



**ADDIS ABABA UNIVERSITY
INSTITUTE OF TECHNOLOGY
SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING**

**STUDY ON THE PRACTICES OF PRICE ADJUSTMENT IN THE
ETHIOPIAN BUILDING CONSTRUCTION**

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**A thesis submitted in partial fulfillment for the requirement of the degree of
Master of Engineering in Construction Technology and Management**

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Author's Disclaimer

I hereby declare that, the work which is being presented in this research paper in partial fulfillment of the requirement for the degree of Master of Engineering in Construction Technology and Management is an authentic record of my own work. To the best of my knowledge and belief, this research paper contains no material previously published or written by another person except where due reference is made.

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Abstract

Price adjustment refers to a provision in a contract which calls for an adjustment in price in the event of an increase or decrease in certain costs. Price adjustment clauses are becoming increasingly common in building construction contracts as a means to cover unexpected costs resulting from fluctuations in the prices for raw materials, fuel and labor during the course of the construction project.

However, Lack of properly designed standard procedures for price adjustments and lack of clear understanding on price adjustment clauses and formula to implement the price adjustments when necessary has been a problem to the construction industry and the time associated with cost of construction could not be maintained and managed in a proper way for the successful accomplishment of projects. Therefore, this research paper aims in examining the price adjustment practices being currently implemented in the Ethiopian Building Industry, knowing the construction industry has the big share of the country's budget every physical year, with reference to international good practices and attempts to develop a draft standard procedure of Price Adjustment formulae.

Key Words: Price Adjustment, Price Adjustment Clause, Price Adjustment Formula

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Abbreviations

PA	Price Adjustment
PAC	Price Adjustment Clause
CPI	Consumers Price Index
PPI	Producers Price Index
BCIS	The Building Cost Information Service
CSA	Central Statics Agency
PPA	Public Procurement Agency
FDRE	The Federal Democratic Republic of Ethiopia
FIDIC	Fédération Internationale Des Ingénieurs – Conseils (from French, the International Federation of Consulting Engineers)
MDBs	Multilateral Development Banks
FHWA	Federal High Way Administration
BaTCoDA	Building and Transport Construction Design Authority
OECD	Organization for Economic Cooperation and Development
HICE	Household Income, Consumption and Expenditure
GCC	General Conditions of Contract
SCC	Special Conditions of Contract

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Abbreviations

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1. General

1.1. Introduction

The provisions of Price Adjustment on account of increase or decrease in costs of goods and services in construction contracts are practiced world over to have more realistic competitive bids and execution of contracts on equitable and just manner. Prices of goods and labor are highly variable due to fluctuations in the currency market. Construction professionals, therefore, thought it to be economical to compute the cost of contracts on current prices, keeping provisions of Price Adjustment for probable fluctuations. [4]

Moreover, the continuous increase in the prices of different materials, labor and other resources and the increase of the foreign exchange rates for imported construction materials are some of the causes of inflation on the cost of construction of the buildings.

Due to the unstable market prices of construction inputs, price adjustment clauses in construction contracts are introduced and intended to reduce the financial risk to project owners and contractors if the input costs rise or fall sharply during construction period.

A price adjustment clause (PAC) is a contractual mechanism that allows a contractor to be at least partially protected against material or fuel price increases that may occur between the contract award and the execution of the work. This is done by having an owner accepting the risk for escalating prices by offering a price adjustment clause that pays the contractor for any increases above an agreed-upon threshold. Frequently, there is a minimum contract duration and contract amount to which a price adjustment clause is applied, although this is not always the case. Also, many price adjustment clauses contain provisions for the contractor to provide a rebate to the owner in the event of decreasing commodity prices. Price Adjustment Clauses (PACs) are used in a number of industries in order to mitigate the amount of uncertainty inherent in contract work. [1]

The advantage of using Price adjustment clauses on the construction industries include:

- Decreased bid prices during tendering since the provision of the clause helps to reduce speculation by the contractor for uncertainty in material and labor cost movement. The contractor can price his tender based on material and labor costs as at the date pre-fixed in the tender document

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- More bidders will be involved if tender documents include price adjustment clauses.
- Better reliability in the supply chain and better market stability as well.
- More consistent contractor profit margins.

However, there are a number of risks and disadvantages associated with PACs such as: the accuracy of indices, Price adjustment payouts, and Political and industry resistance. [1]

Contractors and suppliers working in today's volatile materials market find that estimating, bidding and financing the construction projects to be challenging. In the Ethiopian Building Construction Industry, the contractor works in an environment of risk and uncertainty caused by the economic factors such as fluctuations in the costs of materials, labor and equipment.

Two previous research papers in relation to the Ethiopian Construction Industry have been cited for this project work. One devoted on identifying the specific characteristics and patterns of fluctuation of construction inputs prices in the past years and their effects on the capacity of the Ethiopian construction contractors and developing strategies for minimizing the adverse effects that would result from the fluctuation. [2]

And another paper also devoted on the assessment of the causes and effects of price escalation and its administration on federal road construction projects.[3]

This new research paper will attempt to develop the previous works by providing

- an assessment of the current practices of application of the Price Adjustment Clauses and Formulae in the Ethiopian Building Construction sector with reference to internationally accepted good practices and also attempt
- to suggest a draft Procedure for the application of Price Adjustment formulae in the Building Construction Sector based on the Federal Public procurement Authority Works Contract (2011) for governmental projects .

1.2. Statement of the Problem

Today's construction projects require modern construction technique, technological equipments, qualified professionals and large amounts of modern construction materials. Therefore, too much amount of money is required and invested to implement the projects. Moreover, as the construction business is of much risky and needs a huge amount of finance, the money which falls under risk needs an advanced way of construction management. Unless the project is successfully implemented in quality, cost and time, the failure of it may cause serious damage among the contracting parties.

Time and Cost elements of this sector are among the parameters which can easily be affected with the unhealthy movement of construction material prices, whose consequences largely affect the development of a country.

Similarly, the Ethiopian building construction sector is believed to be affected by delay of projects and over budgeting due to increase of cost of construction inputs.

This research paper attempts to assess the application of price adjustment clauses and procedures being implemented to compensate damages during price change of construction inputs in the Ethiopian building construction sector by testing the following problem statements:

- Are the current practices of Price Adjustment, being done due to the continuous price fluctuation of construction resources (globally and locally), in Ethiopian building construction sector up to the standards (In terms of uniformity and methods of application)?
- What does the current practices of price adjustment look like with respect to internationally accepted good practices in similar sectors?

Therefore, this research paper tries to answer the problems in the Ethiopian Building Construction Industry with regard to price adjustment through analysis of primary data (collected through questionnaire and interview) and secondary data collected through archival documents/literatures (journals, reports, researches and text books).

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1.3. Objectives

1.3.1. General Objective

The general objective of this particular research is to assess the common practices in the use of Price Adjustment in the Ethiopian Building Construction.

