Association
ERA	_	Ethiopia Road Administration
FIDIC	_	Fédération Internationale des Ingénieurs Conseils
GCC	_	General Condition of Contract
GDP	_	Growth Domestic product
MoWUD	_	Ministry of Work and Urban Development
PMBOK	_	Project Management Body of Knowledge
PPA	_	Public Procurement Agency
PPI	_	Producer Price Index
RPI	_	Retail Price Index
SBD	_	Standard Bidding Document
SSC	_	Special Section of Contract

Chapter One – Introduction

1.1 Background

The construction industry plays a vital role in the economy of all countries. According to Oladinrin et al., (2012), the construction sector is one of the main drivers of economic growth and development. Also, it provides an important contribution to creating job opportunities for millions of skilled and unskilled labor. In developing countries growth and development largely depend on the development of their physical infrastructures such as buildings, roads, and bridges. World Bank (2012) confirmed that infrastructure development surely makes a considerable contribution to fixed capital formation.

The state of the construction industry would have an impact on the most common indicators of a country's economy, like GDP. According to Kassa (2017), the industry contributes between 6 and 9% of the GDP in many countries and according to (Bhimaraya (2017), it rises to 10%.

In sub-Saharan African countries, experienced an increase in the economic contribution of gross domestic product (GDP) to 21 % in 2015 (Kirchberger, 2020). According to the Ministry of Works and Urban Development (MoWUD, 2010) The Ethiopian construction industry contributed 5.8% of GDP. According to the report of Africa Economic Outlook (2017) quoted in (Demissie, 2020), its contribution reached up to 15.9% of GDP in the 2015/16 fiscal year.

However, the construction sector in Ethiopia encounters many challenges in its practice such as cost and time overrun, poor quality, appropriate procurement system and inability to adapt best practices (Ayalew et al., 2016). Time and cost overrun were the most significant problems of construction projects in Ethiopia (Biyadgilgn 2017). (Rahel 2016) also described that the industry is widely affected by time and cost overrun. Eventually, the country lost billions of birr and extended the provision of infrastructures. Cost overruns and inflation have a substantial relationship in both public and private building projects. Escalation has become a persistent issue that affects the whole construction industry (Wondimagegn 2022).

Due to continuous escalation on the cost of material, labor, and equipment seriously challenges stakeholders in the implementation of construction projects. It will significantly increase the project's overall cost, cause it to take longer to complete, and reduce the economic accruals or rate of return to the constructors for the work they have done, which would result in a loss of profit (Ogunsina & Ugochukwu, 2014). As a result, it can have a catastrophic effect on the budget which leads the construction companies getting into financial difficulties and going out of business (Outram, 2022). Also, it affects other stakeholders involved in the construction industry like; clients, employees, suppliers and so on.

During times of high or unpredictable escalation, as well as for large projects, long-term contracts, and complex projects, it is important to think about reducing the risk of inflation. By including a price adjustment clause in the contract for the event that some costs increase or decrease outside either party's control, the risk and uncertainty brought on by escalation in the cost of labor, materials, and equipment have been reduced (Solomon , 2017). Price adjustment give a sense of security for contracting parties to take care of the price volatility of materials that are associated with the contract purpose(D.Sharma, 2016).

Asteway's (2008) study, "The Effects of Unpredictable Price Fluctuation on the Capacity of Construction Contractors," examined the ability and profitability of contractors when prices fluctuated during a project. Also, he assessed the total amount of compensation requested and the amount of compensation received rather than conducting the way of price fluctuation adjustment which may or may not be given guidelines in the contract document.

Ameha (2018) in his study on the effect of birr devaluation in the case of the Nefasilk Lafto sub-city office building project observed that the effect of devaluation on the increase in material prices caused the contractor to suffer greatly. The study shows that the contract document was devised with a price adjustment provision to secure the contracting parties from such uncertainty/risk.

However, the contract document did not include base price indices in dealing with price adjustment and it exposed to ambiguity in contract administration between contract parties.

Ameha (2018), the contractor was entitled to a price adjustment twelve months from the contract's effective date. The contractor eventually lost a significant amount of money and filed for bankruptcy. In Solomon's (2017) Review of Price Adjustment Valuation Practices in Ethiopian Federal Road Construction Projects, ERA used the formula approach to adjust prices by figuring out adjustment factors for aggregated Bill No(s) and adjustment factors for individual Bill Nos. The scope of each bill item is different, and the quantity of materials, labor, and equipment is also different (Solomon K. 2017). He suggested that each bill item should have its adjustment factor to make the price adjustment more accurate. The study also revealed that the local labor component was not included in the price adjustment calculation.

As discussed earlier, none of the previous studies addressed the standard procedures of price adjustment provision to manage uncertainty/risk due to inflation. Therefore; this research will focus on assessing the guidelines in the standard condition of contract for price adjustment and its implementation on public building projects. Also, try to point out the problem in price adjustment and valuation on different public building projects by reviewing international practices.

1.2 Objectives of the Study

1.2.1General Objective

The main objective of this research is the assessment of price adjustment practices on public building construction projects in Addis Ababa.

1.2.1.2 Specific Objectives

1) To assess the price escalation of construction materials since 2015 G.C.
2) To identify the impact of price escalation on construction material and labor on selected public building construction projects in Addis Ababa.
3) To assess the standard form of contract which gives a guideline on the method of price adjustment due to escalation and the percentage of reimbursement in a public building project in Addis Ababa.

1.3 Research Questions

a) What is the escalation rate on construction materials since 2015?
b) What is the impact of escalation on a public building construction project in Addis Ababa due to fluctuating prices of construction material, labor, and Fuel?
c) How much does the standard form of the contract allow to compensate for the escalation in the price of material?

1.4 Significance of Study

By comparing current price adjustment valuation practices in public building projects to international experience, this study will assist project stakeholders(contractors, consultants, housing corporations, and suppliers) in understanding the impact of escalation and taking it into account when estimating costs. The contracting parties will also secure the most effective method of escalation compensation.

1.5 Scope of the Study

Assessing the impact of inflation on public building construction projects in Addis Ababa is the primary emphasis of the study, which is specifically restricted to evaluating the rate of inflation of carefully chosen materials and price adjustment practices in public building projects.

1.6 Organization of the Research

The research will be arranged into five chapters, The first chapter deals with the introduction the background of the study, the statement of the problem, the research question, the research objectives, the scope of research, and the relevance of the research. The second chapter examines pertinent literature on the construction industry, project costs, the effects of inflation on construction projects, and how material, labor, and machinery prices are adjusted to compensate for inflationary prices. The research process, which includes the problem statement and issue identification, literature review, research design, data analysis, conclusion, and recommendation, is explained in Chapter 3.

Chapter 4 talks about the analysis that was done and what was discovered. The chapter is organized as follows: a broad overview of the cases; methods for adjusting prices to offset inflation-driven price increases; and the overall effect of inflation on construction projects. Finally, the conclusions and recommendations for the concerned stakeholders from the study were forwarded in chapter five.

Chapter Two - Literature Review

2.1 Introduction

The construction industry is the backbone of the economic and social development. It plays a major role in the economy by contributing significantly to the gross domestic product and linkage strongly with other economic sectors(Gashaw, 2013). Construction fulfills basic physical and social needs through buildings and infrastructure. According to (Asnake, 2021) the objective of the construction project is to provide a solution for society's needs through appropriate infrastructure development with required quality. Additionally, construction is done to develop a unique product or service with predetermined parameters for scope, quality, cost, and time (Habenom, 2017).

The construction sector influences the most widely used indicators of a country's economic health, including GDP, and is used as a gauge of national wealth in the performance of infrastructure provision. In most countries for example in Afghanistan, the construction industry can contribute around 10% of the country's GDP for economic development (Abbas & Painting, 2017). In India construction industry consumes 40% - 50% of the national budget and contributes 20% of GDP (Rajaprabha R et al., 2016).

Ethiopia's construction sector has experienced rapid growth since 2001. Given its GDP share and rising investment in the construction and expansion of numerous facilities, it makes a substantial contribution to the Ethiopian economy. According to the study of (Zewdu & Aregaw 2015) quoted in (Ayalew et al., 2016), the GDP contribution of the industry has been 5.6%. The 2017 Africa Outlook Report indicates that Ethiopia's construction sector contributed 15.9% of GDP during the 2015–16 fiscal year (Essayas, 2020). The contribution of the construction sector to GDP measures across various nations is shown in Table 2.1 below.

Table 2. 1 Construction Industry Contribution to GDP

S.N	Country	Contribution to GDP (in billion USD)	Percentage of GDP
1	United Kingdom	152.1	6%
2	European Union	1700	9%
3	Indonesia	110	11%
4	Singapore	11.98	3.70%
5	Finland	18.64	7.40%
6	Germany	0.21	5.60%
7	Italy	80	4.20%
8	Georgia	1.26	8.30%
9	Poland	40.39	7.70%
10	Iceland	1.77 7	7.40%
11	Austria	27.9	6.70%
12	Malaysia	14.15	4.50%
13	United States	790	4.10%

Source from (Muhammad Ali Musarat, Wesam Salah Alaloul 2020)

The construction industry uses flexible technology and can create significant work opportunities for skilled and unskilled laborers (Abraham, 2017). In Malaysia, construction and engineering services created job opportunities for 7,505,000 workers in 2019 and are expected to raise 864,700 new jobs in 2026 with an estimated growth rate of 12%. (Musarat, Alaloul, & Liew, 2020). Similarly in Ethiopia, 507,000 workers were employed in the construction industry (Abraham, 2017).

Ethiopia's building sector has made significant contributions to lowering poverty, boosting employment through the growth of small and medium-sized businesses, and creating jobs by building affordable homes in Addis Ababa.(Ministry of Urban Development and Construction, 2012). Additionally, the construction sector contributes significantly to government revenue through employee income tax, rental and sales income gain tax, and corporate income tax for businesses. It also boosts government revenue through international trade in engineering services and building material supplies. (Abraham, 2017).

So the Ethiopian Government will recognize the role of the construction industry and its contribution to the economy and give attention to its growth. Throughout the economy, the construction sector creates multiplier effects and has several backward and forward links with other industries (Ethiopian Contractors Association Report, 2018).

2.2 Risk in Construction Project

Risk is an unpredictable event or circumstance that, if it materializes, can have a positive or negative impact on the goals of a project. Risks and uncertainties in construction projects include a variety of potential financial outcomes that may be better or worse than anticipated.(Kassa, 2017). Uncertainty and risk may have detrimental effects on construction projects. According to PMBOK 2016, every construction project continuously faces a variety of uncertainties regardless of its complexity and size due to material shortage, unskilled workforce, material price change and involvement of many stakeholders.

The most critical risks of construction projects in Ethiopia are inadequate schedule, late interim payment, late submittal& approval of construction documents and inflation. Among the major risks and challenges in the construction industry is facing the cost at completion of the projects becomes much higher than the original estimated contract price (Andualem, 2020). The risk of construction material and skilled labor cost fluctuation with supply chain pressure and shortage persistently affects the construction project in extending the project completion date and adversely deviates the project's estimated cost at completion(Mohammed, 2017). Price inflation is among the economic risks and highly affects the project's progress. Contracting parties have no control over the market price inflation of building materials utilized for contracted work. The standard condition of the contract must include a price adjustment clause to satisfy the contractual parties' significant concerns regarding pricing uncertainties for construction inputs.

Price adjustment provision devised in the standard condition of the contract to take care of price inflation of materials, labor and equipment used for executing the contracted construction project. It set procedures to minimize the cost impact of materials, labor and equipment price uncertainty. It also allows contracting parties to respond to such price uncertainty by transferring a portion of the risk among the contracting parties(Sharma, 2016).

2.3 Price Escalation

Escalation is a change in the price of a particular good or service over a predetermined time in a particular economy(Ahmed, 2023). Different scholars defined price escalation in the construction industry in their works. 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 markets and/or at the labor market. (Stukhart 1982). Furthermore, (Dawood et al, 2001) 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 several factors ranging from design changes to the high cost of materials, machinery, and labor (i.e. more than initially anticipated)(Kassa, 2017).

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. According to (Mohammed, 2015) price escalation is defined as an increase in the cost of equipment, material, labor, etc., due to continuing price changes over time. Construction price escalation is therefore understood as the situation when the money required to construct a project exceeds the original budgeted value (Bhosale & Khatri, 2017). Price escalation difference in the price of materials at contract signing and completion stage of the project as a result of an increase in the cost of labor, materials, equipment, and other production factors and ongoing price changes(Bethlehem, 2023).

2.4 Cause of Price Escalation

Price escalation or the increase in price of goods or services over time can be caused by a variety of factors, internal and external.

A. Internal Factors

i. Poor Estimation and Planning

Inaccurate initial cost estimation and inadequate project planning can lead to unforeseen expenses and material shortages contributing to price increases. Estimation documentation must be in a form that can be understood, checked, verified, and corrected. The foundation of a 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 inadequacies and poor performance in planning and estimation procedures and techniques.

ii. Project Schedule Change

Frequent changes to the project schedule can disrupt the procurement process leading to higher material costs and potential delays. 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.

iii. Construction Complexities

The 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.

iv. Ambiguous Contract Provision

Lack of clarity in contract provision can lead to disputes and disagreement over price adjustment potentially resulting in increased cost. Dilute responsibility and cause misunderstanding between the employer and other contractual parties, including design consultants and/or project contractors, providing too little information in the project documents can lead to cost overruns during the execution of the contract.

B. External Factor

i. Inflation and Material Cost Increase

Rising inflation and increased material prices can significantly impact project costs. 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. The longer the expected construction period, the more accounts will need to be taken of expected inflationary price increases over time. Initial cost estimates will need to allow for the value that will need to be paid at the time the project goes ahead(Mohammed, 2013).

ii. Market Condition

Fluctuations in supply and demand as well as changes in economic conditions can significantly impact material and labor costs. An unstable construction market would make it difficult for contractors to decide on the optimal level of overhead costs that enable contractors to win and efficiently administer projects.

Changing market conditions during the construction of a project that reduces the number of bidders, affects the labor force, and other related elements can disrupt the project schedule and budget (Chang, 2002).

iii. Local Concerns and Requirements

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 during the planning and design phases, 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 affecting inflation allowances or adding direct cost.

iv. Change in Legislation

Change in legislation during the contract time of the project is one cause of price variation. These additional costs due to changes in legislation are considered during the contract and approved for extended completion time. The changes in cost and legislation clause (clause 70), in the FIDIC IV general condition of the contract, are intended to make provision for the possible effect of such matters as variation in the cost of labor and materials arising during the execution of the works.

v. Force Majeure

Unknown soil conditions can affect excavation, compaction, and structure foundations. Contaminated soils may be present, thereby resulting in the need for special mitigation works. If the Contractors have incurred additional costs related to the increment of sales tax, surtax, VAT, and other government and custom taxes during the execution of the contracts caused by subsequent legislation, they are entitled to compensation of some amount to the additional cost incurred. The additional cost incurred due to subsequent legislation should be requested separately in addition to the additional cost due to price escalation.

vi. Increase Demand for Construction Materials

One of the most fundamental factors determining the prices of any products or services including construction is the relationship between demand and supply in which the market prices are determined by the equilibrium conditions. The capability of material sources has not increased as much as demand has increased. This gap in the supply-demand equilibrium has resulted in increases in material prices.

2.5 Effect of Price Escalation on Construction Material

The risk of rising construction material, labor, equipment, and energy costs, among other risk factors, which could result in delays and financial instability, makes cost escalation inevitable in large construction projects. To complete the project successfully, it is essential to identify the factors that contribute to cost escalation and then take the necessary actions to control or mitigate them. Customer satisfaction and planned objectives are always impacted by cost overruns(Ahmed, 2023). The impact of price escalation is being felt in the public construction sector. For public projects, substantial price increases present exceptional problems. Public bodies are then confronted with the alternatives of keeping projects on hold while additional funding is pursued, withdrawing the project if additional funds are not available, or making an attempt to reduce the project scope(Bethlehem, 2023)

According to (Mohammed, 2013) Price fluctuation can affect contractors, clients/owners, and the project itself. The major effect of price fluctuation on contractors, if not well compensated is the cash flow (project financing) problem of the projects. Price escalation results in delays in construction projects, the reduced scope of projects or projects being canceled. Escalation clauses could also affect public projects negatively because prices being submitted are not guaranteed for long periods. Contractor and supplier fears concerning probable price escalation and the lack of price escalation clauses in most construction contracts usually lead to higher contract prices and larger project costs (Vamsidhar et al., 2014 cited by Bethlehem, 2023).

In the public construction sector, the effect of price escalation was delayed projects, reduced-in-scope projects, or canceled projects have been the result. In several projects, material prices increased significantly and bids came in at prices much beyond the approved contract amounts. Public bodies are then faced with the alternatives of putting projects on hold while supplemental funding is sought or terminating the project if additional money is not available. Projects significantly delayed as a result of price escalation difficulties have frequently experienced higher project costs. Contractor and supplier fears regarding potential, and future price escalation, and the absence of price escalation clauses in most construction contracts, often lead to higher contract prices and larger project costs.