1.3.2. Specific Objectives

- ✚ To analyze the response of construction professionals regarding practices of price adjustment in the Ethiopian building construction sector.
- ✚ To identify problems on the practices and procedures during implementation of price adjustments on Government contracts made under “FPPA Works Contract”.
- ✚ To identify gaps on implementation of price adjustment with reference to internationally accepted good practices.
- ✚ To suggest methods or better approaches that improves the current practices of price adjustments.

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1.4. Scope and Limitation of the Study

As it is explained in the previous sections, the research of this paper is limited to the Building Construction sector of the Industry and practices of price adjustment process and application of the formula on the Road Construction Sector is not cited. The target population of this research is the professionals in the industry that were engaged on the construction of buildings sector at the time of data collection.

The research is also limited to government buildings which are under the Ethiopian Federal Public Procurement Agency Works Contract (Version 1, 2011). And, private buildings under different contracts and government buildings under the FIDIC contract were not cited for this research.

Since this research attempt to deal on the practices of price adjustment only on government owned buildings, further research on similar area is required to encompass the Building Sector as a whole.

1.5. Literature Review

1.5.1. Historical Development of Price Adjustment

The construction industry has been challenged with the rise of construction delivery costs due to the continuous and unpredictable change of the macroeconomic environment. Since the rise of input costs do not match with the budget of the projects, contractual clauses have been formulated to cater for optimum recovery of cost escalations. As a consequence of the world oil crisis in the seventies, prices started rising in unpredictable manner. Fixed price contracts were no longer suitable for such an economic environment since contractors were at risk with regard to recovery of profit due to cost escalation. Contracts were then subject to a cost-escalation provision in which a contractor was compensated for all increases in costs since the base date of tendering [1].

Since then, several methods for cost recovery have been tried and these include traditional method and consumer price index (CPI) based formulae. However each of these methods has shortcomings with regards to optimum cost recovery. The traditional method of ascertaining the amount of price fluctuation requires the contractor at the time of tender, to provide a list of the principal materials, plant and labor to be used in the contract and the unit price for those materials on which bill rates were based [2]. The traditional method is referred to as a partial fluctuation reimbursement because the amount of increase recovered is much less than the total amount by which costs have really increased/varied [3]. CPI based formulae include Osborne and Haylett formulae for building works, the Engineering formula for civil works and Baxter formula for civil contracts that are expected to be in excess of 24 months duration. Known also as full reimbursement methods, CPI based formulae were introduced in United Kingdom in the 1970s as an alternative to the traditional method to fully reimburse the contractor for losses incurred due to price fluctuation [2].

The Haylett formula was introduced in 1976 as a formula method for price fluctuation in labor costs, material prices, plant and equipment, and fuel. This formula provides roughly 85% constant, which is subject to adjustment and 15% non-adjustable portion.. The Haylett formula considers the adjustment based on following expression:

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$$A = 0.85V (X_e/X_o) - 1$$

Where, A is the amount of adjustment, 0.85 is a constant which provides for 15% non-adjustable elements, V is the work value of the index applicable to such a work group and valuation period, X_e is the value of the index applicable to such work group and valuation period and X_o is the value of the index applicable to such work group for the base month.

The rising costs of construction fuels and materials have been a reality of the last 30 years. Diesel, asphalt, steel, and cement have all experienced profound price increases during this period. The reasons for these price fluctuations (both increasing and declining) have been mainly attributable to:

- Competition for raw materials from developing nations who are improving their infrastructure.
- Increases in crude oil prices, especially in 2008.
- Declining or stagnant global economy since 2008. [1]

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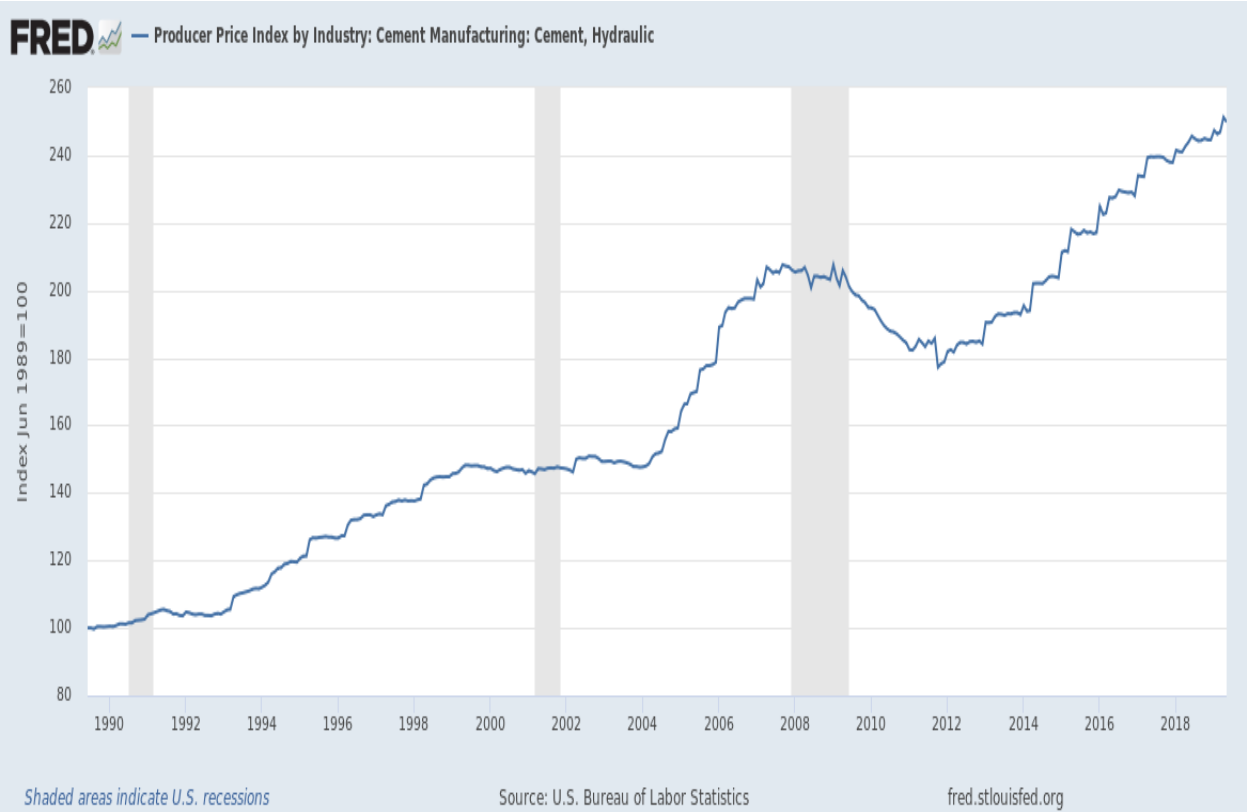
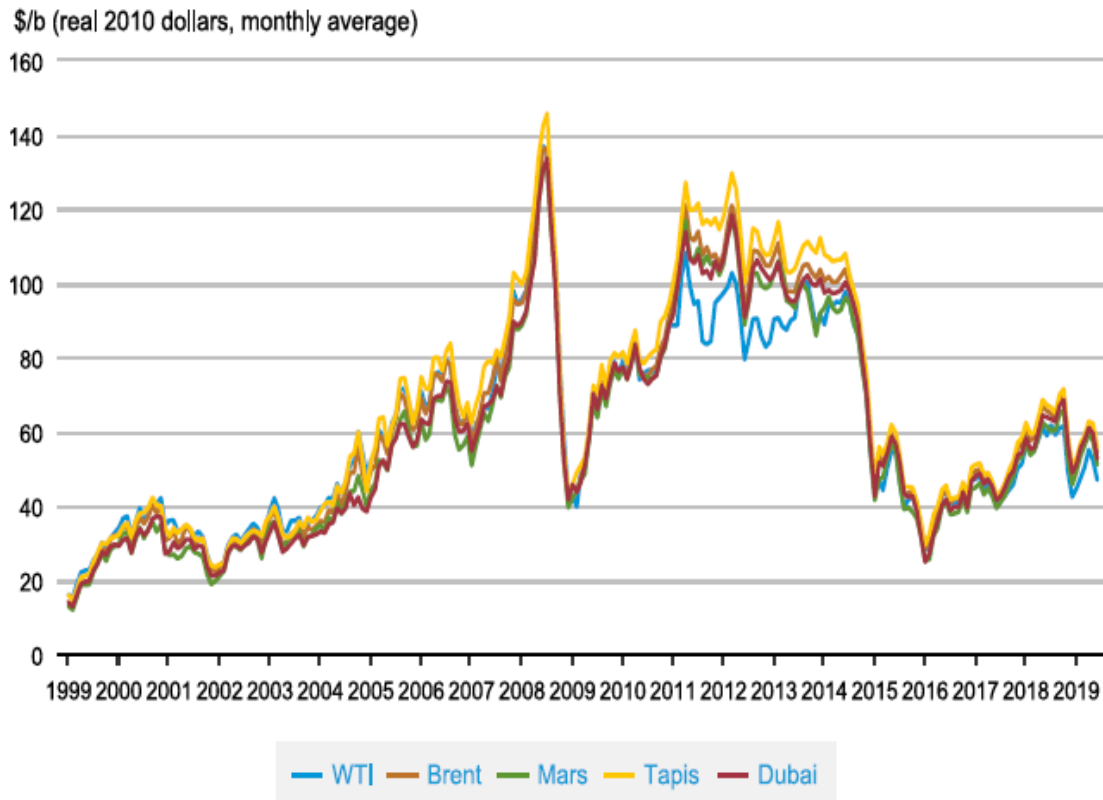