The effects of price escalation are identified and summarized as

- Delay
- Project Termination
- Reduce the Number of Bidder
- Higher Project Cost
- Cash Flow Problem of the Project
- Dispute between the parties

2.6 Managing price escalation

The first step in measuring or managing escalation on construction projects is to understand the factors that lead to it. This is particularly important in the current scenario, where price fluctuations have been so volatile that it has been hard to estimate or predict what bid prices might be. Minimizing the consequences of price escalations should start in the bidding phase. During the bidding process of a project, contractors, subcontractors, and suppliers should identify which materials are most susceptible to price fluctuation and address them with the upstream contracting party(Bethlehem, 2023). To manage cost escalation and minimize the impact of future cost increases the project owners need to become partners in the risk. The project owners to take more responsibility for the risk associated with material price fluctuations.

Because the owner is much more diversified, they are better able to handle the risk(Gashaw, 2013). The best way to mitigate risks associated with material cost volatility is to include price escalation provisions in contract documents. Escalation accounts for unforeseen increases in material, labor, and equipment costs. It is important to account for escalation when project completion time exceeds a year. Escalation is generally tied to inflation, and it is advisable to have an escalation clause in construction contracts. (Mohammed, 2013) recommend some methods to manage price escalation such as considering price escalation clause, bulk material purchase, regularly monitoring cost throughout the project life and considering locally available material in design.

2.7 Effect of Price Escalation on Construction Project

According to (Musarat, et al. 2020a), construction projects are crucial to economic development and growth. Critical project investment, cost, profit, time, and marketing value are all directly impacted by macroeconomic factors in construction projects (Hong & Shao, 1996). Construction projects involve a huge investment and play a significant role in creating job opportunities for millions of workers. Cost, schedule, and scope criteria are typically used to evaluate construction projects(Mohammed, 2017). According to (Musarat et al., 2020) construction cost is the primary limitation on construction projects. Construction materials, labor, and equipment prices are the primary determinants of a building construction project's cost.

While construction materials account for 35–45% of the overall project cost, they can account for up to 60% of some projects. Most mega-construction projects spend 50 percent of the total project cost on purchasing construction materials (Ogunsina & Ugochukwu, 2014). Because price escalation raises the cost of construction materials, construction costs go above budget, and contractors' economic accrual or rate of return declines (Oghenekevwe et al., 2014). Project stakeholders may choose to postpone the project to avoid cost overruns, primarily as a result of inflation (Musarat, Alaloul, & Liew, 2020).

However, if the project's duration increases, the effect of price escalation on the project will also increase. In Malaysia, construction projects are expected to be completed within 8 years and the final project cost has exceeded 23.21% of the initial project cost due to escalation (Musarat et al., 2020). Moreover in Nigeria, the building material prices have been steadily rising over time, causing cost overruns, a shortage of available housing, and an elevated cost of urban housing (Ogunsina & Ugochukwu, 2014).

Similarly, in Ethiopia, the major portion of construction inputs are imported by paying in hard currency which affects the contract balance in deviating the project cost. According to (the Ethiopian Contractors Association Report, 2018) From October 2017 to January 2018 the price of construction materials on average increased by 51.39% and the building project cost increased by 31.64%.of the original project cost/contract price. Currently, escalation in the cost of construction materials alerts the project owner, government officials, contractors and the public about extreme project cost increases and supply chain disruption affecting construction. Due to that Ethiopian government made a decision not to start a new project in the 2023/24 fiscal year.

2.8 Contract provision for price adjustment practice

Construction is always considered one of the high-risk sectors for the stakeholders in construction projects. In the construction sector, the biggest risk and challenge is that the final project cost would be significantly greater than the initial contract price. It is necessary to create specific contract clauses to deal with the impact of price fluctuations and inflation. (Barthet, 2010) quoted by (Kassa, 2017) three types of price adjustment techniques were considered and used to address the uncertainty of inflation. These are the invoice method, index method and hybrid method. The invoicing method requires the contractor to prepare a document that reflects any increase in material cost that occurred between the contract being signed and the actual materials purchased time. In the index method, the price adjustment clause consists of some list of materials costs coupled with an index for price adjustment applicability.

It can lead to a loss when the cost of materials drops and permits the contract to adjust in line with any local or regional changes to the price index for specified materials. On the other hand, the hybrid approach, which is based on a certified bid cost where the contractor validates its estimate of the costs of certain items, combines the invoice and index techniques. The contract may be modified by a predetermined percentage change in the certified bid cost.

According to (Sharma, 2016) in Nepal, the procurement contract provision stipulates that "Unless otherwise specified in the procurement contract, the competent authority may adjust the price if price needs to be adjusted in the course of implementation of a procurement contract having duration exceeding fifteen months (15 months)." Nepal's Procurement Regulation 2064 stipulates that the maximum price adjustment that can be made is typically no more than twenty-five percent (25%) of the initial contract costs. Additionally, the procurement contract may stipulate that the public entity may terminate the contract, negotiate with the construction entrepreneur, supplier, service provider, or consultant to keep the contract price within the approved budget or take other steps to reduce costs or set up additional funding if the value of the price adjustment exceeds that price.

The UK provides a simple and transparent method of escalation linked adjustment clause to calculate and reimburse the fluctuation. Mostly applied adjustment formula indices (PAFI) method prepared by Building Cost Information Services (BCIS) institute. The formula method of escalation adjustment was introduced as a credible way of reimbursing the fluctuating cost due to the reliability of resource cost indices and weighted to represent resources to model the impact of inflation. BCIS advises selecting suitable indices for inflation risk adjustment for specific work because applying a general construction index to certain sectors or using the Retail Prices Index (RPI) exposes a double risk to the contractor, The risk of the escalation measured by the index and the risk of escalation in their actual costs. In Nigeria, standard contract formats allow for price adjustments to account for actual changes brought on by the economy's varying inflationary trends. The actual rises or falls in the pricing of resources used can never be completely evaluated, even if the conventional contract form includes a clause for compensation of fluctuations (Oghenekevwe et al., 2014).

Fluctuation provision clauses in construction contracts enabled contractors to pass on to their clients increases in input costs, including labor and material prices, during the time between the tender date and the completion of the project. According to the South Africa Contract Price Adjustment Provision(CPAP Committee, 2018) user's manual addresses the needs of contractors who need a precise, agreed-upon escalation recovery formula method to prevent disagreements and disputes with employers and subcontractors and to provide reasonable reimbursement for price fluctuations. Actual cost variations on a contract or any specific work element cannot be accurately reflected by the calculation. By using the formula, the primary agent will determine an adjustment amount for each valuation period for each work group.

$$A = 0.85 * V(\frac{Xe}{X0} - 1)$$

Where:

A = the adjustment amount

0.85 = a constant which provides for a 15% non-adjustable element

V = the work value in such work group and the valuation period

Xe = the value of the index applicable to such work group and the valuation period for the calendar month during which the payment certificate is dated

Xo = the value of the index applicable to such work group for the base month

Price adjustment clauses must be included in contracts for construction projects that are fully or partially funded by the World Bank for durations longer than 18 months (or even shorter periods in nations with significant rates of inflation). When official indices for the price fluctuations of construction inputs are available, the World Bank advises using the formula method of price adjustment; in contrast, the document evidence (invoice) method of price adjustment is discouraged and should only be used in situations where official indices are unavailable or it is not feasible to

determine proxy indices. Asian Development Bank (ADB) implements price adjustment clauses in contracts funded entirely or partially by ADB grants, loans, or ADB-administered funds for projects that take longer than 18 months to complete. Some construction material changes their price significantly within a period of shorter than 18 months. In such a situation ADB is deemed to include a price adjustment provision for a project duration of less than 18 months as stated ‘‘where the price of material fluctuates over a short period, it is also appropriate to include a price adjustment clause, whatever the length of the contract.’’

Additionally, ADB establishes a range of permissible weights or coefficients for each cost factor that will be subject to a price adjustment depending on the construction methods. To reduce the possibility of influence and misuse that could result in an unwarranted payment to the contractor, ADB advises establishing price adjustment formulas and indexes in a clear, objective manner under appropriate monitoring. As seen below, various price adjustment algorithms are used in contracts of varying sizes and components in the standard bid document of ADB.

Table 2. 2 Price adjustment formulas from the standard bidding documents (SBD) of ADB

SBD	Reference	Clause	Formula
Large Work	FIDIC 1999 MDB 2010	GCC 13.8	$P_n = a + b\left(\frac{L_n}{L_o}\right) + c\left(\frac{E_n}{E_o}\right) + d\left(\frac{M_n}{M_o}\right) + \cdots$
Small Work	MDB Harmonized	GCC 54.1	$P_c = A_c + B_c\left(\frac{I_{mc}}{I_c}\right)$
Plant	Engineering Advancement Association of Japan	Section 9 appendix-2	$P_1 = P_0 \times \left(a + b\frac{L_1}{L_0} + c\frac{M_1}{M_0}\right) - P_0$
Goods	MDB Harmonized	GCC 15.2	$P_1 = P_0 \times \left(a + b\frac{L_1}{L_0} + c\frac{M_1}{M_0}\right) - P_0$

FIDIC Red Book (1999), the contract price must be modified to account for any cost variations brought about by new laws or changes to the nation's current laws that have an impact on the contractor's ability to fulfill their end of the bargain. The amount of payment to the contractor is determined using a general formula that accounts for changes in labor, material, and other work-related costs.

$$Pn = a + b\frac{Ln}{Lo} + c\frac{En}{Eo} + d\frac{Mn}{Mo} + \cdots$$

Where:

‘‘Pn’’ the adjustment multiplier to be applied to the estimated contract value in relevant currency of the work carried out in period ‘n’.

‘‘a’’ a fixed coefficient representing a non-adjustable portion in contractual payment.

‘‘b’’,’‘c’’ ‘‘d’’ … coefficient representing the estimated portion of each cost element related to the executed work.

Ln, En, Mn …. The current cost/price indices for a period n which applies to the date 49 days before the last date of the period.

Lo, Eo, Mo … the base cost indices which apply to the relevant listed cost element on the base date. Particular care should be taken in the calculation of the weighting/coefficients ‘‘a, b,c…’’ the total sum of which must not exceed one.

Africa Development Fund (ADF) states in its guidelines for procurement of goods and stipulates that the bidding document must include a clear declaration that the offered price is either set or susceptible to price adjustments in the event of specific events outside the contractor's control. ADF deemed that Price adjustment clauses are typically not required in straightforward contracts that involve the delivery of goods or the completion of services within 18 months.

In Ethiopia, the Public Procurement and Property Administration Proclamation No. 649/2009 stipulated the price adjustments that may be made during contract implementation and the circumstances and the manner under which such price adjustments can be made to special procurements prescribed by the Minister. The contract is to be eligible for the price adjustment of normal price change during implementation, the contract time (project duration) should be greater than 18 months. The practice of most procuring entities in the building sector considers price

adjustment for some selected materials and labor price changes. Ethiopian Roads Authority (ERA) better exercised the practice of implementing the price adjustment provision for major inputs of road construction. Ethiopian Contractors Association Report, 2018)Price adjustment provision is limited to the total amount of price adjustment for a maximum of 20% of the contract price(Ethiopian Contractors Association Report, 2018). (PPA2011) states that the amount of adjustment must not exceed the amount that accounts for pricing indicators or indexes published by the Public Procurement and Property Administration Agency or the Ethiopian Central Statistical Agency.

2.9 Price adjustment provision in Ethiopia condition of contract

Price adjustment is a contemporary and new clause in contract management to allocate risk/uncertainty between contracting parties in Construction industries. In Ethiopia, price adjustment has been covered in the MoWUD 1994, PPA 2006 and PPA 2011 contract form for NCB, and FIDIC 1999 clause of contract for ICB. Price adjustment equations include fixed or nonadjustable and adjustable cost parts. In most countries, organizations and governmental bodies determine the non-adjustable and adjustable items, as well as the consumer price indices for each specific construction material, such as cement, gravel, concrete, brick masonry, and so on.

2.9.1 MoWUD 1994 Contract Form

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

The contract price in the priced Bill of Quantities is based upon the rates of wages, other emoluments and expenses applicable at the site date of bid pricing. If the said rates of wages, 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 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.

2.9.2 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 after deducting for Advance Payment:

Price Adjustment factor $Pn = A + b\frac{Ln}{Lo} + c\frac{Mn}{Mo} + d\frac{En}{Eo} + etc$

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

2.9.3 PPA 2011 Contract Form

The PPA 2011 standard conditions of contract provide contract form for the procurement of construction work for national competitive biddings. It has three parts and nine sections to address different issues of construction projects from the bidding procedures to contract administration. The contract form provides general and special conditions contract to be included in the agreement for the care of contracting parties. The procedures and provision for price adjustment were stated under clause/article 62.

Clause 62- Price Adjustment

Clause 62.1 Adjustments of contract prices shall be allowed after twelve (12) months from the effective date of the Contract where it is verified that the performance of the contract requires more than 18 months. Use the formula to determine the adjustment on each item for any such price variation.

$$PA = \left[NV + A\frac{(MLI - BLI)}{BLI} + B\frac{(MMI - BMI)}{BMI} + C\frac{(MEI - BEI)}{BEI} + D\frac{(MFI - BFI)}{BFI} \right](BC)Q$$

Where:

PA = the amount of the Price adjustment to be paid to the Contractor, in currency specified in SCC;

NV= Non Adjustable part or a fixed coefficient of the price adjustment

A, B, C, D coefficient of the selected Average Labor, Material, Equipment and Fuel Price Index respectively.

MLI MMI, MEI and MFI = the most recently available(current price index) of selected Average Labor, Material, Equipment and Fuel Price Category Index on the date on which the Public Body received notification of the proposed increased price from the Contractor.

BLI, BMI, BEI and BFI = Benchmark Average Labor Material, Equipment and Fuel Category Earnings Index applicable to the Works at base date

BC = Current Contract Price applicable to the Works

Q = Quantity;

(a) NV+A+B+C+D are equal to 1.00

However, **the** PPA2011 price adjustment formula is not applicable and has a problem when implementing the contract for price adjustment provision. Public procurement and property authority discussed with stakeholders and Ethiopia construction authority assured that the formula has a problem in implementing price adjustment provisions. High inflation on the cost of construction inputs with the problem of price adjustment provision formula was the main reason for dispute between contractor and client (public offices), challenging the construction industry development and project completion time.

According to the Public Procurement and Property Administration Proclamation No. 649/2009, public procurement and property authority has a responsibility to prepare appropriate documents for public procurement, to implement and make it situational. Therefore public procurement and property authority provided that from 23/03/2022 the price adjustment provision for the previous price adjustment provision contract and then after based on the formula in PPA 2006 price adjustment implementation manual.(the circular attached in appendix 1).

$$Pn = A + b\frac{Ln}{Lo} + c\frac{Mn}{Mo} + d\frac{En}{Eo} + etc$$

1. Pn is a price adjustment factor to be applied to the amount of each payment certificate.
2. A is a constant specified in the contractor's bid representing non –adjustable portion in contractual payment.
3. b, c, d, etc., are weightings representing the estimated proportion of each cost element (labor, materials, equipment usage, etc.) in the Works, A,b,c,d, etc shall be one
4. Ln, Mn, En, etc., are the current cost indices or reference prices of the cost element at the date of 28 days before the deadline for bid submission.
5. Lo, Mo, Eo, etc., are the base cost indices or reference prices corresponding to the above cost element at the date 28 days before the last day of the period to which a particular interim payment certificate.

2.9.4 FIDIC 1999

The FIDIC condition of construction contract (edition 1999) which is widely used for international contracts in Ethiopia under clause 13.8 states that the amount payable to the contractor shall be adjusted for rises or falls in the cost of labor, goods and other inputs to the work, by the addition or deduction of the amount determined by the formula.

$$Pn = a + b\frac{Ln}{Lo} + c\frac{En}{Eo} + d\frac{Mn}{Mo} + \cdots$$

Where:

‘‘Pn’’ is the adjustment multiplier to be applied to the estimated contract value in the relevant currency of the work carried out in period ‘n’.

‘‘an’’ a fixed coefficient representing a non-adjustable portion in contractual payment.

‘‘b’’,’‘c’’ ‘‘d’’ … coefficient representing the estimated portion of each cost element related to the executed work.

Ln, En, Mn …. The current cost/price indices for a period n which applies to the date 49 days before the last date of the period.

Lo, Eo, Mo … the base cost indices that apply to the relevant listed cost element on the base date.

2.10 Necessary Condition for Price Adjustment in Ethiopia Condition of Contract

In most conditions of a contract, the necessary criteria for price adjustment are change /fluctuation cost of construction inputs and legislation. In this research, all the selected cases use the PPA 2011 condition of contract. PPA (2011) General condition of contract clause 62 “states that "contract price adjustments shall be permitted after twelve (12) months from the contract's effective date where it is confirmed that the performance of the contract requires more than18 months”.

Two necessary conditions for price adjustment in the case of PPA 2011 condition of the contract, which is the condition of contract for the specific project under consideration are price change of construction inputs (material, labor and equipment) and project contract duration longer than 18 months.

Currently the price of input materials for construction projects like cement and reinforcement changes within in short period. In the first 12 months of the project duration, the client hasn't any responsibility to share the risk/ uncertainty due to material price change and the contractor is obligated to absorb the risk due to inflation. PPA 2011 allowed price adjustment after twelve (12) months whatever the construction inputs price dramatically changed within 12 months of project duration, this precondition highly affects the contractor and overall construction performance.

From international practice, mitigation measures have been taken to manage such high uncertain inflation. For example, Japan considers a partial price adjustment/escalation against a sudden rise of specific material prices within the year. World Bank also recommends including a price adjustment provision for contracts less than 18 months in countries with a high inflation rate. Furthermore, according to the Asian Development Bank's (ADB) price adjustment criteria, some components' prices may still fluctuate dramatically over periods shorter than 18 months. Regardless of the length of the contract, it is appropriate to add a price adjustment clause for materials like cement, petroleum, bitumen, reinforcement, etc., whose prices fluctuate over short periods.

Table 2. 3 Condition of contract provision on price adjustment related issues.

Basis of comparison	**MoWUD 1994**	**PPA 2006**	**PPA 2011**	**FIDIC 1999**
Necessary condition for price adjustment	Change in cost of labor and contractor's compulsory contribution	Fluctuating cost of construction inputs	Change in cost of inputs for projects longer than 18 months duration	Change in cost and legislation
Starting date of price adjustment	-	After 12 month	After 12 month	-
Adjustment application	Individual Items	Certified amount less advance deduction	Contract value multiplied by quantity	The amount payable to the contractor
Basic pricing date	15 days before the latest bid submission	28 days before the latest bid submission	Bid closing or previous contract price adjustment date	28 days before the latest bid submission
Methods of Adjustment	Price difference	Index formula	Index formula	Index formula

2.11 Cost Estimation and Escalation

Cost is the fundamental component of any construction project**.** It controls the capital flow as well as material and labor resources they have cost implications. An appropriate estimate of the expected cost of construction projects has a serious effect on the expected profit margin of construction contractors (Yadav & Swamy, 2018). Accuracy of project cost estimation has a significant effect on assessing the capacity of a contractor to compete with another contractor.

2.11.1 Cost Estimation Component

According to (Asteway, 2008) construction project consists of direct cost, indirect cost and risk allowance.

a) Direct construction costs

Costs of completing work that is directly spent on its performance and is required for its completion. Direct construction costs are all costs that can be specifically detailed with an activity in a project. The majority of the project's expenses are focused on direct costs, which are much easier to plan, track, and measure than indirect costs (Asteway, 2008). The direct costs mainly include;-

i) Direct material costs
ii) Direct labour costs
iii) Direct equipment costs
iv) Subcontract costs

b) Indirect costs

Indirect construction costs are any expenses that are necessary to maintain the project's overall functioning but cannot be directly incurred under a particular activity (Asteway, 2008). In construction, it is costs that do not become a final part of the activity in the construction project but are needed for the organized completion of the construction activities(Yadav & Swamy, 2018). These costs are also called overhead costs, which mainly include the following:-

i) Head office costs

Head office overhead expenses are required to manage the construction company's whole operations at one point in time. Indirect labor costs (not including senior management wages and perks), head office building rental costs, utility costs (such as electric power and office furniture), transportation costs, insurance costs, and other miscellaneous expenses are included in this category.

ii) Site overhead costs

All expenses necessary to carry out a particular construction project at the site level are referred to as site overhead costs. These include: site establishment costs (site offices), salaries and benefits of (site Engineers, office engineers, administrative and finance staff), mobilization and demobilization costs and water and electricity supply charges.

C) Risk allowance

Incorporating risk allowance into the construction project cost estimation process is crucial. The negative effects of various risks, including contractual, technical, political, and economic risks, are lessened because of this. Every stage of a construction project carries some level of risk, and it is crucial to recognize, measure, and control the risk related to time, money, quality, and safety while the project is being carried out. Inflation surpasses project completion time and explains unforeseen increases in labor, material, and equipment costs. (Asteway, 2008).

2.10.2 Cost Estimating Techniques

The process of creating an approximate estimate of the financial resources needed to build a project is known as cost estimation. More specific project information is needed for methods that generate more accurate estimates. The most widely used construction estimating methods include analogous, bottom-up, parametric, three-point estimating, and Monte Carlo simulation methods (PMBOK, 2013).

a) Analogous (Conceptual) Estimating

Analogous cost estimating is a method of cost estimation that bases the present project's cost estimate on the actual past costs of projects that are similar. Less time-consuming, less precise, and frequently used to estimate costs when project information is scarce. For the most recent cost and pricing information, historical indexes and consumer price indices should be examined. When prior efforts are similar not just in appearance this method is the most dependable. Usually, the estimate is modified to account for complexity or other elements like time, place, or the time value of money.

b) Parametric Estimating

Parametric estimating is a technique that determines the necessary resource cost estimate for the intended project by utilizing a statistical link between historical data and other variables (such as square meters in construction). Depending on the model's underlying data and complexity, this method can yield higher accuracy levels. When combined with other estimating techniques, parametric cost estimates can be used for the entire project or specific project components.

c) Bottom-Up (Detailed) Estimating

When a thorough project design is available, bottom-up methodologies are used to estimate costs. The cost of each particular work package or activity, as well as the direct cost of each component of the work or activity, is estimated with the highest level of specified information. The quantity and complexity of each activity or work package usually affect the cost and accuracy of bottom-up cost estimating. A visible, well-organized, and more accurate and dependable estimate for the project is provided by the thorough estimating technique.

d) Three-Point Estimating

Using three estimates to define an approximate range for an activity's cost and taking estimation uncertainty and risk into account can increase the accuracy of single-point activity cost estimates:

1) **Most likely (CM).** The activities cost, which takes into account any anticipated expenses and a reasonable effort evaluation for the necessary job. The average cost of the activity from previous projects can be used to determine the most likely cost.
2) **Optimistic (CO).** The cost of the activity is determined by analyzing the activity's best-case scenario. Performing this task will have perfect or near-perfect results and ideal circumstances exist (e.g., perfect requirements, right tools available, best worker, excellent design, etc.). The most likely cost can be established by taking the lowest cost of the activity from past projects.
3) **Pessimistic (CP).** The cost of the activity was determined by analyzing the activity's worst-case scenario. Assumes that the task will be completed in the "worst case scenario." For example, inadequate specifications, a lack of equipment, unskilled labor, etc. The most likely cost can be established by taking the highest cost of the activity from past projects.

e) Monte Carlo Simulation

The common statistical distributions used to model construction costs are beta, triangular, and lognormal distributions; however, opinions vary regarding the practical benefits (accuracy of estimates) of employing mathematical models for project cost analysis and quantitative risk analysis, which is related to cost estimates. cost estimation for multiyear projects should take into account market conditions and monetary inflation, which can impact the cost of labor, machinery, and construction materials; and the currency used and fluctuations in exchange rates are crucial factors to take into account when estimating costs in construction projects (PMBOK, 2013).

The frequent errors made in the preparation of investment project evaluation arise out from not considering the impact of inflation on the financial and economic performance of potential projects (Jenkins, 1978). Most literature on investment appraisal of public and private sector projects ignores considering the impact of changes in the relative price level of construction inputs needed through the project life. Project cost overrun was reported to have occurred because of inflation when in fact project costs were expressed in terms of a constant price level. In a period of rapid inflation, the historical cost of stocks now being used in construction will be much less than the current

replacement of these things. Inflation will modify the real net financial cash flow of the project through its impact on the nominal interest rate.

2.12 Summary of the literature review

Construction is always considered one of the high-risk sectors for the stakeholders in construction projects. The construction project continuously faces a variety of uncertainties regardless of its complexity and size due to material shortage, unskilled workforce, material price change and involvement of many stakeholders. Inflation is among the economic risks and highly affects the project's progress and some of terminated due to high price inflation. According to the review, the major cause of inflation is categorized into demand pull and cost push inflation. The three main price indices used to gauge inflation are the producer price index, GDP deflator, and consumer price index.

The majority of economic actors, including the government, and the most significant macroeconomic indicators are impacted by inflation. These include economic growth, declining competitiveness, interest rates, unequal income distribution, rising unemployment, and instability. With rising labor, material, and equipment costs, it poses a severe threat to building projects. Consequently, the project was exposed to time and cost overrun.

A clause in the contract that allows for price adjustments if specific costs increase or decrease beyond the contracting party's control has been used to manage the risk and uncertainty caused by inflation in the cost of labor, materials, and equipment. As a global trend, many price adjustment value approaches were thoroughly evaluated. Internationally recognized best practices for price adjustment were examined to determine the non-adjustable component, weigh representative elements, and allocate risk fairly.

Chapter Three-Research Methodology

3.1 Introduction

The Oxford Advanced Dictionary defines research as a systematic investigation carried out to get new knowledge and facts. According to AAU (2009), research is the methodical process of gathering and evaluating data to better comprehend the topic being studied. According to Saunders, Lewis, and Thornhill (2003), research is an activity people do to expand their knowledge by methodically learning new topics. Research will concentrate on a particular facet of the subject and aim to address well-defined objectives, solve specific problems, or provide answers to particular questions (Naoum, 2007).

Research methodology is a methodical approach to issue solving. It is a science that studies how to do research. It refers to the methods that researchers use to describe, explain, and forecast occurrences. Research methods are the strategies procedures, or techniques used in the gathering of data or evidence for analysis to find new information or develop a deeper understanding of a topic.

Schwardt (2007) defines methodology as the process of framing an issue so that it may be examined through specific designs and procedures, as well as the development and selection of suitable data collection methods. To investigate a particular circumstance that is most likely to achieve the research's goal and collect the right kind of data, a variety of research methodologies and a combination of approaches are employed.

3.2 Types of Research

Several factors are used to classify the sort of research, such as the research's objective and methodology (Igwenagu, 2016). The research was categorized as theoretical and applied, descriptive and explanatory, quantitative and qualitative, and conceptual and empirical, according to AAU (2009). Additionally, studies are categorized according to their goal, specific objective, approach, design, data types, and field of study.

This research is a descriptive study, that investigates the effect of inflation on public building construction projects and is carefully examined. It provides information on the phenomenon's current state. Additionally, this research also aims to investigate the cause-and-effect relationship between escalation and the cost of construction inputs. The objective of this research includes the assessment of construction inputs (materials) price escalation rate and exploring the current practice of price adjustment and evaluation associated with escalation risk allocation between the contracting party in public building projects.

Therefore this research studies assess the practice of price adjustment and evaluation techniques in public building projects using descriptive, exploratory qualitative and quantitative analysis.

3.3 Research Design

According to Leedy (1997), a research design is a plan for a study that offers the general framework for gathering data. According to MacMillan and Schumacher (2001), it is a strategy for choosing study participants, locations, and methods for gathering data to address the research question or questions (Oshagbemi, 2017). Furthermore, research design is a strategic framework for action that connects the execution of the research strategy with the research questions (Durrheim 2004:29).

This research, which is a case study, began with the identification of the problem through a review of the literature and conversations with experts in the construction industry. To gain a thorough understanding of the research topic and its goals, a literature review has been conducted. Books, journals, articles, thesis papers, and online resources are all included in the review. The case study approach investigates the problem in real real-life context. (Creswell, 2009) quoted in (Molwus, 2014) strengthens the idea that researchers explore in depth about a particular event in a case study research. Different data collection techniques include interviews, observation, and document analysis. Case studies are divided into single-case and multi-case categories based on the number of cases or units of analysis, according to Yin (2003). Research designs that are used for trials where one entity is observed repeatedly over a certain period, under varying amounts of at least one independent variable, are known as single-case designs.

To reduce the possibility of deception and to maximize the access required to gather the case study material, single-case designs necessitate a thorough examination of the possible case. Choosing two or more cases that are thought to be exact replicas is known as a multiple-case design. It enables a deeper understanding of the cases as a whole by highlighting their similarities and differences. It requires extensive resources and time beyond the means of a single student or independent research investigator. This research designs multiple cases in an embedded manner using seven cases for more than a unit of analysis to make the research more reliable and strong evidence.

3.4 Sampling Technique

Sampling is the process of choosing a subgroup of individuals from a given population to estimate the characteristics of the full population. Different types of sampling techniques apply to the researchers widely used for gathering data (Igwenagu, 2016).

a) Simple random sampling, which falls under the category of probability sampling, is the selection of a sample from a large population at random and completely by chance. A simple random sample is a straightforward surveying method (Saul McLeod, 2014; Igwenagu, 2016). The idea behind simple random sampling is that each elementary unit has an equal chance of being selected.
b) Stratified sampling – involves first dividing the population into homogeneous subgroups and then taking a sample. Stratified sampling is a technique for reducing variation when estimating population statistics from a known population using Monte Carlo methods. With stratified sampling, even though there is a chance that it won't be chosen, at least one observation is chosen from each of the sub grouped elements.
c) Systematic sampling is a statistical method involving the selection of elements from an ordered sampling frame. It is to be applied only if the given population is logically homogeneous because systematic sample units are uniformly distributed over the population.

Using a systematic sampling approach, the impact of inflation on the cost of building materials in particular and its effect on the time and cost performance of public building construction projects were examined. To assess the escalation rate on the price of some selected construction materials data was gathered from 2merkato.com. The source provides a price list on construction materials, construction equipment. The price of construction materials collected from different spots in Addis Ababa. 2merkato.com also has organized historical data and regularly updates the price on a monthly base and, for cement and reinforcement bars the price is updated every two weeks.

In addition, seven public building projects were selected to assess the practice of price adjustment evaluation techniques. The project status was above 80% which is better to understand the effect of escalation on public building projects.

3.5 Method of Data Collection

In an established research technique, data collection is the process of obtaining and measuring information on variables of interest to accomplish the research objective(s). According to (J. Hussain,2017) data collecting is an extremely difficult job that requires careful planning, diligence, patience, dedication, and more to be completed properly. In any study, a researcher may have a choice of collecting the relevant data or relying entirely on existing data already collected by someone else.

The data-gathering strategy used will depend on the type of data and the nature of the inquiry (Naoum, 2007). Data collecting is the most significant stage in doing research after establishing the sorts of data required for a selected sample from a set of populations utilizing specified data collection equipment (J. Hussain,2017). Data are classified as primary or secondary sources based on their uniqueness and source. Both primary and secondary data categories are taken into account in this study.

Primary data - Data that has been collected from first-hand experience has not been published yet, not altered by human beings, more reliable, authentic, and objectives. A primary source contains original information that is not generated from interpretation, summing, or assessing someone else's work and its validity is greater than secondary data (J. Hussain, 2017). Primary data required the collection of all information from the beginning.

Secondary data- data often readily available from books, literature, analyzed and interpreted of any type of primary data. Since secondary data has already been manipulated by humans, contains a limited amount of information, and may be subjective and misleading, it is the least trustworthy and subject to biases (J. Hussain, 2017).

3.5.1 Case Study

According to (AAU, 2009), case studies provide a strong emphasis on a thorough contextual investigation of a small number of circumstances or occurrences and their connections. Case studies are employed when academics want to provide a thorough examination of a specific occurrence to bolster their point. The conclusion reached will be specific to one occurrence rather than being generalized because the case study's focus is on a single facet of an issue (Naoum, 2007). Moreover, it is an intense study, which is important to grasp the phenomena in-depth for the particular/specific action. Jacobsen (2002) contends that rigorous research techniques are effective at gathering pertinent and in-depth data.

Typically, case studies are carried out by choosing a few best-fit cases for the phenomenon under study and focusing on contextual analysis of a limited number of events or conditions and their relationships. (Yin, 2003) pointed out that theoretical replication may require a larger case number, while literal replication may require two fit cases. To ensure the quality of the research, it is necessary to select the right type and number of cases. This research systematically selected seven (7) projects as a case study 3 projects from the federal government and 4 projects from Addis Ababa city administration public projects.

To assess the impact of inflation on construction projects specifically in public projects a case study method was applied and the data collected through document analysis and deep interviews with the concerned stakeholders would be carried out. It is important to picture the impact of inflation on public projects and document analysis involves professional agreement in public projects between stakeholders and review of necessary project historical data. This study uses both Primary and secondary data sources.

3.5.2 Document Analysis

According to Bowen (2009), document analysis is a type of qualitative research in which the researcher interprets documents to provide context and voice for an evaluation issue. To illustrate the effect of inflation on a few public building construction projects in Addis Ababa, a document analysis is done. The contract document referred to assess the impact of inflation on the project's cost, time and evaluate the management practice of uncertain risk of inflation between the contracting parties. Regard to secondary data source contractual document, monthly project progress, price adjustment practice document (payment certificate) and other related literature were thoroughly reviewed in document analysis.

3.5.3 Interview

Greater returns are guaranteed when data is gathered directly from interviewers, particularly if the enumerator is persuasive. The interviewer has the chance to clarify challenging inquiries (Igwenagu, 2016). (Rabiee ,2004) states that this method is "a technique involving the use of in-depth group interviews in which participants are chosen because they are a purposive, although not necessarily representative sampling of a specific population, this group being focused on a given topic." In this research interview with key stakeholders in depth using semi-structured questionnaire about the impact of inflation on the project performance and indirectly used to cross-check the correctness of data taken from the document.

3.6 Method of Analysis

According to Yin (2018), research data gathered from primary and secondary sources is analysed through the use of tabulation, categorization, evidence testing, examination, or a combination of these methods. For case study research, Bowen (2009) advises reviewing and assessing the available documents using a systematic procedure document analysis technique (Shibru, 2020). Interview and observation give additional dimension to the case.

In this research, the data was analyzed using description and narration. The study concentrated on qualitative and quantitative analysis to examine the price adjustment practice against with standard condition of contract and international practices. The collected data presented in tabular form and detailed discussion would be for each case study independently. Lastly, a conclusion and recommendation are made in light of the analysis and results.