Figure 1.1.Cement Price Index, 1990-2018 (Source: U.S. Bureau of Labor Statistics) [15]

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Bench Marks in Oil Pricing

WTI – North America's West Texas Intermediate crude

Brent – North Sea Brent Crude

Mars – United States Gulf Coast Crude

Dubai - UAE Dubai Crude

Tapis - Malaysian [crude oil](#)

Figure 1.2. Price Fluctuations in Diesel Fuel Prices, 1999–2019 (Source: U.S Energy Information Administration, July 9, 2019) [15]

1.5.1.1.Global Practices and Views on Price Adjustment

As the price increase in cost of construction inputs is a global phenomenon, the use of price adjustment clause has been a common practice to alleviate the effects that occur on financial flow of the projects. The following provides an overview of the practice in dealing with construction price fluctuations in other countries.

United Kingdom

It was in the UK that the formula rule method of dealing with price fluctuations first introduced by using the Baxter and the Osborn formula in the 1970s and the FIDIC (Fédération Internationale des Ingénieurs-Conseils) based formulae were developed based on the fundamental knowledge of the two formulae.

Consumers Price Index (CPI) based formulae were introduced (in the UK) as an alternative to the traditional method to fully reimburse the contractor for losses incurred due to price fluctuation.

Conditions of Contract commonly used in the UK include either FIDIC (Founded in 1913 by three countries, each wholly or partly francophone, specifically Belgium, France and Switzerland. There are now 78 Member Associations from all over the world) or ICE (Institutes of Civil Engineers, a traditional Condition of Contracts firstly published in 1945 in the UK). Both these sets of conditions include a clause to allow for price fluctuation adjustment.

In the United Kingdom, the Building Cost Information Service (BCIS) publishes formulae and indices, and provides guidance on their use. [11]

United States

AASHTO “Suggestions and Guidelines for Combating Shortages and Minimizing the Effect of Price Uncertainties for Materials and Fuel in Construction” (1974)

AASHTO produced a document in 1974 entitled “Suggestions and guidelines for combating shortages and minimizing the effect of price uncertainties for materials and fuel in construction.”

This report appears to be the first to discuss price adjustment for construction materials. It suggested that shortages in materials can create problems with bid preparation for contractors, and that fixed quote pricing can be affected by these shortages.

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FHWA Technical Advisory T 5080.3 “Development and Use of Price Adjustment Contract Provisions” (1980)

In December of 1980, the Federal Highway Administration (FHWA) produced a technical advisory document entitled “Development and Use of Price Adjustment Contract Provisions.” The purpose of this document was to outline procedures for price adjustment that would minimize the effects of volatility in the cost of materials to be used for construction.

The adjustment parameters are based mostly on the United States Department of Transportation’s Technical Advisory. [11]

Common Formulas

There are two unique equations used for calculating price adjustment.

- **Inclusive price adjustment:** In an inclusive price adjustment clause, the entire difference between the current price and base price is paid. A trigger value can be specified to invoke the calculation. If there is no trigger, then the entire difference is paid regardless of price change. The price adjustment at the end of the invoice period, PA, is given based on the general equation as:

$$PA = (CP - BP) * Q * R$$

Where,

BP ≡ base price, which is the price of the material at the time of the contract (\$/quantity),

CP ≡ current price, which is the price of the material at the end of the invoice period (\$/quantity),

Q ≡ quantity of the material consumed during the invoice period, in appropriate quantity units for that material, and

R ≡ price adjustment reduction factor:, is a value less than 1 that decreases a price adjustment. It provides a means to share the risk when prices change, especially when the price change is dramatic.

When the current price is greater than the base price, the price adjustment is a positive dollar amount, which represents an increased payment to the contractor. When the current price is less than the base price, the price adjustment is a negative dollar amount, which represents a decreased payment to the contractor. [6]

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- **An exclusive price adjustment formula:** In an exclusive price adjustment clause, a partial difference between the current price and base price is paid. A trigger value is required to invoke the calculation. The price adjustment at the end of the invoice period, PA, is given based on a general equation as:

$$PA = (CP - ((1 \pm T) * BP)) * Q$$

where T \equiv trigger value, which is the percent change from base price (expressed in decimal form) required to invoke a price adjustment. If the trigger value is not reached, then no adjustment is made. If the trigger value is reached, the adjustment amount corresponds to the price change that exceeds the trigger value. [6]

Australia

One of the standard forms of contract used in Australia, which has provisions for fluctuations, is known as the “HIA (Housing Industry Association) Standard Cost - plus Contract”. It is used mainly by employers who are constructing personal domestic houses. This form is designed for small works and would not necessarily be applicable for major infrastructure works. Different states in Australia have varying legislation on whether cost plus contracts are allowed or whether fluctuation clauses are allowed.