Chapter Four- Data Presentation and Analysis

4.1 Introduction

The construction industry currently experiences unpredictable rises in material prices. Contractors face strong challenges during the execution of the project due to deviating the actual execution cost of the project from the estimated cost. Especially in Ethiopia, the challenge is not only the dramatically fluctuating market price of construction materials but also poor compensation (price adjustment) practice. In this research, seven public building projects were selected as a case study to assess the impact of inflation (price fluctuation) on the project performance. In the Road sector, the client is ERA and applies the same standard in calculating adjustment factors for each bill and aggregate bill to address price fluctuation (price adjustment) as per PPA or FIDIC. Whereas in the building sector, the price adjustment factor for listed materials and labor are different to exercise price adjustment and evaluation.

Using a case study this research would demonstrate the extent of inflation on project performance and the practice of price adjustment evaluation in public projects. All selected case studies are public building projects from the federal government and the Addis Ababa administration. The cases are delivered by the DBB project delivery method and undertaken by local contractors. In This chapter first presents the description of the cases and presents detailed analysis and discussions of the cases.

4.2 General Description of the Cases

The selected cases are all public building projects in Addis Ababa with contracts signed from April 20/2011 up to October 04/2018. Among the cases, 3 projects were selected from federal government office projects and the rest are from Addis Ababa administration public projects. Project contract duration for cases taken from federal government projects is around 3 years period. Whereas case selected for this study from Addis Ababa administration project duration was around 18 months. Currently all selected cases for this research project progress greater than 80 percent. Table 4. 1 Basic Information Description.

Description	Case 1	Case 2	Case 3		Case 4	Case 5	Case 6	Case 7
			PhaseI	Phase II				
Project contract amount (ETB)	310,397,377.28	128,274,153.30	87,786,259.65	169,593,843.09	58,077,481.35	69,258,707.84	28,329,885.09	97,806,207.91
Contract duration (calendar days)	900	910	900	1080	540	530	365	515
Project start date	Oct 21/2016	Jun 8/2016	April 20/2011	August 1/2013	June 03/2015	April 28/2017	May 07/2018	Oct 04/2018
Original contract time completion	March 1//2020	December 1/2018	Oct 20/2013	August 1/2016	Nov 03/2016	Sept 14/2018	May 07/2019	Feb 04/2020
Extension of Time granted(days)	461	110			1804	1129	923	626
Project progress	86%	100%	94%		88%	91.82%	80%	99.80%
Total certified payment to date	320,377,194.72	113,198,801.87	40,853,047.90	142,078,476.63	32,332,559.40	68,785,492.57	27,980,942.57	61,533,080.47
Total price adjustment certified to	39,921,369.60	5,610,398.82	544,518.24	3,564,320.16	11,724,930.56	14,674,885.01	14,094,119.14	12,338,524.51

4.3 Construction Contract and Price Adjustment

The concept of price adjustment in a contract addresses changes in the cost of input materials used in construction. Price adjustment clauses are included in typical contract provisions to establish protocols to reduce the cost impact of uncertain material prices and to avoid a scenario where excessive inflation reduces the contractor's profit margins (Sharma, 2016). The selected cases was applied PPA 2011 standard condition of contract for the procurement of works issued. The agreement was an admeasurement contract, which is predicated on the contractor's priced bill of quantities and the engineers' estimated quantities of the work items.

Price adjustment provision were devised in the contract for a project takes a duration more than 18 months as stated in PPA 2011 clause 62.1 ‘‘ Adjustments of contract prices shall be allowed after twelve (12) months from the effective date of the Contract where it is verified that the performance of the contract requires more than 18 months.’’

Among the selected cases the federal government office projects (case1, case 2 and case 3) incorporated price adjustment provision in the contract to compensate the contractor and employer in case of increase and decrease of material /labour price or any modification in a legislation as per PPA 2011 clause 62 and public procurement directive 2010. Whereas cases selected from Addis Ababa Administration office projects have a project duration was less than 18 month during contract signed. For that price adjustment provision clause didn’t included in the contract. However the actual project duration exceeded more than 18 months due to reason of client, contractor and other issues. Price adjustment evaluation method was not provided clearly in contract document to secure the contracting parties from the risk of inflation. Addis Ababa construction bureau treat price adjustment using the revision of unit rate for each activities every three month. The revised unit rate based on currently investigated direct cost of specific work items and consider the indirect cost (overhead and profit) of the company.

4.4 Price Adjustment Practice

A price adjustment is a change made to the contract's total cost to account for reasonable variations in the cost of carrying out the agreement. It consider the price change of material, equipment and labour due to currency fluctuation, inflation, shortage of material or any other circumstance that varies the cost. As discussed in literature review there are three categories of price adjustment techniques namely invoice method (rise and fall method), index formula method and hybrid method. All the selected cases are use PPA2011 standard condition of contract form but only case1, case2 and case3 projects include condition of contract provision to treat price adjustment using index formula.

On the selected cases (case1, case2and case3) the price adjustments are implemented using index formula method by calculating adjustment factors for each base materials schedule and labours. In this study Case 1 consider only some listed material cement, reinforcement and fuel for price adjustment and case 2&3 include labour in addition to materials. The consumption of construction inputs (labours, material and equipment) is not constant throughout the project life but the price adjustment evaluation use uniform weighing coefficient throughout the project.

Addis Ababa city administration give a authority for Addis Ababa design and construction work bureau in a proclamation number 64/2011 to assess the current direct construction cost quarterly four times a year. Addis Ababa design and construction bureau use current quarterly investigated direct construction price of different work items to carried out the price adjustment in revising a new price of the remaining work items of the contract for the next three month. The assessment was also consider the indirect cost (overhead and profit) in revising new rate. In standard price adjustment evaluation practice overhead and profit used to calculate the fixed portion of price adjustment formula because the contractor reasonably control overhead cost and profit level. Whereas Addis Ababa construction bureau exercise price adjustment practice by setting new unite rate in every three month based on quarterly investigated direct construction price of different work items.

Company indirect cost (overhead and profit) determined in percentage from the direct construction price of each work items. So the new unit rate would include company indirect cost (overhead cost and profit). Depends on company capacity and number of projects at hand overhead cost percentage were different. So that Addis Ababa design and construction bureau consider different overhead cost percentage for different construction company levels for the price adjustment.

1) Construction company grade 3 and above overhead cost 10% of direct cost
2) Construction company grade 4,5 and 6 overhead cost 8% direct cost
3) Below grade 6 overhead cost 6% of the direct cost.

Profit of the company depend on the project cost on setting new price of remaining work items for price adjustment.

1) Project cost less than 5 million profit considered 13% of direct cost
2) Project cost 5 million – 15 million profit considered as 11% of direct cost
3) Project cost 15million -30 million profit considered as 10% of direct cost
4) More than 50 million profit cost considered as 7% of direct cost.

Addis Ababa design and construction bureau price adjustment treatment practice was not stated in standard condition of contract PPA 2011. From international practice price adjustment clause recommended to devised in the contract document for a high inflation rate whatever the project duration less than 18 months. According to PPA2011 price adjustment evaluation applied for some specifically categories of inputs as stated in clause 62.7 ‘‘unless specifically stated otherwise in the Contract, the basis for compensation will be only those categories of inputs, which are specifically listed as specified items in the SCC.’’ However Addis Ababa design and construction bureau exercise price adjustment in setting new unit rate for remaining work items including overhead cost and profit every three month. Also PPA procedure recommend the contractor to submit the calculation for price adjustment as stated in clause 62.10 ‘‘Contractor shall submit to the Public Body for review and approval all calculations and supporting information necessary to determine the price adjustment.’’

But the market price assessment and approval of setting new price as a price adjustment were taken by only Addis Ababa design and construction bureau. There is nowhere for contractors to participate in this process to provide the computation and data required to assess price adjustments. The contractor's roll were restricted only to execute remaining work items with newly modified unite rate. On other hand the price adjustment practice takeover the consultant work pressure in the assessment (calculation) and approval (review) of compensation amount.

4.5 Component of Price Adjustment Formula

A price adjustment is a revision made to a contract's total cost to account for reasonable variations in the cost of building materials needed to complete the project. It is a system that divides the risks of unpredictable changes in input prices between the client and the contractor. Provisions for price adjustments contain formulas intended to solve issues and can shield contractors and clients from changes in prices. Three fundamental elements are typically found in price adjustment formulas: an adjustable component, a nonadjustable component, and a price index to measure the adjustment.

4.5.1 Non- Adjustable Factor

The portion of the inflation risk which is shared by the contractor. Other than labour, equipment, and materials, the fixed portion of a price adjustment formula consists of pricing components that are determined from cost components that the contractor has reasonable control over like overhead costs, profit level, and price contingencies. Different perspective are there in proper value of the non-adjustable portion based on contractor's contingency/risk and profit. In South Africa institute of civil engineering and construction industry development board in together non-adjustable portion consider as 10%. Moreover (ADB, 2018) price adjustment guides use 15% non-adjustable portion for procurement of work. A non-adjustable percentage of 15% has been set by nations including China, India, and Nepal. However, according to the Pakistan Engineering Council, the non-adjustable share is fixed at 45% to 65%, depending on the nature of the project and decision of employer.

In this study the selected cases used different value of non-adjustable portion of the contract which is calculated from overhead cost and profit. For example case 1 consider non-adjustable portion as 55% and in case 2 raise the value up 72.53%. Furthermore case 3 has two phases and its non-adjustable portion fixed as 56.61% and 55.18% respectively for phase I and phase II. Price adjustment give a sense of security on price escalation of construction inputs to contractor and client. As per the international practice recommendation the fixed or non-adjustable portion of price adjustment considered to the maximum 15% except in Pakistan which apply 65%. In this research case2 would implement the reverse of international practice in which the adjustable component considered only 27.47%. The price adjustment provision provide more security for client and the contractor exposed to suffer for inflation on price of construction materials and labour. Similarly in case 1 and case 3 the contractor would take the risk of escalation on price of construction materials and labour more than 50%. In such scenario the risk of price escalation highly decrease the marginal profit of the contractor and led to terminate the project. Eventually the company/firm became bankruptcy and out of the business industries.

4.5.2 Adjustable Component

The adjustable component covers the contract's primary cost components that are beyond the contractor's control, like materials, labour and equipment. Because the costs of materials like bitumen, cement, reinforced steel, labour and fuel are high and dependent on the state of the market, they are frequently included in the contract's adjustable section for civil works projects. Consultant should determine the weight for each cost element which has taken a significant portion in the works and submitted as part of the bid document. In this research case 1, case 2 and case 3 submitted material and Labour components subjected for price adjustment as part of contract document. In every project, the main cost components of the contract are cement, reinforcing bars, and fuel. In addition case 3 also submitted aluminium accessories, electric cables and sanitary pipes as a cost component for price adjustment portion. Mason, carpenter and daily labours are included in the contract for the subject of price adjustable component.

The contribution of equipment in building construction projects is not considered as a cost component for price adjustment. The contractor should carefully identify major materials and labour take a portion throughout the project work and sort in a schedule of materials for adjustment portion in the contract. In choosing elements (materials and labour) for adjustable portion consider major criterial like material and labour having considerable cost weight in the contract, having reliable source and highest trend of price variation in the past. However in case 3 the contractor submitted materials for phase I and Phase II some materials like power cables takes zero contribution for price adjustment. The reason for that materials like power cables has no trend of price variation. On other hand cement is major construction material and experience price variation in the market, but in case 3 phase 1 the contractor is not submit as a cost component in base material schedule for price adjustment.

According to (PPA,2011) GCC article 62.7, unless the contract specifies differently, only input categories that are expressly mentioned as specified items in the SCC will be used as the basis for compensation. The maximum and minimum number of listed or representative items are not determined. Minister of urban and infrastructure investigate the representative elements implemented in price adjustment from 2017-2022.Based on that the representative elements determined as cement, reinforcement bar, fuel (diesel and ceramic (imported) from 2022. As a result case 1 specifically list 3 materials as a representative items, case 2 specify 3 materials and 10 labours in the contract basis for adjustable portion. Whereas case 3 consider 27 materials and 3 labours as a representative items in the contract for compensation.

4.5.3 Weightings/ coefficient

Categories of inputs were specifically listed in the contract for compensation and to set weighting coefficient or percentage contribution is crucial to implement the calculation. The weighting coefficient of materials and labours were computed in assuming constant amount of consumption for a given work item throughout the project life. The weighting coefficient of some materials and labour of the cases were as shown in table 4.2

Table 4. 1 Weighting/ coefficient of materials and labours in case 1 case 2and case 3

Materials		Case1	Case2	Case 3	
				Phase I	Phase II
Cement	OPC	15%	4.07%		7.52%
	PPC		2.35%		0.94%
Reinforcement	S-300		2.16%	11.34%	14.87%
	S-400	20%	7.78%		
Fuel	Diesel	10%	2.17%	2.87%	4.90%
	Regular		0.31%	0.06%	0.07%
Labour	Mason		0.25%	0.17%	
	Carpenter		1.71%	0.61%	
	Daily Laborer		4.03%	3.06%	
	Bar Bender(B)		0.72%		
	Gang Chief(G)		0.06%		
	Electrician (E)		0.28%		
	Plumber(P)		0.17%		
	Painter(Pa)		0.21%		
	Plasterer(Pl)		0.61%		
	Mixer Operator(Mo)		0.05%		

4.5.4 Source of Price Index

The determined adjustable elements will be modified in accordance with their target price indices. PPA clause 62.8 states that the Public Procurement and Property Administration or Ethiopian Central Statistics Agency (ECSA), is the government agency in charge of issuing the current material price index. Depending on the contract price categories chosen, the sum must not exceed the price indexes or price indicators published by the Public Procurement and Property Administration Agency or the Ethiopian Central Statistical Agency.

In addition, PPA clause 62.9 states that in the event that the Public Procurement and Property Administration Agency or the Ethiopian Central Statistical Agency are unable to provide up-to-date price indexes, the price data that is available from a reputable local producer or a capable foreign institution may be utilized. However, there is uncertainty about the reliability of using local suppliers and manufacturers because the employer lacks the power to compel the contractor to change its supplier.

As per the bid document the contractor expected to submit a valid price /index from reliable source for specifically categorized items for adjustment. There are two types of cost index/price in the contract namely base price index and the current price index. Basic or base indices is the rate of adjustable elements often 28 days before tender submission from their reliable sources. Whereas Current indices is the rate of adjustable elements often 28 days before interim payments. In this study the base price index submitted adjustable elements would be as shown below.

Table 4. 2 schedule of base material with base price/index for case 1

Material	Source of material	Base price/index (Oct 2016)	Current price/index (Nov 2021)
Cement in quintal	Mugher Cement factory	254.78 br/qtl	295.65 br/qtl
Steel Reinforcement bar(kg)	Guna Trading plc.	18.52 br/kg	60.87 br/kg
Fuel(diesel)in Litter	Ethiopian petroleum supply enterprise	14 br/lit	23.18 br/lit

The base indices normally stipulate in contract data on base date and current indices are derived from the time of invoice submission. In Case 1 contractor submitted base price/index and with reliable sources for adjustable elements as shown above in table 4.3. The contractor also provide monthly current price indices from the same sources for interim payment.

Table 4. 3 Schedule of base materials and labours with base price /index for case 2

Type Of Materials		Basic unit price index (May, 2016)	Current price/index (April 5, 2019)
Cement (qtl)	OPC	230	215
	PPC	160	183
Reinforcement(kg	S-300	15.63	43.71
	S-400	15.99	36.37
Fuel(lit	Diesel	14.14	17.93
	Regular	16.59	20.02
Labour(day)	Mason	130	230
	Carpenter	150	200
	Daily Laborer	55	85
	Bar Bender(B)	130	230
	Gang Chief(G)	70	117
	Electrician (E)	230	230
	Plumber(P)	230	230
	Painter(Pa)	100	230
	Plasterer(Pl)	135	237
	Mixer Operator(Mo)	75	104

The basic or base indices prevailing often 28 days prior to the latest tender submission and current price index collected 28 days before application of interim payment certificate included in the contract without reliable source. In this case the base price indices normally stipulated in the contract data on base date when signed the contract (SCC Clause 62.7 and 62.13) and current indices are derived from the time of invoice submission. On other hand when price index sources becomes unreliable, new reliable sources can be adopted for all payment.

Table 4. 4 Schedule of base materials and labours with base price /index for case 3 phase I

Type Of Materials	Source of material	Basic unit price (March, 2011)	Current price/index (April 2013)
Reinforcement bar Dia. 8 to 24mm(kg)		20.87	22.30
Daiken acoustic ceiling(m^2)		850	900.00
Aluminum door(m^2)		2430	2900.00
Aluminum window(m^2)		2230	2900.00
5mm tinted glass(m^2)		270	295.65
Aluminum fire resistant door(m^2)		10500	12000.00
Aluminum hand rail(m^2)		1800	2900.00
Aluminum Curtain wall(m^2)		4500	4900.00
Aluminum sun breaker(m^2)		1800	2800.00
Aluminum partition wall(m^2)		2100	2900.00
Aluminum composite panel wall(m^2)		1500	1800.00
2cm. Thick Granite floor tile(m^2)		1020.5	796.00
Granite wall cladding(m^2)		1020.50	796.00
Epoxy flooring(m^2)		495.00	725.00
8mm thick first grade Rak wall tile(m^2)		230.00	285.00
250x250mm porcelain floor tile(m^2)		400.00	508.25
3cm thick Wolega marble tile(m^2)		700.00	863.90

Petrol(Regular) in Lit		15.55	18.78
Diesel in Lit		13.24	16.91
Electrical wire (Roll)			
Size 1x2.5mm^2 Electric Wire	Ethiopian Plastic Factory	492.00	586.96
Power Cable (ML)			
Size; 3x2.5mm^2 (Roll=100ML)	Local supplier	21.12	25.18
Size; 3x4mm^2 (Roll = 100ML)	Local supplier	43.00	38.64
Size; 3x6mm^2 (Roll = 100ML)	Local supplier	56.00	57.00
Size; 3x10mm^2 (Roll = 100ML)	Local supplier	98.00	99.55
Size; 5x10mm^2 (Roll = 100ML)	Local supplier	148.00	220.00
Size; 2(3x150/70+1x70)mm^2	Local supplier	1275.00	3200.00
Size; 3x25/16+1x16mm^2	Local supplier	288.00	311.84
Size; 3x35/16+1x16mm^2		357.00	384.86
Galvanized steel pipes (pcs)			
GSP 40mm with 1 socket	Akaki Metal Factory	520.00	600.00
GSP 40mm with 1 socket	Akaki Metal Factory	693.91	693.91
GSP 80mm with 1 socket	Akaki Metal Factory	1130.44	1173.91
PPR PN 20 PIPE(ML)			

PPR PIPE Dia. 20MM		20.06	20.06
PPR PIPE Dia. 25MM		21.95	21.95
PPR PIPE Dia. 32MM		34.27	34.27
PPR PIPE Dia. 40MM		42.64	42.64
PPR PIPE Dia. 50MM		56.18	56.18
PPR PIPE Dia. 65MM		99.14	99.14
HDPE PN 16 PIPE(ML)			
Dia 20mm		17.25	17.25
Dia 25mm		20.70	20.70
Dia 32mm		26.82	26.82
Dia 40mm		41.75	41.75
Dia 50mm		62.35	62.35
Dia 65mm		99.14	99.14
Dia 75mm		140.90	140.90
Dia 90mm		231.33	149.00
UPVC PN 6 PIPE(ML)			
Dia. 50MM		121.12	121.12
Dia. 110MM		288.83	524.50
Dia. 125MM		482.48	679.00
Dia. 150MM		869.80	931.00
Dia. 200MM		1300.74	1701.00

Dia. 250MM		2197.83	2496.00
Dia. 300MM		3061.73	3061.73
Stone (M3)		55.00	100.00
Sand (M3)		70.00	120.00
Skilled and Unskilled laborer(day)			
Carpenter		70	120.00
Mason		65.04	120.00
Daily Labour		25.04	55.04

Adjustable elements (materials and labors) should have a considerable cost weight throughout the project, having reliable source and highest trend of price variation in the past as a requirement. From the table 17 most adjustable elements (materials) except aluminum had exhibit stable price within two years of project life. Even if much more materials submitted for price adjustment evaluation the contribution of price variation would be moderate. Materials has a major portion in the project not carefully identified because some adjustable elements for example power cable and sanitary line materials their proportional value (weight/coefficient) to the total contract amount became negligible.

Table 4. 5 Schedule of base materials and labours with base price /index for case 3 phase II

Type Of Materials	Source of material	Basic unit price (August, 2013)	Current price/index (Jun 2015)
Cement (PPC) in qtl	Mugher factory	187.0	187.0
Cement (OPC) in qtl	Mugher factory	252.2	253.5
Sand(m^3)		144.0	250.0
Gravel(m^3)		350.0	419.9
Reinforcement bar Dia. 8 to 24mm(kg)		22.7	23.9
Aluminum door(m^2)		2666.7	3500.0
Aluminum window(m^2)		2333.3	3500.0
5mm tinted glass(m^2)		550.0	269.6
6mm clear glass(m^2)		650.0	304.3
Aluminum fire resistant door(m^2)		12000.0	18682.4
Aluminum hand rail(m^2)		3100.0	3100.0
2cm. Thick Marble floor tile(m^2)		700.0	1725.0
5mm thick Epoxy flooring(m^2)		725.0	725.0
6mm thick First grade Klienker floor tile(m^2)		850.0	827.9
Petrol(Regular) in Lit		18.8	17.4
Diesel in Lit		16.9	16.1
Electrical wire			

Size 1x2.5mm^2 Electric Wire(Roll)	Ethiopian Plastic Factory	782.6	608.5
Power Cable (ML)			
Size; 3x10mm2	Local supplier	107.8	97.5
Size; 5x6mm2	Local supplier	111.1	83.3
Size; 5x10mm2	Local supplier	183.8	195.0
Size; 5x16mm2	Local supplier	273.6	315.0
Size; 2(3x150/70+1x70)mm2	Local supplier	3480.3	3200.0
Size; 2(3x185/95+1x95)mm2	Local supplier	4432.8	4400.0
Size; 3(3x300/150)mm2	Local supplier	10332.8	2958.0
Size; 3x35/16+1x16mm2	Local supplier	421.4	346.8
Size; 3x50/25+1x25mm2	Local supplier	590.4	474.0
Size; 3x120/70+1x70mm2	Local supplier	1490.2	1187.0
Skilled and Unskilled laborer per day (day)			
Carpenter		120.0	215
Mason		120.0	215
Daily Labour		60.0	90

The period between 2013 -2017 Ethiopia's inflation rate was single digits and did not accelerate (Ali, 2022). Macro economy stability minimize inflation on the price of materials and labour. From table 18 observed that except aluminum and power cable (Size; 3(3x300/150) mm^2) most of adjustable elements experienced flat line of inflation. Aluminum door, Aluminum window and Aluminum fire resistant door raised up the price with 151% in two years. On other hand power cable with different size decreased the unit price by 61.87%.On average Price index difference between the base price and current price of adjustable materials within two years of the project duration shows constant price.

4.6 Impact of Price Escalation on Project Performance

Construction is one of a high - risky sector for stakeholders involved in the industry. Risk in construction projects is related to time, cost, and quality and safety aspects of project execution. One of the biggest dangers and difficulties that the construction industry faces is that the final project cost will be significantly greater than the contract price. Price escalation is a sensitive risk in construction projects in altering initial estimated project cost which affect the stakeholders involved in the project. High price escalation rate lead to extremely increase the construction input price especially material price fluctuation become out of the control of the contractor and the contractor couldn't execute the project work as per the schedule. Subsequently affect the total cost and total duration of the projects

In fact construction projects take over a year for completion which leads an increase cost of material, labour and equipment. What's more projects constructed under Addis Ababa design and construction bureau had been lower project performance. Then Addis Ababa construction bureau organise a committee to conducted a detail assessment in September 2021 and evaluate the projects problem on their current performance of the projects. The assessment committee identified twenty (20) projects and recommended to apply a price adjustment for 16 projects based on the current performance. The price adjustment implemented for the remaining activities in each projects based on the first quarterly assessed market price in 2021.

The new adjusted price for the remaining work in the projects would renewed quarterly in a year. On other hand four projects were decided to terminate the project contract by the committee.In this research the selected cases were affected by project cost deviation and time extension. Project cost deviation due to escalation and uncertainty were evaluated using formula method of PPA as discussed in section 4.5. From the price adjustment evaluation the project initial cost deviate by 12.46% in case 1 whereas in case 3 the impact of inflation on project cost change with a maximum of 3% project cost. In which the inflation rate on material price exhibit constant rate from 2011-2015. Projects cost and time performance of case study projects as shown below in table 4.7.

Project deviated cost has direct relation with economic inflation rate of the country. Central statistical agency report showed that Ethiopia experienced decreasing economical inflation rate from 2011 to 2016. Macroeconomic stability minimize the impact of escalation on estimated project cost. As a result case 3(phase 2) change a maximum of 3% deviation of initial project cost. On other hand the period between 2016-2022 average annual inflation rates was increased continuously. Moreover the construction materials exhibit a considerable price increment. Thus have a huge impact on deviating the estimated project cost.

Contractors were recorded different reasons to grant time extension (additional time) to complete the project. Financial issues, poor planning and scheduling, material shortage, variation order, design change and external factors were major factors to prolong project duration in Ethiopia public projects(Abebe, 2023). Moreover escalation rate has multiplicative relationship with project cost overrun and project delay. It contribute significantly for increasing the price of material labour and machineries over time which persist the project for longer time. Minister of finance state in the circular for minister of education that construction projects in different university difficult to complete the projects on time because of increased escalation rate on construction inputs. Therefore price adjustment should be implemented based on identified representative items for the remaining works. The circular clearly justify the impact of escalation on material price directly extend project time overrun.

Table 4. 6 Effect of Price Escalation on case study projects performance

Description	Case 1	Case 2	Case 3		Case 4	Case 5	Case 6	Case 7
			Phase I	Phase II				
Project cost (ETB)	310,397,377.28	111,542,742	87,786,259.65	169,593,843.09	58,077,481.35	69258707.84	28,329,885.09	97,806,207.91
Project duration(calender days)	900	910	900	1080	540	530	365	515
Project status to date	86%	100%	94%		88%	91.82%	80%	91%
To date granted time extension(days)	461	110			1804	1129	923	626
Total certified payment to date (ETB)	320,377,194.72	113,198,801.87	40,853,047.90	142,078,476.63	32,332,559.40	68,785,492.57	27,980,942.57	61,533,080.47
Total price adjustment certified to date(ETB)	39,921,369.60	5,610,398.82	544,518.24	3,564,320.16	11,724,930.56	14,674,885.01	14,094,119.14	12,338,524.51
Total price adjustment in%	12.46%	4.96%	1%	3%	36.30%	21.30%	50.40%	20%

4.7 Price Escalation of Construction Material

Construction projects consume a huge amount of materials. Construction material take an amount 35-45 percent of total construction project cost for erecting and completing the construction work. According to (Ogunsina &Ugochukwu, 2014) materials make up over half of the production costs of the majority of megaprojects. By raising the cost of construction materials, inflation put the economy's construction industry under pressure. When inflation affects construction material prices, the planned and real costs of a construction project diverge, making it difficult to reach cost targets and preserve profit margins.

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The price of input materials for erection and completion of construction projects increased significantly since 2015. Birr devaluation and extreme high exchange rate contribute its own shadow for significant increase of material price. The Ethiopian construction industry heavily depend on imported material and equipment. From 2013-2017 Ethiopia imported 3.2 million tons of reinforcement bar imported from Turkey (42.8%) and China (24.5%). Imported materials have a great negative impact on previously estimated project cost due to inflation and high exchange rate(Ethiopian Contractors Association Report, 2018). The rise of construction material price lead the projects to cost overrun and delay. From October 2017 –January 2018 the price of construction material on average increased by 51.39% and the building project cost increased with 31.64%(Ethiopian Contractors Association Report, 2018). In this research specifically assessed the market price of concrete making, carpentry work, some selected finishing and sanitary materials.

Table 4. 7 Concrete making materials average price from 2015-2023 G.C

Materials	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cement(OPC) (Birr/quintal) Mugher	230	285	325	340	340	420	720	1400	
Cement(PPC) (Birr/quintal) Mugher	210	215	225	240	255	480	558	550	1765
Reinforcement (imported) (Birr/ kg)	19.35	21.6	26.95	45.51	41.75	41.24	69.09	112.43	148.87
Reinforcement (Ethiopia) (Birr/ kg)	16.54	19.73	23.11	43.31	39.86	39.39	65.45	110	131.16
Aggregate (Birr/M3)	450	405	486	524	500	585	747	1154	2817
Sand (Birr/M3)	550	408	539	535	640	822	979	1191	2492

a) Concrete production materials

Cement, aggregate, sand and Re-bar are major items in concrete production. Cement requirement in Ethiopia met from local production. The price of cement has been stable in 2015 which was 230 birr per quintal. In 2022 average price of cement has shot up to 1400 birr per quintal which was increased in 508.7%. Re-bar requirement met through local production and imported for building and infrastructure projects. The average price of imported re-bar in 2015 was 19.35 birr per kg and the local produced was priced at 16.54 per kg. In 2023 the price of imported re-bar shoot up 148.87 birr per kg and local steel had increased to 131.16 birr per kg i.e. 669% and 693% respectively increment as compared to the average yearly price the period 2015-2023. From Table 3 the price of aggregate exhibits a considerable rise from 450 birr per m3 to 2817 birr per m3, an increment of 526%.

Table 4. 8 Carpentry work materials price from 2017-2023 G.C

Material	2017	2018	2019	2020	2021	2022	2023
Timber 2.5*30*400cm imported (per pcs)	322	386	760	452	638	1081	2075
Timber 2.5*30*400cm Local (per pcs)	267	284	257	301	383	486	1017
Purlin 5cmx7cmx400cm imported (per pcs)	167	275	500	502	565	700	1131
Purlin 5cmx7cmx400cm Local (per pcs)	114	132	150	152	209	318	513
Battens - 40X50mmX4m - Shashement	70	100	90	100	129	230	710
Battens - 40X50mmX4m - Austria	30	45	50	60	163	560	1361

b) Materials for Carpentry work

From Table 4 the price of imported timer and purlin has a considerable change. The average price of timber (imported) shoot up by 544% from 322 birr per pcs to 2075 birr per pcs. Also the average price of purlin increased from birr 167 to birr 1131 per pcs, an increment of 577%.

Table 4. 9 Finishing materials price fluctuation from 2015-2023 G.C

Material	2015	2016	2017	2018	2019	2020	2021	2022	2023
Marble with 3cm thick white marble per m2	1200	1200	1436	1620	1620	1140	2356	4650	6322
Porcelain per m2	380	437	720	720	440	911	1571	1643	2391
Granite: 3cm thick (Ethiopia) per m2	1800	1800	1800	1820	1820	1136	2145	4188	5550
Granite: 3cm thick (Imported) per m2	1600	1670	1887	1950	1950	1950	2725	5700	6596
Ceramic tile: 30cm x 30cm - 7mm thick per m2	315	280	230	255	230	250	345	475	982
Ceramic tile: 30cm x 60cm - 10mm thick per m2		377	405	645	565	472	615	507	820
Ceramic60cm x 60cm - 10mm thick per m2	570	515	410	575	430	600	650	515	1083

c) Finishing Materials

The average price of ceramic tiles increased slightly relative to other finishing materials. Whereas porcelain had a considerable price variation which shoot up to birr 2391 per m2 from birr 380 per m2 with an increment of 529%. Also the price of granite exhibit radical increment on both imported and locally made by 312% and 208% respectively.

Table 4. 10 price of selected sanitary materials from 2015

Material Type	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hand Wash Basin: 45cm x 55cm (AQUA) per pcs	1500	1500	1685	1500	1767	2134	3747	6586	8400
Hand Wash Basin: 50cm x 60cm (Gold dragon - sealed) per pcs	3000	3000	3183	2708	1700	2592	5353	8859	10200
UPVC Pipe: φ50, 2.2mm thick per pcs	120	120	120		220	204	249	566	834
PPR pipe: 1 inch (25mm) - 1PPR is 4m long	185	227	263	332	400	220	659	1215	1530
PPR pipe: 1 1/4 inch (32mm) - 1PPR is 4m long per pcs	290	305	420	455	500	335	1130	2810	3313
Water Closet: low flash (AQUA) per pcs	2000	2000	2394	2665	2600	2972	6302	11689	13315
Water Closet: low flash (Gold Dragon) per pcs	3000	3000	3492	3782	3700	4244	10030	18250	19215

d) Sanitary work Materials

The price of sanitary fixtures and sanitary line pipes also increased. According to information obtained from table 6 the price of sanitary materials has on average increased by 596% between the periods 2015-2023 G.C. the price of Hand Wash Basin in different brand (Aqua and Gold dragon) on average increased by 350%. Finally from the above discussion the construction materials exhibit exponential price change. In order to comprehend how inflation affects both contract administration and overall project success.

4.8 Effect of Price Escalation on Stakeholders

4.8.1 Effect of Price Escalation on Contractor

Contractor is one of major actor (stakeholder) in construction project have an agreement with the owner to implement the ideal design on the ground. Contractor play a significant role in realizing construction project and face problems and challenges in execution of the project. Inflation highly affect the contractor in disturbing cash flow specially contractor having lower financial capacity obligated to subsidize from other projects.

Even though they can't deliver materials on time and required amount due to that contractor and subcontractor execute the project as late of the schedule and project become delayed. On other hand contractor create work opportunity for subcontractor and many daily labourer, due to shortage of material contractor productivity become less and intended to minimize number of subcontractor and daily labourer. From the interview with project managers, inflation highly eroded company profit margin but they were not volunteer to describe the amount. Contractors execute in injecting a huge amount of money from other sources for the sake of completing the contract work intending future work opportunity from the government. On average they request payment monthly but the interim payment use to maximum 15 days to execute the project and until next payment the company intended to inject financial resource from other sources.

According to the Project managers the companies inject much amount of finance from other projects and in addition the company sales fixed assets to complete the government project in sacking future compensation in others government projects. Eventually the contractors' profit margin become eroded.

In general inflation has the following impact on contractor:-

a) Disturb cash flow (project financing problem)
b) Affect productivity
c) Project delay
d) Loose profit margin
e) Project Termination

4.8.2 Effect of Price Escalation on Client

Client is the main stakeholder involve critically for the success of every construction project. Price Escalation affect the client in changing project cost at completion in much higher of the contract price. Project delay is one of negative consequence of Price Escalation on public building construction projects. The federal government building project office and Addis Ababa city design and construction bureau are the clients for government projects on behalf of the end users of the

public projects for the federal government office and the Addis Ababa city administration office, respectively. Many government offices do not have their own office building and rely on rental space; the projects are not completed on time for the intended purposes, and the government offices incur additional rental costs.