Queensland Department of Main Roads in Australia and government legislation provide for formula-based adjustment (rise and fall provisions) in contracts of 365 days or more. The formula is applied to 85% of the value of a work item or material (minus the value of bitumen and the value of work completed after the Date for Practical Completion).

The indices are taken from the Road and Bridge Construction Index published by the Australian Bureau of Statistics. [11]

Japan

In Japan, the standard form of contract known as “Form of Contract for Construction Works” includes a provision for the treatment of material price fluctuations, with a base date of cost indices (date of signing of contract), the effective date of fluctuation (1 year after signing of contract) and a minimum fluctuation rate (1.5%) clearly stipulated. However, it leaves the base indices to be mutually agreed between the employer and the contractor and then to be included in the Contract Agreement. [11]

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China

In China CPFS (Contract Price Fluctuation System: a mechanism included in a construction contract between the employer and the contractor that compensates for the risk of fluctuation in the price of certain predetermined elements of the contract in a pre-agreed calculation method) was first introduced in 1976 in government civil engineering contracts with contract duration exceeding 12 months. The system was subsequently extended to building contracts in 1977. In 1995, the threshold for CPFS was raised from 12 months to 21 months in order to make greater use of fixed-price contracts so as to achieve tighter budgetary control.

Since 2008 the government of Hong Kong developed a policy to implement contract value adjustment for changes on the cost of labor and materials in all government capital works contracts of any duration. The monthly indices for labor and materials costs published by the Census and Statistics Department of Hong Kong are used with the formula.

The following table 1.1 summarizes the standard General Conditions of Contract (GCC) being used by the Government for different types of construction works and the applicability of the fluctuation clause: [11]

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Type of Contract	Document	Fluctuation Clause applicable?
Civil Engineering Works	General Conditions of Contract for Civil Engineering Works 1999 Edition	Yes (included as Clause 89)
	General Conditions of Contract for Term Contracts for Civil Engineering Works, 2002 Edition	Yes (included as Clause 92)
E&M Engineering Works (Electrical & Mechanical Works)	General Conditions of Contract for E & M Engineering Works, 1999 Edition	No (expressly stipulated in Clause 89)
	General Conditions of Contract for Term Contracts for Electrical And Mechanical Engineering Works (2007 Edition)	No
Building Works	General Conditions of Contract for Building Works, 1999 Edition	Yes (included as Clause 89)
	General Conditions of Contract for Term Contract for Building Works (2004 Edition)	No
Design and Build Contract	General Conditions of Contract for Design and Build Contract 1999 Edition	Yes (included as Clause 89)

Table 1.1 Standard Clause Used by the Government of China for Different Contracts [11]

1.5.1.2. Historical Development of Price Adjustment Clauses and Practices in the Ethiopian Construction Industry

Literatures reveal that Price adjustments on governmental projects have been administered in the Ethiopian Construction Industry since the development of the MoWUD Contract Form (1994) by the Ethiopian Ministry of Works and Urban Development. The currently used form of contract for governmental constructions works of National Competitive Bid (NCB) is the FPPA 2011 Contract Form (Version 1, 2011).

The Historical Development of the Contract Forms for Government projects are described below:

- **MoWUD 1994 Contract Form**

The Price Adjustment Clause on this form of Contract (Clause 70) states how adjustment on the contract price to be considered and the manner set out for calculation is specified on the sub-clauses as:

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

The contract price shall be considered to have been calculated in the manner set out below and shall be subject to the adjustment in the events specified here under:-

- The rate contained in the priced Bill of Quantities are based upon the rates of wages and other emoluments and expenses applicable at the site at the date of bid pricing.
- If the said rates of wages and other emoluments (benefits from employment) 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 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.
- The rates contained in the priced Bill of quantities are based upon the rates of the Contractor's compulsory contributions payable at the date of bid pricing under or by virtue of any Act, statute, Decree, Regulation and the like applicable at the Site.

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- If any of the said rates of contribution shall be increased or decreased after the said date of bid pricing or if any new compulsory contribution becomes payable after that date, then the net amount of the difference between what the contractor actually pays in respect of works people engaged upon or in connection with the works and what he would have paid in respect of such persons had any of the said rates not become payable as aforesaid 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. [7]

MoWUD 1994 conditions assume the market to be a stable one. In the absence of such an adjustment, contractors are obliged to cover the incurred extra expenses offsetting the balance from their profit margin. These conditions do not explicitly address an increase or decrease in cost of labor or materials with respect to the country's market but rather deal with only increase or decrease of rates of wages and other emoluments and expenses subsequent to change in legislation. It used to amend and ratifies price rise/falls from time to time to address adjustments attributed to price escalation. However, these provisions were later put in to effect through "Construction Conditions Amendment 001/1996 E.C" by MoI (Ministry of Infrastructure) in March 2004. The directive comprises nine amendment clauses where provisions on advance payment and price escalation are dealt with among others.

Most local contractors have been discouraged because of the assumption of the MoWUD 1994 Conditions of contract which proposed adjustment to be made up on changes of wages. However, the issue was brought to attention according to clause 4 of the construction condition amendment of 2004. According to the amendment of MoI (2004) the price adjustment is based on correctly recorded price rise/falls against the basic material price indices stated in the contract,

- **PPA 2006 Contract Form (January 2006)**

This form of contract has a clause on Price adjustment (**Clause 47**) which states that Prices to be adjusted for fluctuations in the cost of inputs only if provided for in the Special Conditions of Contract part of the contract document. If so provided, the amounts certified in each payment certificate, after deducting for Advance Payment, to be adjusted by applying the respective price

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adjustment factor to the payment amounts due in each currency. A separate formula of the type indicated below applies to each Contract currency:

$$P_n = A + b \frac{L_n}{L_o} + c \frac{M_n}{M_o} + d \frac{E_n}{E_o} + \text{etc.}$$

Where:

P_n is a price adjustment factor to be applied to the amount in each specific currency for each payment certificate;

“A” is a constant, specified in the Contractor’s Bid, representing the non-adjustable portion in contractual payments;

“b, c, d, etc.,” are weightings or coefficients representing the estimated proportion of each cost element (labor, 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; L_n , M_n , E_n , etc., are the current cost indices or reference prices of the cost elements in the specific currency of origin at the date 28 days prior to the deadline for bid submission; and

L_o , M_o , E_o , 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 is related.

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

Z_o is the number of units of currency of the country of the index, equivalent to one unit of the currency of payment on the date of the base index, and Z_n is the corresponding number of such currency units on the date of the current index.