In federal office and Addis Ababa public office projects the clients complain least bidder mechanism which highly affect the overall performance of the projects. To be a least bidder the contractors poorly estimate the project cost and couldn't perform the project specially in the first 12 month because the material price highly inflated and the PPA directive not allow to compensate the price change even if the project duration more than 18 months. Finally the project delayed and leads to terminate due to poor performance of contractor.

In Addis Ababa city government public projects are have project duration less than 18 month intentionally in order to avoid price adjustment provision clause in the contract. Actually the contractor couldn't implement the project work as per the schedule and leads to delay and dispute is a common practice. Addis Ababa design and construction bureau asses the current direct price of all work items and set new price for the contractor in such case the client obligated to take the risk of inflation without any devised clause of price adjustment in the condition of contract. In general the client (government) aimed to complete projects under construction in allocating a new budget for price adjustment due to inflation rather than planning to develop a new infrastructure. The public raise social and economic claim to the government due to shortage of infrastructure development.

Chapter Five Conclusion and Recommendation

5.1 Conclusion

In conclusion, inflation is a major challenge facing the construction sector in Ethiopia. High inflation rate on price of construction materials, labour and other inputs made difficult to complete public building projects on schedule with in budget. This has led to delay project provisional time, allocate additional budget, decrease contractor profit and reduce development of infrastructures. Inflation is among the economic risk and highly affect the project progress. Contracting parties have no control over the market price inflation of construction inputs. The uncertainties/risk in the Price of construction inputs were a vast concern to the contracting parties and the standard condition of contract need to prepare with price adjustment provision.

The case study approach was used to address the research's specific objective. The information gathered through a thorough document review, stakeholder interviews, and a well-developed discussion and analysis was examined in the previous chapter. Based on the results from the analysis the following conclusions have been drawn and summarized in accordance with the objectives of the research.

1. In Ethiopia the price of construction material increase significantly since 2015. Extreme high exchange rate and birr devaluation takes significant contribution for material price increment.
2. The Public Procurement and property Administration Proclamation No. 649/2009 stipulated that the price adjustments made during contract implementation with two necessary conditions which are price change of construction inputs (material, labour and equipment) and project contract duration longer than 18 months.

3. Price adjustment practice use formula method calculation and calculating the factor of items which are listed in SCC from the total inputs of work. The price index of major resources (cement , reinforcement , fuel , labour) set a base price during bidding with choice of reliable

source and price adjustment calculation was depend on selected supplier/local producer and invoice submission.

4. In public building projects there is no common procedure in fixing percentage of adjustable components and non-adjustable portion of price adjustment. The number of representative elements for adjustable elements different from case to case even if the cases used the same standard condition of contract.
   - In case 1 the percentage of adjustable component and non-adjustable portion fixed as 45% and 55% respectively. Cement, reinforcement bar and diesel were submitted as a representative elements for price adjustment components.
   - In case 2 cement, reinforcement bar, fuel (diesel and regular) and labours considered as base materials for adjustment able components with a percentage of 27%. Non-adjustable portion takes 73% of price adjustment evaluation.
   - Whereas in case 3 cement, reinforcement bar, aluminium accessories, power cables with different size, galvanized steel pipe with different size, PPR PN 20 pipe, UPVC PN 6 pipe and HDPE PN 16 pipe with different sizes as a representative items for adjustable portion. Those representative materials share 43.4% for adjustable portion and fixed (non-adjustable) part would be 56.6%.

5. PPA and public procurement directive 2010 not include inflation treatment mechanism for a project having a duration less than 18 months whatever the inflation on price of construction inputs is high. Due to that Addis Ababa design and construction work bureau practice price adjustment by setting new unit rate for the remaining activities in specific project quarterly including overhead cost and profit based on company grade.

5.2 Recommendation

Assessing the effect of inflation on public building construction projects and suggesting solutions to reduce the negative effects on project performance are the objectives of this study. The following recommendation are forwarded to the competent body in public construction projects to improve public construction projects performance.

1. PPA and Public procurement directive states a minimum elapse period as major necessary conditions the contractor to request price adjustment in considering the price will not change significantly within a year. This provision doesn't work in volatile market condition. International practices recommend to include price adjustment clause whatever the length of the contract where the price of specified material fluctuates over a short period of time. PPA and Public procurement directive recommended to take such consideration.

2. PPA and public procurement directive has no a formal guide lines to treat a price adjustment for a project duration less than 18 months. Due to that in public project intentionally limit the project duration below 18 month to deny price adjustment provision in contract. This lead to informal way of price adjustment practice and intended to change inflation into variation. PPA better to set a common guidelines for all public project the contract length extended more than 18 month due to different reasons.
3. Contractors poor project cost estimation during bidding has its own contribution for inflation because the contracts aims to be a least bidder in order to win the bid. Contractor better to consider current market material price fluctuation and carried out proper and detail cost estimation practice also PPA 2011 procedures for price adjustment take in to account would make advantageous.
4. The standard contract document (PPA) should set appropriate bid document or contract agreement in considering expected uncertainty of inflation and incorporate handling mechanism of such uncertainty of inflation. Also professionally estimate appropriate project duration which compliance with PPA2011 and device necessary contract provision in the contract document.

5. Conducting research in construction industry become enervating and difficult to achieve the research objective due to inaccessibility of data specially government office. To held problem solver research in construction industry all stakeholders should cooperate in giving appropriate data and encourage the researcher for further investigation.

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Appendix 1- price adjustment revision circular to address changes.

Public Procurement and Property Authority
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የፌዴራል ግዥ ፈጻሚ መ/ቤቶች በግንባታ ሥራ ውል አፈጻጸም ወቅት የዋጋ ማስተካከያ ለማድረግ በስራ ላይ ያለው ለግንባታ ሥራ የተዘጋጀው በመደበኛ የጨረታ ሰነድ አጠቃላይ የውል ሁኔታዎች አንቀጽ 62.12 የተቀመጠው ቀመር ከብዙ ግዥ ፈጻሚ መ/ቤቶች እንዲሁም ከኢትዮጵያ ኮንስትራክሽን ባለሥልጣን በተጻፉ ደብዳቤዎች እና በተለያየ ጊዜ በተደረጉ ባለድርሻ አካላት በተደረገ ወይይት መሰረት በማደረግ የግዥና ንብረት ባለሥልጣን ባደረገው የዳሰሳ ጥናት በቀመሩ መሰረት ዋጋ ለማስተካከል ከፍተኛ ችግር እያጋጠመ መሆኑ ለማረጋገጥ ተችሏል።

አሁን ካለው የግንባታ ግብዓት ዋጋ በከፍተኛ ሁኔታ መጨመር ጋር የዋጋ ማስተካከያ ቀመሩ ችግር በግዥ ፈጻሚው መ/ቤቶችም ሆነ የግንባታ ሥራውን እያከናወነ ባለው ተቋራጭ መካከል ለሚፈጠሩ አለመግባባቶች ምክንያት በመሆኑ ኢንዱስትሪው በሚፈለገው መንገድ እንዳያድግ እና የግንባታ ሥራዎች በወቅቱ እንዳይጠናቀቁ አሉታዊ ተፅዕኖ እያሳደረ የሚገኝ በመሆኑ በመንግስት ደረጃ በልዩ ሁኔታ እየታየ ይገኛል።

ስለሆነም በመንግስት ግዥና ንብረት አስተዳደር አዋጅ ቁጥር 649/2001 አንቀጽ 15/4 ላይ መደበኛ የጨረታ ሠነዶችን፣ አሰራሩን የሚመሩ ቅጾችን እና ሌሎች ለግዥና ንብረት አግባብነት ያላቸውን ሠነዶች የማዘጋጀት፣ ሥራ ላይ እንዲውሉ እና ወቅታዊ የማድረግ ተግባር ለግዥና ንብረት ባለሥልጣን በተሰጠው ኃላፊነት መሰረት ለችግሩ አፋጣኝ መፍትሄ መስጠት አስፈላጊ ሆኖ ተገኝቷል።

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$$pn = A + b\frac{Ln}{Lo} + c\frac{Mn}{Mo} + d\frac{En}{Eo} + etc$$

1. Pn is a price adjustment factor to be applied to the amount for each payment certificate;
2. A is a constant, specified in the Contractor's Bid, representing the nonadjustable portion in contractual payments;
3. b, c, d, etc., are weightings or coefficients representing the estimated proportion of each cost element (labour, materials, equipment usage, etc.) in the Works or sections thereof, net of Provisional Sums, as specified in the Contractor's Bid; the sum of A, b, c, d, etc., shall be one;
4. Ln, Mn, En, etc., are the current cost indices or reference prices of the cost elements at the date 28 days prior to the deadline for bid submission; and
5. Lo, Mo, Eo, etc., are the base cost indices or reference prices corresponding to the above cost elements at the date 28 days prior to the last day of the period to which a particular Interim Payment Certificate .

ሥራ ላይ አንዲውል የተወሰነ መሆኑን እየገለጽን፣

ይህ ደብዳቤ ወጪ ከተደረገበት ቀን ጀምሮ የሚከናወን የዋጋ ማሰተካከያ ከላይ የተገለጸውን ቀመር ተከትሎ ተግባራዊ እንዲሆን እናሳስባለን።

ከሠላምታ ጋር

ግልባጭ፣
- ለገንዘብ ሚኒስቴር
- ለኢትዮጵያ ኮንስትራክሽን ባለሥልጣን
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- ለመንግስትግዥናንብረትአዲስናክትልዳይሬክቶሬት
- ለመንግስትግዥአስተዳደርዳይሬክቶሬት

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Appendix-2 List of Representatives Items for price Adjustment determined by Minister of Urban and Infrastructure.

በኢትዮጵያ ፌዴራላዊ ዲሞክራሲያዊ ሪፐብሊክ
የከተማና መሠረተ ልማት ሚኒስቴር
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
MINISTRY OF URBAN AND INFRASTRUCTURE

ቁጥር
Ref.No 851 ዐዐ ፊዐ/195
ቀን
Date 15/09/2014

ለኢ.ፌ.ዲ.ሪ ገንዘብ ሚኒስቴር
አዲስ አበባ

ጉዳዩ፡- የወካይ ግብዓቶች የዋጋ ዝርዝር መላክን ይመለከታል፤

በዋጋ ማስተካከያ አተገባበር ላይ ጥናት እንዲያጠና የተቋቋመው ቡድን ከ2009 ዓ.ም ጀምሮ የነበሩትን የወካይ ግብዓቶች ዋጋ መረጃ ከዚህ በፊት በተላከው ሰነድ ውስጥ ተያይዞ መቅረቡ ይታወቃል፡፡

ሚኒስቴር መ/ቤታችሁ በተሰበሰበው የወካይ ግብዓት ዋጋ ላይ የኢትዮጵያ ስታቲስቲክስ አገልግሎት አስተያየት እንዲሰጥ በጠየቀው መሠረት መረጃዎችን መላኩ ይታወቃል፡፡

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ሚኒስትር

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ግልባጭ፡-

- ለትምህርት ሚኒስቴር
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- ለክቡር ሚ/ር ዴኤታ የመሰረተ ልማት ዘርፍ
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- ለኢትዮጵያ ኮንስትራክሽን ባለስልጣን
  አዲስ አበባ

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May 19, 2022 |የተመረጡ ወሳይ ግብዓቶች የነበረው ዋጋ|

1. የ2017 በየወሩ የወሳይ ግብዓቶች ዋጋ

No.	Month	Diesel (Birr/Lit)	Cement (Birr/Qtl.)	Rein. Bar (Birr/Kg)	Ceramic Tiles (Imported) (Birr/m2) (30cm x 30cm)
1	July 2017	16.35	174.06	19.31	249.58
2	August 2017	16.35	174.06	20.19	236.47
3	September 2017	16.35	174.06	22.76	230.60
4	October 2017	16.35	174.06	27.07	251.98
5	November 2017	16.35	174.06	27	250.40
6	December 2017	16.35	174.06	27.67	269.18

2. የ2018 በየወሩ የወሳይ ግብዓቶች ዋጋ

No.	Month	Diesel (Birr/Lit)	Cement (Birr/Qtl.)	Rein. Bar (Birr/Kg)	Ceramic Tiles (Imported) (Birr/m2) (30cm x 30cm)
1	January 2018	16.35	174.06	29.77	274.83
2	February 2018	16.35	174.06	33.23	279.65
3	March 2018	16.35	174.06	38.67	281.77
4	April 2018	16.35	191.77	39.74	281.14
5	May 2018	16.35	191.77	39.42	283.80
6	June 2018	16.35	191.77	39.85	265.69
7	July 2018	16.35	191.77	39.79	282.49
8	August 2018	16.35	191.77	39.74	287.45
9	September 2018	16.35	191.77	39.48	277.56
10	October 2018	16.35	191.77	39.15	274.81
11	November 2018	17.78	191.77	39.15	278.42
12	December 2018	17.78	191.77	39	282.70

የኢትዮጵያ ኮንስትራክሽን ባለሥልጣን

Page 1

3. የ2019 በየወሩ የወካይ ግብዓቶች ዋጋ

No.	Month	Diesel (Birr/Lit)	Cement (Birr/Qtl.)	Rein. Bar (Birr/Kg)	Ceramic Tiles (Imported) (Birr/m2) (30cm x 30cm)
1	January 2019	17.91	191.77	39	279.23
2	February 2019	18.03	191.77	38	290.57
3	March 2019	18.03	191.77	38	297.74
4	April 2019	18.03	194.66	39	295.82
5	May 2019	18.75	194.66	39.86	300.85
6	June 2019	18.75	194.66	39.86	307.97
7	July 2019	18.75	194.66	40	315.42
8	August 2019	18.75	194.66	38.5	320.37
9	September 2019	18.75	194.66	38	305.52
10	October 2019	18.75	197.56	37.14	294.20
11	November 2019	18.75	197.56	36.5	307.06
12	December 2019	18.75	199.01	35.61	309.71

4. የ2020 በየወሩ የወካይ ግብዓቶች ዋጋ

No.	Month	Diesel (Birr/Lit)	Cement (Birr/Qtl.)	Rein. Bar (Birr/Kg)	Ceramic Tiles (Imported) (Birr/m2) (30cm x 30cm)
1	January 2020	18.75	199.01	35.5	316.79
2	February 2020	18.75	208.54	35.64	310.43
3	March 2020	18.75	208.54	35.64	320.04
4	April 2020	18.75	212.88	39.29	317.41
5	May 2020	18.75	212.88	39.29	324.26
6	June 2020	18.75	212.88	39.29	316.41
7	July 2020	18.75	208.83	38	327.25
8	August 2020	18.75	208.83	38	330.89
9	September 2020	18.75	216.94	38	321.79
10	October 2020	19.09	216.94	38.29	314.05
11	November 2020	19.09	216.94	41.14	301.62
12	December 2020	19.09	234.33	42.86	312.45

May 19, 2022 |የተመረጡ ወካይ ግብዓቶች የነበረው ዋጋ|

5. የ2021 በየወሩ የወካይ ግብዓቶች ዋጋ

No.	Month	Diesel (Birr/Lit)	Cement (Birr/Qtl.)	Rein. Bar (Birr/Kg)	Ceramic Tiles (Imported) (Birr/m2) (30cm x 30cm)
1	January 2021	23.04	234.33	55	316.57
2	February 2021	23.04	251.27	57.29	329.25
3	March 2021	23.18	253.47	57.29	319.80
4	April 2021	23.18	253.47	55	336.66
5	May 2021	23.18	253.47	56	347.57
6	June 2021	23.18	257.24	58	352.74
7	July 2021	23.18	276.88	75	392.59
8	August 2021	23.18	303.48	75.07	421.42
9	September 2021	28.94	310	75.07	409.99
10	October 2021	28.94	453	75.07	431.42
11	November 2021	28.94	450	85	426.29
12	December 2021	28.94	450	95	475.28

1. የ2022 በየወሩ የወካይ ግብዓቶች ዋጋ

No.	Month	Diesel (Birr/Lit)	Cement (Birr/Qtl.)	Rein. Bar (Birr/Kg)	Ceramic Tiles (Imported) (Birr/m2) (30cm x 30cm)
1	January 2022	28.94	450	110	478.38
2	February 2022	28.94	450	110	475.03
3	March 2022	28.94	450	110	493.74

Appendex-3 Publication Manuscript

Assess Price Adjustment Practice on Public Building Projects in Addis Ababa, The Case of Selected Projects.

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Abstract:

The construction sector contributes significantly to a nation's GDP, which is crucial for economic growth and development in terms of the development of physical infrastructure. Ethiopian allocate huge amount of budget for the development of public projects. Even though most public projects in Ethiopian face challenges to complete successfully with in planed budget and specified time frame. Ethiopia's building industry has faced difficulties due to the market price fluctuations and inadequacies of the necessary construction inputs. The study looks into how Addis Ababa's public building projects are affected by inflation in terms of project performance in terms of project cost and time overrun. The study employed a case study methodology to investigate how inflation affects public construction projects. Systematic sampling techniques applied for the selection of few best fit cases and focused in detail contextual analysis.

In order to measure the impact of inflation on public building projects, construction material price investigated for different period, contract document review and analysed to explore the current price adjustment practice to overcome the risk of inflation with crosschecking the provision of different condition of contract forms.

The research show that the price adjustment practice observed on the selected cases were different on the subject of selected construction inputs for price adjustment, non-adjustable portion, permissible weighting/ coefficient and the source of price/index. The number of representative elements for price adjustment component, fixing non-adjustable factor and establishment of permissible weight/coefficient were not consistent in the selected cases in this study. On other hand Addis Ababa construction bureau implement price adjustment evaluation for projects having a duration less than 18 month in setting new unite rate in assessing direct cost of each work item. In conclusion, escalation is a major challenge facing the construction sector in Ethiopia. High escalation rate on price of construction materials, labour and other inputs made difficult to complete public building projects on schedule with in budget.

Key Words: Construction Projects, Price Escalation, Price Adjustment

1. Introduction

The construction industry plays a vital role in the economy of all countries. According to Khan (2008) quoted by (Oladinrin et al., 2012) the construction sector one of the main drivers of economic growth and development. Also it provide important contribution in creating job opportunity for millions of skilled and un-skilled labour. In developing countries growth and development largely depend on the development of their physical infrastructures such as building, road, and bridges. World Bank (2012) confirmed that infrastructure development surely gives considerable contribution to fixed capital formation.The state of the construction industry would have an impact on the most common indicators of a country's economy, like GDP. According to Chitkara (2004), cited in Kassa (2017), the industry contributes between 6 and 9% of GDP in many countries and according to Bhimaraya (2001), it rise up to 10%. In sub- Sahara Africa countries it experienced

increased in economical contribution of gross domestic product (GDP) to 21 % in 2015 (Kirchberger, 2020). According to Ministry of Works and Urban Development (MoWUD, 2010) Ethiopian construction industry contributed 5.8% GDP. According to the report of Africa Economic Outlook (2017) quoted in (Demissie, 2020) its contribution reached up to 15.9% of GDP in 2015/16 fiscal year.

However the construction sector in Ethiopia encounter many challenges in its practice such as cost and time overrun, poor quality, in appropriate procurement system and in ability to adapt best practice(Ayalew et al., 2016). Time and cost overrun were the most significant problem of construction projects in Ethiopia (Biyadgilgn T, 2017). (Rahel T, 2016) also described that the industry widely affected by time and cost overrun. Eventually the country lose billions of birr and extended provision of infrastructures. Cost overruns and escalation have a substantial relationship in both public and private building projects. Price escalation has become a persistent issue that affects the whole construction industry (Wondimagegn T, 2022).

Due to continuous escalation on the cost of material, labour and equipment seriously challenging stakeholders on the implementation of construction projects. It will significantly increase the project's overall cost, cause it to take longer to complete, and reduce the economic accruals or rate of return to the constructors for the work they have done, which would result in a loss of profit (Ogunsina & Ugochukwu, 2014). As a result it can have a catastrophic effect on budget which led the construction companies getting financial difficulties and going out of business (Outram, 2022). Also it affects others stakeholders involved in construction industry like; client, employees, suppliers and so on.

During times of high or unpredictable escalation, as well as for large projects, long-term contracts, and complex projects, it is important to think about reducing the risk of escalation. By including a price adjustment clause in the contract for the event that some costs increase or decrease outside either party's control, the risk and uncertainty brought on by escalation in the cost of labour, materials, and equipment have been reduced.(Solomon K, 2017). Price adjustment give a sense of

security for contracting parties to take care the price volatility of materials that are associated with the contract purpose (D.Sharma, 2016).

2. Literature Review

2.1 Contribution of Construction Industry

The construction industry is the backbone of the economic and social development. It plays a major role in the economy by contributing significantly to the gross domestic product and linkage strongly with other economic sectors (Mohammed Gashaw, 2013). Construction fulfill basic physical and social need through buildings and infrastructure.

According to (Asnake Getu, 2021) the objective of construction project is providing a solution for society need through appropriate infrastructure development with required quality. Additionally, construction done to develop a unique product or service with predetermined parameters for scope, quality, cost, and time (Habenom Gebru, 2017). The construction sector influences the most widely used indicators of a country's economic health, including GDP, and is used as a gauge of national wealth in the performance of infrastructure provision. In most countries for example in Afghanistan the construction industry can contribute around 10% of country GDP for economic development (Abbas & Painting, 2017). In India construction industry consume 40% - 50% of national budget and contribute 20% of GDP (Rajaprabha R et al., 2016).

Ethiopia's construction sector has experienced rapid growth since 2001. Given its GDP share and rising investment in the construction and expansion of numerous facilities, it makes a substantial contribution to the Ethiopian economy. According to the study of (Zewdu & Aregaw 2015) quoted in (Ayalew et al., 2016) the GDP contribution of the industry has been 5.6%. The 2017 Africa Outlook Report indicates that Ethiopia's construction sector contributed 15.9% of GDP during the 2015–16 fiscal year (Essayas, 2020).

2.2 Risk in Construction Project

Risk is an unpredictable event or circumstance that, if it materializes, can have a positive or negative impact on the goals of a project. Risks and uncertainties in construction projects include a variety of potential financial outcomes that may be better or worse than anticipated. (Kassa, 2017). Uncertainty and risk may have detrimental effects on construction projects. According to PMBOK 2016 every construction projects continuously face variety of uncertainty regardless of its complexity and size due to material shortage, unskilled workforce, material price change and involvement of many stakeholders.

The most critical risk of construction projects in Ethiopian are inadequate schedule, late interim payment, late submittal& approval of construction documents and inflation. Among the major risks and challenges in construction industry is facing the cost at completion of the projects become much higher than the original estimated contract price (Andualem, 2020).

The risk of construction material and skilled labour cost fluctuation with supply chain pressure and shortage persistently affect the construction project in extending project completion date and adversely deviate project estimated cost at completion (Mohammed, 2017).

Price escalation is among the economic risk and highly affect the project progress. Contracting parties have no control over the market price inflation of building materials utilized for contracted work.

2.3 Price Escalation

Escalation is a change in the price of a particular good or service over a predetermined time period in a particular economy (Ahmed, 2023). Different scholars defined price escalation in the construction industry in their works. 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 labour market. (Stukhart 1982).

Furthermore (Dawood et al, 2001) 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)(Kassa, 2017). 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. According to (Mohammed , 2015) price escalation is defined as an increase in the cost of equipment, material, labor, etc., due to continuing price changes over time. Construction price escalation is therefore understood as the situation when the money required to construct a project exceeds the original budgeted value (Bhosale & Khatri, 2017). Price escalation difference in the price of materials at contract signing and completion stage of the project as a result of an increase in the cost of labor, materials, equipment, and other production factors and ongoing price changes(Bethlehem, 2023).

2.4 Cause of Price Escalation

Price escalation or the increase in price of goods or services over time can be caused by a variety of factors, internal and external.

A. Internal Factors

i. Poor Estimation and Planning

Inaccurate initial cost estimation and inadequate project planning can lead to unforeseen expenses and material shortage contributing to price increase. 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 inadequacies and poor performance in planning and estimation procedures and techniques.

ii. Project Schedule Change

Frequent change to the project schedule can disrupt the procurement process leading higher material costs and potential delays. 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.

iii. **Ambiguous Contract Provision**

Lack of clarity in contract provision can lead to disputes and disagreement over price adjustment potentially resulting in increased cost. 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.

B. **External Factor**

i. Inflation and Material Cost Increase

Rising inflation and increase material price can significantly impacted project cost. 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. The longer the expected construction period, the more account will need to be taken of expected inflationary price increases over time. Initial cost estimates will need to allow for the value that will need to be paid at the time the project actually goes ahead (Mohammed, 2013).

ii. Market Condition

Fluctuation in supply and demand as well as changes in economic condition can significantly impact material and labour costs. An unstable construction market would make it difficult for contractors to decide on the optimal level of overhead costs that enables contractors to win and efficiently administer projects. Changing market conditions during the construction of a project that reduces the number of bidders, affects the labour force, and other related elements can disrupt the project schedule and budget (chang, 2002).

iii. Force Majeure

Unknown soil condition can effect excavation, compaction, and structure foundations. Contaminated soils may be present, thereby resulting in the need for special mitigation works. If

the Contractors have incurred additional costs related to increment of sales tax, sur tax, VAT and other government and custom taxes during the execution of the contracts caused by subsequent legislation, they are entitled to compensation of some amount to the additional cost incurred. The additional cost incurred due to subsequent legislation should be requested separately in addition to the additional cost due to price escalation.

2.5 Effect of price escalation on Construction Material

Construction projects consume a huge amount of materials. Construction material take an amount 35-45 percent of total construction project cost for erecting and completing the construction work. According to (Ogunsina &Ugochukwu, 2014) materials make up over half of the production costs of the majority of megaprojects. The risk of rising construction material, labour, equipment, and energy costs, among other risk factors, which could result in delays and financial instability, makes cost escalation inevitable in large construction projects. To complete the project successfully, it is essential to identify the factors that contribute to cost escalation and then take the necessary actions to control or mitigate them. Customer satisfaction and planned objectives are always impacted by cost overruns(Ahmed, 2023). The impact of price escalation is being felt in the public construction sector. For public projects, substantial price increases present exceptional problems. Public bodies are then confronted with the alternatives of keeping projects on hold while additional funding is pursued, withdrawing the project if additional fund is not available, or make an attempt to reduce the project scope(Bethlehem, 2023).

In the public construction sector the effect of price escalation were delayed projects, reduced-in-scope projects, or cancelled projects have been the result. In a number of projects material prices increased significantly and bids came in at prices much beyond the approved contract amounts. Public bodies are then faced with the alternatives of putting projects on hold while supplemental funding is sought, terminated the project if additional money is not available. Project significantly delayed as a result of price escalation difficulties have frequently experienced higher project costs. Contractor and supplier fears regarding potential, future price escalation, and the absence of price

escalation clauses in most construction contracts, often leads to higher contract prices and larger project costs.

2.6 Effect of Price Escalation on construction project

According to (Musarat, et al. 2020a), construction projects are crucial to economic development and growth. Critical project investment, cost, profit, time, and marketing value are all directly impacted by macroeconomic factors in construction projects (Hong & Shao, 1996). Construction project involved a huge investment and play a significant role in creating job opportunity for millions of workers. Cost, schedule, and scope criteria are typically used to evaluate construction projects (Mohammed, 2017). According to (Musarat et al., 2020) construction cost is the primary limitation on construction projects. Construction materials, labour, and equipment prices are the primary determinants of a building construction project's cost. Because inflation raises the cost of construction materials, construction costs go above budget, and contractors' economic accrual or rate of return declines (Oghenekevwe et al., 2014). Project stakeholders may choose to postpone the project in order to avoid cost overruns, primarily as a result of inflation (Musarat, Alaloul, & Liew, 2020).

However, if the project's duration increases, the impact of inflation on the project will also increase. In Malaysia mega construction project expected to complete within 8 years and the final project cost has been exceed by 23.21% of the initial project cost due to inflation (Musarat et al., 2020). Moreover in Nigeria the building material prices have been steadily rising over time, causing cost overruns, a shortage of available housing, and an elevated cost of urban housing (Ogunsina & Ugochukwu, 2014). Similarly in Ethiopia the major portion of construction inputs are imported through paying in hard currency and affect the contract balance in deviating the project cost. According to (Ethiopian Contractors Association Report, 2018) From October 2017 –January 2018 the price of construction material on average increased by 51.39% and the building project cost increased with 31.64%.of the original project cost/contract price.

Currently inflation on cost of construction materials alert the project owner, government officials, contractors and public about extreme project cost increase and supply chain disruption affecting construction.

2.7 Managing price escalation

The first step in measuring or managing escalation on construction projects is to understand the factors that lead to it. This is particularly important in the current scenario, where price fluctuations have been so volatile that it has been hard to estimate or predict what bid prices might actually be. Minimizing the consequences of price escalations should start in the bidding phase. During the bidding process of a project, contractors, subcontractors, and suppliers should identify which materials are most susceptible to price fluctuation and address them with the upstream contracting party(Bethelhem, 2023).

To manage cost escalation and minimize the impact of future cost increases the project owners need to become partners in the risk. The project owners to take more responsibility for the risk associated with material price fluctuations. Because the owner is much more diversified, they are better able to handle the risk(Gashaw, 2013). The best way to mitigate risks associated with material cost volatility is to include price escalation provisions in contracts document. Escalation accounts for unforeseen increases in material, labor, and equipment costs. It is important to account for escalation when project completion time exceeds a year. Escalation is generally tied to inflation, and it is advisable to have an escalation clause in construction contracts. (Mohammed, 2013) recommend some methods in order to manage price escalation such as considering price escalation clause, bulk material purchase, regularly monitor cost throughout the project life and consider locally available material in design.

2.8 Contract provision for price adjustment practice

According to (Kassa, 2017) three types of price adjustment techniques were considered and used to address uncertainty of inflation. Those are invoice method, index method and hybrid method. Invoice method require contractor to prepare document that reflect any increase in material cost occurred between the contracts was signed and actual materials purchased time.

In index method the price adjustment clause consist some list of materials costs were coupled with an index for price adjustment applicability. It can lead to a loss when the cost of materials drops and permits the contract to adjust in line with any local or regional changes to the price index for specified materials. On the other hand, the hybrid approach, which is based on a certified bid cost where the contractor validates its estimate of the costs of certain items, combines the invoice and index techniques. The contract may be modified in accordance with a predetermined percentage change in the certified bid cost. In Nepal Procurement Regulation 2064 stipulates that the maximum price adjustment that can be made is typically no more than twenty-five percent (25%) of the initial contract costs.

UK provide simple and transparent method of inflation linked adjustment clause to calculate and reimburse the fluctuation. Mostly applied adjustment formula indices (PAFI) method prepared by Building Cost Information services (BCIS) institute. Formula method of inflation adjustment was introduced for credible way of reimbursing the fluctuating cost due to the reliability of resource cost indices and weighted to represent resource to model the impact of inflation. In addition South Africa Contract Price Adjustment Provision (CPAP Committee, 2018) apply formula method to prevent disagreements and disputes with employers and subcontractors and to provide reasonable reimbursement for price fluctuations. By using the formula, the primary agent will determine an adjustment amount for each valuation period pertaining to each work group.

$$A = 0.85 * V(\frac{Xe}{X0} - 1)$$

A = the adjustment amount

0.85 = a constant which provides for a 15% non-adjustable element

V = the work value in such work group and the valuation period

Xe = the value of the index applicable to such work group and the valuation period for the calendar month during which the payment certificate is dated

Xo = the value of the index applicable to such work group for the base month

Price adjustment clauses must be included in contracts for construction projects that are fully or partially funded by the World Bank for durations longer than 18 months (or even shorter periods in nations with significant rates of inflation). When official indices for the price fluctuations of construction inputs are available, the World Bank advises using the formula method of price adjustment; in contrast, the document evidence (invoice) method of price adjustment is discouraged and should only be used in situations where official indices are unavailable or it is not feasible to determine proxy indices.

Moreover Asian Development Bank (ADB) implementing price adjustment clauses in contracts funded entirely or partially by ADB grants, loans, or ADB-administered funds for projects that take longer than 18 months to complete. Some construction material changes its price significantly with in a time period of shorter than 18 months. In such situation ADB deemed to include price adjustment provision a project duration less than 18 month as stated ‘‘where the price of material fluctuates over short period of time, it is also appropriate to include a price adjustment clause , whatever the length of the contract.’’ To reduce the possibility of influence and misuse that could result in an unwarranted payment to the contractor, ADB advises establishing price adjustment formulas and indexes in a clear, objective manner under appropriate monitoring.

2.9 Price adjustment provision in Ethiopia condition of contract

In Ethiopia, price adjustment has been covered in the MoWUD 1994, PPA 2006 and PPA 2011 contract form for NCB, and FIDIC 1999 clause of contract for ICB. Price adjustment equations include fixed or nonadjustable and adjustable cost parts. In most countries, organizations and governmental bodies determine the non-adjustable and adjustable items, as well as the consumer price indices for each specific construction material, such as cement, gravel, concrete, brick masonry, and so on.

2.9.1 MoWUD 1994 Contract Form

The contract price in the priced Bill of Quantities is based upon the rates of wages, other emoluments and expenses applicable at the site date of bid pricing. if the said rates of wages, 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.

2.9.2 PPA 2006 Contract Form

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

$$\text{Price Adjustment factor } Pn = A + b\frac{Ln}{Lo} + c\frac{Mn}{Mo} + d\frac{En}{Eo} + etc$$

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

2.9.3 PPA 2011 Contract Form

Clause 62.1 Adjustments of contract prices shall be allowed after twelve (12) months from the effective date of the Contract where it is verified that the performance of the contract requires more than 18 months. Use formula to determine the adjustment on each item any such price variation.

$$PA = \left[NV + A\frac{(MLI - BLI)}{BLI} + B\frac{(MMI - BMI)}{BMI} + C\frac{(MEI - BEI)}{BEI} + D\frac{(MFI - BFI)}{BFI} \right](BC)Q$$

Where:

PA = the amount of the Price adjustment to be paid to the Contractor, in currency specified in SCC;

NV= Non Adjustable part or a fixed coefficient of the price adjustment

A, B, C, D coefficient of the selected Average Labor, Material, Equipment and Fuel Price Index respectively.