As per this form of contract, the sources of indices shall be listed in the Contractor’s Bid, as approved by the Engineer and Indices shall be appropriate for their purpose and shall relate to the Contractor’s proposed source of supply of inputs. As per the proposed basis for price

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adjustment, the Contractor shall submit with his bid the tabulation of Weightings and Source of Indices, which shall be subject to approval by the Engineer.[8]

- **PPA 2011 Contract Form (Version 1, August 2011)**

Request for price adjustment in relation to a particular work items under this Contract may be filed by the Contractor 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

Price Adjustment shall be applicable as payable in full for the original scheduled completion period.

In the event the completion of contract exceeds the original scheduled period:

- In case of default on the part of the Contractor causing delay in original scheduled completion, the rate of Price Adjustment will be frozen at the original scheduled date of completion; however Price Adjustment will be applicable till actual completion. While computing Price Adjustment beyond the scheduled completion period, in the event the rate is reduced, then that reduced rate will be applied.
- The Price Adjustment will be payable in full for the extended period if the Contractor has been granted an extension of time for no fault on the part of the Contractor, duly approved by the public body.

To determine the adjustment on each item any such price variation shall be calculated in accordance with the following formula by applying the combination of above said criteria:

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

Where:

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

NV= The fraction which represents Non Variable element of the Contract Price that is free of contract price adjustment, as specified in the Contractor's Bid;

A = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Average Labor Category Earnings Index;

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- MLI = The most recently available selected Average Labor Category Earnings Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;
- BLI = Benchmark Average Labor Category Earnings Index applicable to the Works either:
- (a) at the bid closing date, or
 - (b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;
- B = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Material Price Index
- MMI = The most recently available selected Material Price Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;
- BMI = Benchmark selected Material Price Index applicable to the Works either:
- (a) at the bid closing date, or
 - (b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;
- C = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Equipment Price Index
- MEI = The most recently available selected Equipment Price Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;
- BEI = Benchmark selected Equipment Price Index applicable to the Works either:
- (a) at the bid closing date, or

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- (b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;

D = The fraction of the Contract Price subject to adjustment in accordance with movements of the Average Fuel Price Index

MFI = The most recently available Average Fuel Price Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;

BFI = Benchmark Average Fuel Price Index applicable to the Works either:

- (a) at the bid closing date, or
- (b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;

BC = Current Contract Price applicable to the Works

Q = Quantity;

And where: $NV+A+B+C+D$ are equal to 1.00

The fraction for each specified element and exact combination of elements that will be applied in the formula for price adjustment shall be determined in the Special Conditions of Contract part of the contract document. [9]

1.5.2. Types of Price Adjustment Clauses

Keeping in view the consistent and unpredictable trend of fluctuation in the prices of construction materials and labor, price adjustment clauses are being the part of the construction contracts to overcome the unpredictability of prices at the start of a project and allow a certain degree of flexibility. These clauses must be tailored with care and should be thoughtfully drafted, specifically identifying the various building materials most at risk for price variation. Three types of price adjustment methods remained in use for the calculation of adjusted prices. [5]

- **Invoice method:**

In this method, the contractor provides documentation reflecting any increase in materials costs in the form of invoice, purchase bill or certification from its supplier to confirm the changes in the price of selected materials. It must reflect the change in the material price from the time of signing the contract to the time when actual purchase was made. On the basis of this document, the contractor is paid the difference between the rates of the material on the two dates.

- **Index method:**

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

The client has the advantage as the rates are monitored by an independent body.

- **Hybrid Method:**

This is the combination of Invoice method and index method, and is based on a “certified bid cost” in which the contractor certifies its estimate of a specific material’s cost based on its current supplier price or an index price listing. When the prices of those selected items change by a certain percentage — such as 5 percent or 10 percent, positively or negatively—the contract would be adjusted accordingly.

Properly drafted, price adjustment clauses in construction contracts minimize risk to both contractor and owner, reducing conflicts and promoting cooperation. The clauses are created

with the full understanding that material, Fuel and labor prices are at risk of fluctuation between the time a contract is signed and the completion of the project. [5]

1.5.3. General Framework for Price Adjustment Clauses

Three common elements that are defined here as **qualifications**, **price adjustment calculations**, and **caps** are currently used and recommended as a general frame work for price adjustment clauses (PACs) in most developed nations. Not all PACs are structured in this manner [6]

i) Qualification

PACs for a specified construction material often must meet some minimum contract requirement(s) to be applicable. In some cases, there might be an option (opt in/out) clause for PACs. The most common requirements invoke minimum material quantities, minimum contract sums, and/or minimum contract duration. PACs can have one or more of these requirements for the same material. Each one is described in the following sections.

- **Minimum Quantity**

Minimum quantity specifies the minimum amount of a material that must be used on a contract to allow price adjustment.

- **Minimum Sum**

A minimum sum can be specified for the entire contract or for the particular item or items associated with each material.

- **Minimum Duration**

Minimum contract duration can be specified in days, months, or years. Price adjustment clauses can contain both short term and long term clauses for the same material. In this case, short term and long term clauses can be differentiated through specification of other minimum qualifications (material quantity and/or contract sum) and/or price adjustment calculations.

ii) Price Adjustment Calculations

Price adjustments are calculated for material quantities purchased in an invoice period, which generally occur on a monthly basis. The formulas and variables used to calculate an adjustment are described in the following sections.

iii) Price Adjustment Caps

A cap can be specified to limit the price adjustment to a maximum acceptable amount. Like the payment reduction factor, it provides a means to share the risk when prices change, especially when the price change is dramatic. Caps can be expressed as a percent change from a base price, a monetary change from a base price, or as a monetary sum. [6]

1.5.4. Price Indices and their measurements

Historically, the general economy has usually fluctuated in such a way as to experience inflation, a loss in the purchasing power of money over time. Inflation means that the cost of an item tends to increase over time, or, to put it another way, the same dollar amount buys less of an item over time. Deflation is the opposite of inflation, in that prices decrease over time, and hence a specified dollar amount gains purchasing power. Inflation is far more common than deflation in the real world. [12]

Consumer Price Index

Consumers usually have a relative, if not a precise, sense of how their purchasing power is declining. This sense is based on their experience of shopping for food, clothing, transportation, and housing over the years. Economists have developed a measure called the consumer price index (CPI), which is based on a typical market basket of goods and services required by the average consumer. This market basket normally consists of items from eight major groups: (1) food and alcoholic beverages, (2) housing, (3) apparel, (4) transportation, (5) medical care, (6) entertainment, (7) personal care, and (8) other goods and services. The CPI compares the cost of the typical market basket of goods and services in a current month with its cost at a previous time. [12]

The CPI is widely used as:

- ✓ a key indicator of an economy's performance and for monitoring and evaluation of a country's monetary and fiscal policy;
- ✓ the main measure of the inflation rate;
- ✓ a tool in wage negotiation and indexation, i.e. it is used to adjust taxes, determine wage levels in the event of trade disputes, social security benefits, public service remuneration and pensions, among others;

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- ✓ a national accounts deflator of the consumption expenditure that is by deflating nominal values (current cost) of goods and services by the prevailing CPI, the real / constant value can be established;
- ✓ an input for Policy making, research and other purposes. [14]

Producer Price Index

The Producer Price Index (PPI) is a family of indexes that measures the average change over time in selling prices received by domestic producers of goods and services. PPIs measures prices from the perspective of the seller.