MLI MMI, MEI and MFI = the most recently available(current price index) of selected Average Labor, Material, Equipment and Fuel Price Category Index on the date on which the Public Body received notification of the proposed increased price from the Contractor.

BLI, BMI, BEI and BFI = Benchmark Average Labor Material, Equipment and Fuel Category Earnings Index applicable to the Works at base date

BC = Current Contract Price applicable to the Works

Q = Quantity;

NV+A+B+C+D are equal to 1.00

But PPA2011 price adjustment formula is not applicable and has a problem when implementing the contract for price adjustment provision. Public procurement and property authority held discussion with stakeholders and Ethiopia construction authority assure that the formula has a problem to implement price adjustment provision. Due to high inflation on cost of construction inputs with the problem of price adjustment provision formula were the main reason for dispute between contractor and client (public offices), challenge the construction industry development and project completion time. According to the Public Procurement and property Administration Proclamation No. 649/2009, public procurement and property authority has a responsibility to prepare appropriate document for public procurement, to implement and make it situational. Therefore public procurement and property authority provided that from 23/03/2022 the price adjustment provision for previously price adjustment provision contract and then after based on the formula in PPA 2006 price adjustment implementation manual.

2.9.4 FIDIC 1999

The FIDIC condition of contract for construction (edition 1999) which is widely used for international contracts in Ethiopia under clause 13.8 state that the amount payable to the contractor shall be adjusted for rise or falls in the cost of labor, goods and other inputs to the work, by the addition or deduction of the amount determined by the formula.

$$Pn = a + b\frac{Ln}{Lo} + c\frac{En}{Eo} + d\frac{Mn}{Mo} + \cdots$$

Where:

‘‘Pn’’ the adjustment multiplier to be applied to the estimated contract value in relevant currency of the work carried out in period ‘n’.

‘‘an’’ a fixed coefficient representing non-adjustable portion in contractual payment.

‘‘b’’,’‘c’’ ‘‘d’’ … coefficient representing the estimated portion of each cost element related to the executed work.

Ln, En, Mn …. The current cost/price indices for a period n which is applicable to the date 49 days prior to the last date of the period.

Lo, Eo, Mo … the base cost indices which is applicable to the relevant listed cost element on base date.

2.10 Necessary Condition for Price Adjustment in Ethiopia condition of Contract

In most condition of contract the necessary criteria for price adjustment is change /fluctuation cost of construction inputs and legislation. PPA (2011) General condition of contract clause 62 “states that "contract price adjustments shall be permitted after twelve (12) months from the contract's effective date where it is confirmed that the performance of the contract requires more than18 month ”. Two necessary condition for price adjustment in the case of PPA 2011 condition of contract, which is condition of contract for the specific project under consideration is price change of construction inputs (material, labor and equipment) and project contract duration longer than 18 months.

PPA 2011 allowed price adjustment after twelve (12) month whatever the construction inputs price dramatically changed with in 12 month of project duration, this precondition highly affect the contractor and over all construction performance. From international practice mitigation measure had been taken to manage such high uncertain inflation. World Bank and Asian Development Bank's (ADB) also recommend to include price adjustment provision for the contract less 18 month in a countries with a high inflation rate. Regardless of the length of the contract, it is appropriate to add a price adjustment clause for materials like cement, petroleum, bitumen, reinforcement, etc., whose prices fluctuate over short periods of time.

3. Research Methodology

According to AAU (2009), research is the methodical process of gathering and evaluating data in order to better comprehend the topic being studied. Saunders, Lewis, and Thornhill (2003), research is an activity people do to expand their knowledge by methodically learning new topics. Furthermore, research design is a strategic framework for action that connects the execution of the research strategy with the research questions (Durrheim 2004:29). This research, design a case study approach began with the identification of the problem through a review of the literature and conversations with experts in the construction industry. To gain a thorough understanding about the impact of inflation on public projects, a literature review has been conducted. Books, journals, articles, thesis papers, and online resources are all included in the review. The case study approach investigate the problem in real life context.

Case studies are divided into single-case and multi-case categories based on the number of cases or units of analysis, according to Yin (2003). This research design multiple cases in embedded manner using seven cases for more than unit of analysis to be the research more reliable and strong evidence.

The study used purposive sampling technique to choose seven (7) best fit projects based on current work progress. The data collected from case study, documents analysis and interview. The data analyzed using description and narration. The study concentrated on qualitative and quantitative analysis to examine the price adjustment practice against with standard condition of contract and international practices. The collected data presented in tabular form and detail discussion would be for each case study independently. Lastly, a conclusion and recommendation are made in light of the analysis and results.

4. Data Presentation and Analysis

4.1 Construction Contract and Price Adjustment

The concept of price adjustment in a contract addresses changes in the cost of input materials used in construction. Price adjustment clauses are included in typical contract provisions to establish protocols to reduce the cost impact of uncertain material prices and to avoid a scenario where excessive inflation reduces the contractor's profit margins (D. Sharma, 2016). Price adjustment provision were devised in the contract for a project takes a duration more than 18 months as stated in PPA 2011 clause 62.1 " Adjustments of contract prices shall be allowed after twelve (12) months from the effective date of the Contract where it is verified that the performance of the contract requires more than 18 months." In this study the federal government office projects (case1, case 2 and case 3) incorporated price adjustment provision in the contract to compensate the contractor and employer in case of increase and decrease of material /labour price or any modification in a legislation as per PPA 2011 clause 62 and public procurement directive 2010. Whereas cases selected from Addis Ababa Administration office projects have a project duration was less than 18 month during contract signed. For that price adjustment provision clause didn't included in the contract. However the actual project duration exceeded more than 18 months due to reason of client, contractor and other issues. Price adjustment evaluation method was not provided clearly in contract document to secure the contracting parties from the risk of inflation. Addis Ababa construction bureau treat price adjustment using the revision of unit rate for each activities every three month. The revised unit rate based on currently investigated direct cost of specific work items and consider the indirect cost (overhead and profit) of the company.

4.2 Price Adjustment Practice

As discussed in literature review there are three categories of price adjustment techniques namely invoice method (rise and fall method), index formula method and hybrid method. All the selected cases are use PPA2011 standard condition of contract form but only case1, case2 and case3 projects include condition of contract provision to treat price adjustment using index formula. The price

adjustments are implemented using index formula method by calculating adjustment factors for each base materials schedule and labours.

The consumption of construction inputs (labours, material and equipment) is not constant throughout the project life but the price adjustment evaluation use uniform weighing coefficient throughout the project. Whereas Addis Ababa construction bureau exercise price adjustment practice by setting new unite rate in every three month based on quarterly investigated direct construction price of different work items.

4.3 Component of Price Adjustment Formula

A price adjustment is a revision made to a contract's total cost to account for reasonable variations in the cost of building materials needed to complete the project. It is a system that divides the risks of unpredictable changes in input prices between the client and the contractor. Provisions for price adjustments contain formulas intended to solve issues and can shield contractors and clients from changes in prices. Three fundamental elements are typically found in price adjustment formulas: an adjustable component, a nonadjustable component, and a price index to measure the adjustment.

4.3.1 Non- Adjustable Factor

Different perspective are there in proper value of the non-adjustable portion based on contractor's contingency/risk and profit. In South Africa institute of civil engineering and construction industry development board in together non-adjustable portion consider as 10%. Moreover (ADB, 2018) price adjustment guides use 15% non-adjustable portion for procurement of work. A non-adjustable percentage of 15% has been set by nations including China, India, and Nepal. In this study the selected cases used different value of non-adjustable portion of the contract which is calculated from overhead cost and profit. For example case 1 consider non-adjustable portion as 55% and in case 2 raise the value up 72.53%.

Furthermore case 3 has two phases and its non-adjustable portion fixed as 56.61% and 55.18% respectively for phase I and phase II. Price adjustment give a sense of security on price inflation of

construction inputs to contractor and client. As per the international practice recommendation the fixed or non-adjustable portion of price adjustment considered to the maximum 15%. In this research the price adjustment provision provide more security for client and the contractor exposed to suffer for inflation on price of construction materials and labour. In such scenario the risk of inflation highly decrease the marginal profit of the contractor and led to terminate the project. Eventually the company/firm became bankruptcy and out of the business industries.

4.3.2 Adjustable Component

The adjustable component covers the contract's primary cost components that are beyond the contractor's control, like materials, labour and equipment. Because the costs of materials like bitumen, cement, reinforced steel, labour and fuel are high and dependent on the state of the market, they are frequently included in the contract's adjustable section for civil works projects. Consultant should determine the weight for each cost element which has taken a significant portion in the works and submitted as part of the bid document.

In this research submitted material and Labour components subjected for price adjustment as part of contract document. In every project, the main cost components of the contract are cement, reinforcing bars, and fuel. In addition submitted aluminium accessories, electric cables and sanitary pipes as a cost component for price adjustment portion. Mason, carpenter and daily labours are included in the contract for the subject of price adjustable component. The contribution of equipment in building construction projects is not considered as a cost component for price adjustment. The contractor should carefully identify major materials and labour take a portion throughout the project work and sort in a schedule of materials for adjustment portion in the contract. In choosing elements (materials and labour) for adjustable portion consider major criterial like material and labour having considerable cost weight in the contract, having reliable source and highest trend of price variation in the past.

4.3.3 Weightings/ coefficient

Categories of inputs were specifically listed in the contract for compensation and to set weighting coefficient or percentage contribution is crucial to implement the calculation. The weighting coefficient of materials and labours were computed in assuming constant amount of consumption for a given work item throughout the project life. The weighting coefficient of some materials and labour of the cases were as shown in table 4.1

Table 4. 1 Weighting/ coefficient of materials and labours

Materials		Case1	Case2	Case 3	
				Phase I	Phase II
Cement	OPC	15%	4.07%		7.52%
	PPC		2.35%		0.94%
Reinforcement	S-300		2.16%	11.34%	14.87%
	S-400	20%	7.78%		
Fuel	Diesel	10%	2.17%	2.87%	4.90%
	Regular		0.31%	0.06%	0.07%
Labour	Mason		0.25%	0.17%	
	Carpenter		1.71%	0.61%	
	Daily Laborer		4.03%	3.06%	
	Bar Bender(B)		0.72%		
	Gang Chief(G)		0.06%		
	Electrician (E)		0.28%		
	Plumber(P)		0.17%		
	Painter(Pa)		0.21%		
	Plasterer(Pl)		0.61%		
	Mixer Operator(Mo)		0.05%		

4.3.4 Source of Price Index

The determined adjustable elements will be modified in accordance with their target price indices. PPA clause 62.8 states that the Public Procurement and Property Administration or Ethiopian Central Statistics Agency (ECSA), is the government agency in charge of issuing the current material price index. Depending on the contract price categories chosen, the sum must not exceed the price indexes or price indicators published by the Public Procurement and Property Administration Agency or the Ethiopian Central Statistical Agency. In addition, PPA clause 62.9 states that in the event that the Public Procurement and Property Administration Agency or the Ethiopian Central Statistical Agency are unable to provide up-to-date price indexes, the price data that is available from a reputable local producer or a capable foreign institution may be utilized.

However, there is uncertainty about the reliability of using local suppliers and manufacturers because the employer lacks the power to compel the contractor to change its supplier. In this study the base price index submitted adjustable elements would be as shown below.

Table 4. 2 schedule of base material with base price/index

Material	Source of material	Base price/index (Oct 2016)	Current price/index (Nov 2021)
Cement in quintal	Mugher Cement factory	254.78 br/qtl	295.65 br/qtl
Steel Reinforcement bar(kg)	Guna Trading plc.	18.52 br/kg	60.87 br/kg
Fuel(diesel)in Litter	Ethiopian petroleum supply enterprise	14 br/lit	23.18 br/lit

The base indices normally stipulate in contract data on base date and current indices are derived from the time of invoice submission. In Case 1 contractor submitted base price/index and with reliable sources for adjustable elements as shown above in table 4.2. The contractor also provide monthly current price indices from the same sources for interim payment.

4.4 Impact of escalation on Project Performance

Escalation is a sensitive risk in construction projects in altering initial estimated project cost which affect the stakeholders involved in the project. High escalation rate lead to extremely increase the construction input price especially material price fluctuation become out of the control of the contractor and the contractor couldn't execute the project work as per the schedule. Subsequently affect the total cost and total duration of the projects. In fact construction projects take over a year for completion which leads an increase cost of material, labour and equipment. In this research the selected cases were affected by project cost deviation and time extension.

Project cost deviation due to inflation and uncertainty were evaluated using formula method of PPA as discussed in section 4.2. From the price adjustment evaluation the project initial cost deviate by 12.46%. Whereas in Addis Ababa construction bureau price adjustment evaluated using unit rate revision and the project cost deviation became 50.4%. Inflation rate has multiplicative relationship with project cost overrun and project delay. It contribute significantly for increasing the price of material labour and machineries over time which persist the project for longer time.

4.5 Effect of Escalation on Stakeholders

4.5.1 Effect of Escalation on Contractor

Contractor is one of major actor (stakeholder) in construction project have an agreement with the owner to implement the ideal design on the ground. Contractor play a significant role in realizing construction project and face problems and challenges in execution of the project. Escalation highly affect the contractor in disturbing cash flow specially contractor having lower financial capacity obligated to subsidize from other projects. Even though they can't deliver materials on time and required amount due to that contractor and subcontractor execute the project as late of the schedule and project become delayed. Contractors execute in injecting a huge amount of money from other sources for the sake of completing the contract work intending future work opportunity from the government. On average they request payment monthly but the interim payment use to maximum

15 days to execute the project and until next payment the company intended to inject financial resource from other sources.

In general escalation has the following impact on contractor:-

- Disturb cash flow (project financing problem)
- Affect productivity
- Project delay
- Loose profit margin
- Project Termination

4.5.2 Effect of Escalation on Client

Client is the main stakeholder involve critically for the success of every construction project. Escalation affect the client in changing project cost at completion in much higher of the contract price. Project delay is one of negative consequence of inflation on public building construction projects. To be a list bidder the contractors poorly estimate the project cost and couldn't perform the project specially in the first 12 month because the material price highly inflated and the PPA directive not allow to compensate the price change even if the project duration more than 18 months. Finally the project become delayed and leads to terminate due to poor performance of contractor. Many government offices do not have their own office building and rely on rental space; the projects are not completed on time for the intended purposes, and the government offices incur additional rental costs.

The client (government) aimed to complete projects under construction in allocating a new budget for price adjustment due to inflation rather than planning to develop a new infrastructure. The public raise social and economic claim to the government due to shortage of infrastructure development.

5. Conclusion and Recommendation

5.1 Conclusion

In conclusion, escalation is a major challenge facing the construction sector in Ethiopia. High inflation rate on price of construction materials, labour and other inputs made difficult to complete public building projects on schedule with in budget. This has led to delay project provisional time, allocate additional budget, decrease contractor profit and reduce development of infrastructures. Based on the results from the analysis the following conclusions have been drawn and summarized in accordance with the objectives of the research. In Ethiopia the price of construction material increase significantly since 2015. Extreme high exchange rate and birr devaluation takes significant contribution for material price increment. The Public Procurement and property Administration Proclamation No. 649/2009 stipulated that the price adjustments made during contract implementation with two necessary conditions which are price change of construction inputs (material, labour and equipment) and project contract duration longer than 18 months.

Price adjustment practice use formula method calculation and calculating the factor of items which are listed in SCC from the total inputs of work. The price index of major resources (cement , reinforcement , fuel , labour) set a base price during bidding with choice of reliable source and price adjustment calculation was depend on selected supplier/local producer and invoice submission. In public building projects there is no common procedure in fixing percentage of adjustable components and non-adjustable portion of price adjustment. The number of representative elements for adjustable elements different from case to case even if the cases used the same standard condition of contract.

5.2 Recommendation

Assessing the practice of price adjustment on public building construction projects and suggesting solutions to reduce the negative effects on project performance are the objectives of this study. The following recommendation are forwarded to the competent body in public construction projects to improve public construction projects performance.

1. PPA and Public procurement directive states a minimum elapse period as major necessary conditions the contractor to request price adjustment in considering the price will not change significantly within a year. This provision doesn't work in volatile market condition. International practices recommend to include price adjustment clause whatever the length of the contract where the price of specified material fluctuates over a short period of time. PPA and Public procurement directive recommended to take such consideration.
2. PPA and public procurement directive has no a formal guide lines to treat a price adjustment for a project duration less than 18 months. Due to that in public project intentionally limit the project duration below 18 month to deny price adjustment provision in contract. This lead to informal way of price adjustment practice and intended to change inflation into variation. PPA better to set a common guidelines for all public project the contract length extended more than 18 month due to different reasons.
3. Contractors poor project cost estimation during bidding has its own contribution for escalation because the contracts aims to be a least bidder in order to win the bid. Contractor better to consider current market material price fluctuation and carried out proper and detail cost estimation practice also PPA 2011 procedures for price adjustment take in to account would make advantageous.
4. The bid entity committee should set appropriate bid document or contract agreement in considering expected uncertainty of inflation and incorporate handling mechanism of such uncertainty of inflation. Also professionally estimate appropriate project duration which compliance with PPA2011 and device necessary contract provision in the contract document.
5. Conducting research in construction industry become enervating and difficult to achieve the research objective due to inaccessibility of data specially government office. To held problem solver research in construction industry all stakeholders should cooperate in giving appropriate data and encourage the researcher for further investigation.