The consumer price index is a good measure of the general price increase of consumer products. However, it is not a good measure of industrial price increases. When performing engineering economic analysis, the appropriate price indices must be selected to accurately estimate the price increases of raw materials, finished products, and operating costs. [12]

1.5.5. Source and Method in the compilation of price Indices

1.5.5.1.Global Practices

The term construction covers a wide variety of activities, these include the construction of dwellings, non-residential buildings, and civil engineering works such as roads, bridges, dams, etc. Construction activity also encompasses repair, renovations, rehabilitation and maintenance of existing structures, etc.

The diversity of construction activity is the cause of one of the major problems in the compilation of construction price indices, that of comparability. The items comprising an index and their relative weights are the result of different norms and standards that apply in each country.

For example, when comparing indices compiled by different countries for housing construction, account needs to be taken of differences in climate, culture, level of affluence, legislative standards, physical characteristics (e.g. geographic size, population density, terrain) etc. [13]

Construction Price Indices

Most of the information used in the compilation of construction price indices are derived from the supply side of the industry (i.e. from construction firms, sub-contractors, materials supply firms, etc.).

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Construction price indices may be described as indices compiled from:

- prices paid by the contractor for inputs to the construction process; or
- the price received for the completed output of construction activity paid by the client; or
- the selling price including all of the demand side cost elements paid by the purchaser or final owner. [13]

Main types of Construction Price Indices

Three main types of construction price indices are compiled in Member countries of OECD (Organization for Economic Cooperation and Development) and the European Union: input price indices, output price indices, and seller's price indices. [13]

Input Price Indices

Input price indices measure changes in the price of inputs to the construction process by monitoring separately the cost of each factor. This generally entails the compilation of a weighted index of the costs of wages and materials.

Initially, representative object (e.g. a dwelling of a specific type, size, style, etc.) is taken and the quantity of labor hours and materials needed for its construction calculated. These quantities are periodically multiplied by the corresponding prices and the outcome totaled.

Output Price Indices

Output price indices measure changes in the prices of what is produced by entities engaged in construction activity.

Output price indices cover most of the items normally built into the price paid by purchasers or clients to entities involved in producing the completed output of the construction activity. These generally include materials, labor, equipment hire, land preparation costs, bathroom/kitchen fittings, overheads, profits, and trade margins. [13]

Seller's Price Indices

Seller's price indices measure changes in the prices of construction output paid by the purchaser or final owner of the output of construction activity.

The inclusion in the index of all the cost elements paid for by the final owner of the construction (particularly the land, finance costs, selling expenses) conceptually brings a seller's construction price index close to being a consumer price index. [13]

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Relation between the Three Types of Indices

The item imposition of the three types of construction price indices is illustrated in the following diagram.

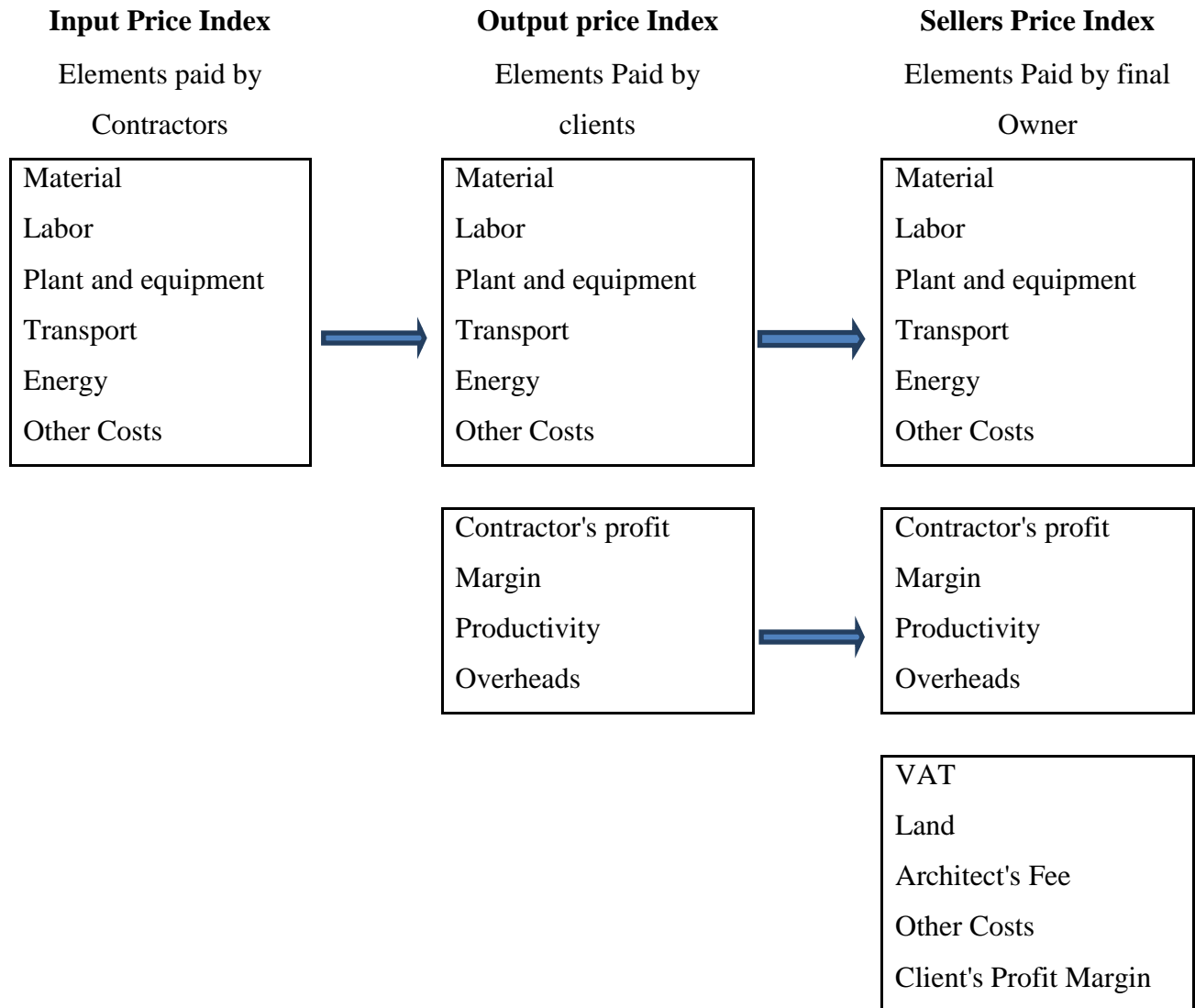


Figure 1.3 Relations between the Three Types of Indices [13]

In practice, there is some degree of overlap in the item composition of the three types of construction price indices described above. For example, output price indices may include professional fees (such as architects, lawyers, engineers) to the extent that they are initially paid by the construction contractor and subsequently included in the output price paid by the client.

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The same principle applies to other cost elements. The development of reliable construction price indices requires a thorough understanding of all stages of the construction process from the materials supply through to the sale of the completed “product” to the final owner.

1.5.5.2. Ethiopian Consumer’s Price Index and Methodology

Central Statistical Agency (CSA) of Ethiopia conducts a Household Income, Consumption and Expenditure (HICE) survey every five years.

The first ever Consumer’s Price Index (CPI) in Ethiopia, that is, the 1963 based monthly Addis Ababa CPI was constructed on the basis of the data collected on the spending pattern of the Addis Ababa HICE survey conducted in 1963.

The Ethiopian CPI attempts to reflect the combined price movement of many retail transactions on a monthly basis. Because of the fact that the consumer price index is based on a fixed basket of goods and services consumed in the base year, it tends to become outdated over time. Changes in the consumption pattern can take place due to several reasons; some of the main ones are given below:

- ✓ Changes in social and economic characteristics of the population;
- ✓ new products and service come into the market as the old one disappears;
- ✓ changes in consumer’s taste and preference;
- ✓ changes in consumers income;
- ✓ changes in relative importance of some goods and services; [10]

The eleven major groups in the Ethiopian CPI are Food, Beverages, Cigarettes and Tobacco, Clothing and Footwear, House Rent, Construction Materials, Water, and Fuel and Power, Furniture, Furnishing, Household Equipment and Operation, Medical Care and Health Transport and Communication, Recreation, Entertainment and Education, Personal Care and Effects, and Miscellaneous Goods and Services.

The Ethiopian HICE is conducted every five years and the weights are also revised after obtaining the household expenditure data from the survey. [10]

1.6. Price Adjustment Clauses and Formula in the Ethiopian Building Construction Contracts

The commonly used contract in the Ethiopian Building construction either use the FIDIC form of contract (the Red Book) in the case of projects run/donated by non-governmental organizations and industries (in which case the share or participation of the foreign institutions/donors is influential) and the other is the FPPA works contract which is mainly implemented on governmental projects.

As the area of the study of this paper is limited on governmental projects, discussions have been produced based on the clauses and formula set on the general conditions of contract.

Generalized Form of Formula

The contract sum can be viewed as comprising two parts: one part composed of elements that are more prone to major price fluctuations (the “Adjustable Elements”) and the other part made up of elements that are less prone to fluctuations (the “Non-Adjustable Elements”). Adjustable Elements generally include materials, equipment and labor; whereas Non-Adjustable Elements are more commonly costs such as preliminaries insurance, project management costs, design costs, contractor’s site office and other fixed overheads.[11]

The price adjustment formula introduced by FPPA (Version 1 August 2011) and being used on all contracts of governmental building projects is:

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

Where:

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

NV= The fraction which represents Non Variable element of the Contract Price that is free of contract price adjustment, as specified in the Contractor's Bid;

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A = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Average Labor Category Earnings Index;

MLI = The most recently available selected Average Labor Category Earnings Index on the date on which the Public Body received notification of the proposed increase price from the Contractor;

BLI = Benchmark Average Labor Category Earnings Index applicable to the Work either:

- a) at the bid closing date, or
- b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;

B = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Material Price Index

MMI = The most recently available selected Material Price Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;

BMI = Benchmark selected Material Price Index applicable to the Works either:

- a) at the bid closing date, or
- b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;

C = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Equipment Price Index

MEI = The most recently available selected Equipment Price Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;

BEI = Benchmark selected Equipment Price Index applicable to the Works either:

- a) at the bid closing date, or
- b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;

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D = The fraction of the Contract Price subject to adjustment in accordance with movements of the Average Fuel Price Index

MFI = The most recently available Average Fuel Price Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;

BFI = Benchmark Average Fuel Price Index applicable to the Works either:

a) at the bid closing date, or

b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;[9]

2. Research Methodology

2.1. Research Design

The objectives of the research have been established in the previous section and here the methods for achieving these goals are discussed in.

Generally the common methods used for the collection and generation of the research data i.e. the questionnaire survey and desk studies on documents have been used. This research is conducted as an exploratory and comparative study of the Price Adjustment Formula of the Federal Democratic Republic of Ethiopia Public Procurement Agency (FPPA) Works Contract and its application in governmental building construction contracts and suggested measures on the limitation of the formula in the context of the Ethiopian Building Construction.

A five-point Likert Scale, with 5 being very high and 1 being very low, is utilized to judge the opinion of the concerned stakeholders. The principal consideration for using likert scale is to determine the extent to which respondents agree or disagree with a particular statement or view, and it also give respondents the extra range of possibilities between "Yes" and "No". The Professionals working in the area of Construction companies (with contractors and real estate developers), Private Consulting firms, Governmental Construction Works Regulatory Authority are the sample population for this research. After the preliminary study, detailed literature review was carried out and a number of prepared questionnaires and secondary data (price adjustment payments, correspondence letters etc) were examined.

A total of 40 questionnaires have been received and the collected data was analyzed using Microsoft Excel. In the last, efforts were made to draw conclusions and give recommendations on the basis of analysis and results obtained from primary and secondary data.

2.2.Data Collection

In order to understand the opinion of the stakeholders, a questionnaire survey was conducted. Determination of the characteristics of the population through sampling is the main purpose of statistics. The sample to carry out the research for the thesis is selected from a population of professionals working on production of designs and tender documents (private consultants), bidding on construction projects (Contractors and real estate developers), working with construction regulatory authority (government body). The questionnaire was, therefore,

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distributed to approximately 40 respondents. The objective of statistics is to have summary measure about some of the characteristics of the complete population through sampling.

2.3. The Questionnaire

The questionnaire developed for the research study consisted of two major parts. Part I was designed to gather information about the respondent like Name, Contact Details, Experience etc. Part II contains a total of 29 questions. Out of the 29 questions, 21 questions are based on the Likert Scale. In the last section of Part II, there are 8 questions in which the respondent has to choose the answer of his choice from the given options.

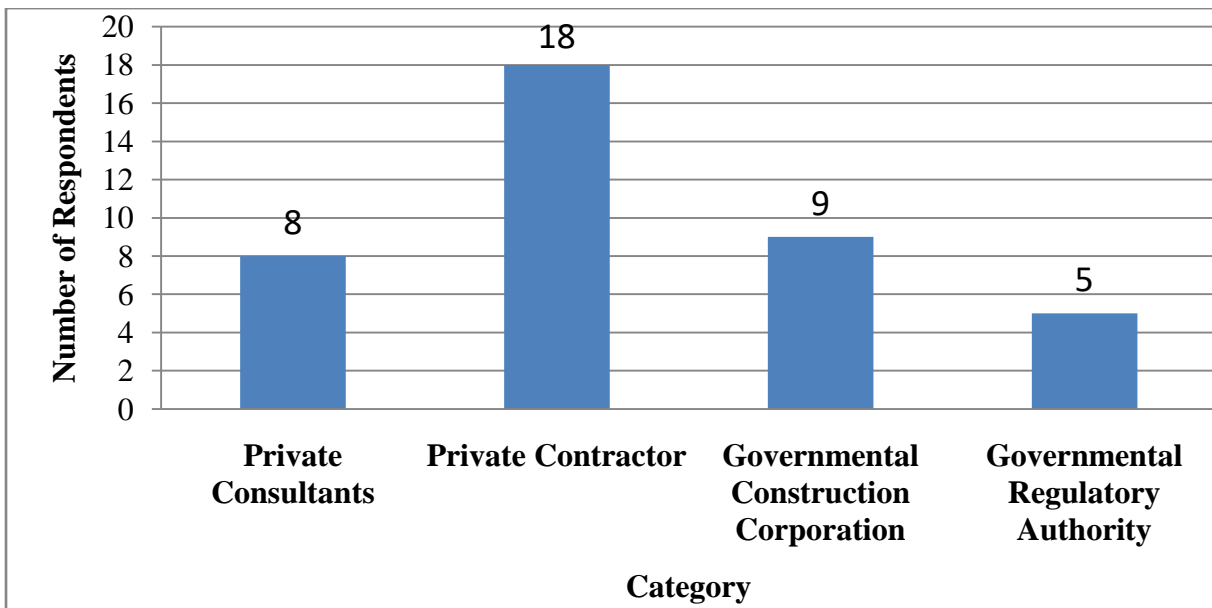


Figure 2.1 Detail of Respondents

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3. Data Analysis and Results

3.1 Characteristics of the Respondents

3.1.1 Grouping of the Respondents

All the 40 respondents have filled the questionnaires properly. Response by Private Consultants was 20%, Private Contractors 45%, Governmental Construction Corporation 22 % and Government Construction Regulatory Authority 12.50%. Category, grouping and percentages of respondents are shown in Table 3.1 and Figure 3.1 below.

No.	Category	Number of Respondents	%age Ratio	Cumulative %ages
1	Private Consultants	8	20	20
2	Private Contractors	18	45	65
3	Governmental Construction Corporation	9	22	87
4	Governmental Regulatory Authority	5	12.5	100
	Total	40	100	

Table 3.1 Category of the Respondents

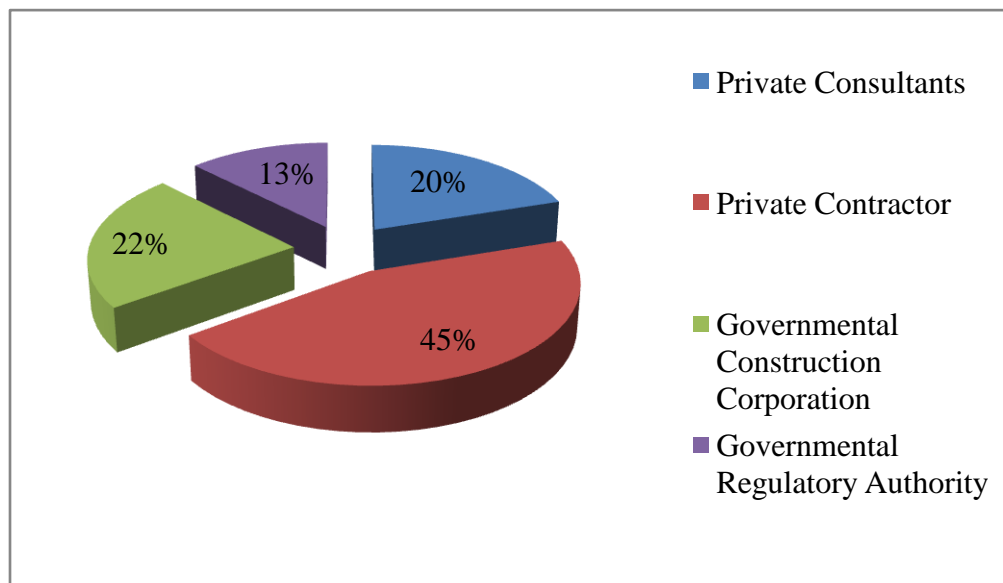


Figure 3.1 Grouping of the Respondents

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3.1.2 Experience of the Stakeholders in the Construction Industry

The respondents on this survey have different work experience in the construction industry. Approximately 7% of the respondents have over 20 years of experience, 27% have experience between 11 to 15 years, 33% have experience between 6 to 10 years and 33% have experience less than 5 years.

Experience of Respondents	Frequency of Respondents	Percentage of Respondent	Cumulative Percentage
0-5 Years	13	32.50	32.50
6-10 Years	13	32.50	65.00
11-15 Years	11	27.50	92.50
16-20 Years	0	-	92.50
above 20 Years	3	7.50	100.00
Total	40	100.00	

Table 3.2 Experience of Respondents in Construction Industry

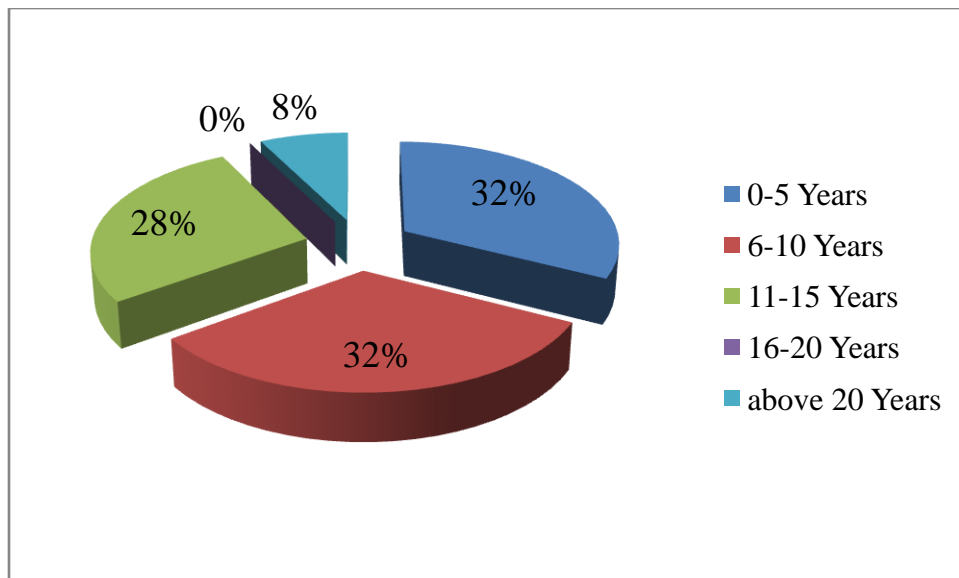


Figure 3.2 Percentage of Respondents Based on Industry Experience

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3.1.3 Positions of the Respondents in the Construction Industry

Table 4.3 and Figure 4.3 show the positions of the professionals who responded to this survey. Approximately 5% of the respondents were either GM or Managers in their organizations, 5% were Project Managers at different levels, 68% were Office Engineers and 22% Site Engineers or Resident Engineers in their Organization.

Position of the Respondents	Frequency of the Respondents	% age Ratio	Cumulative % age
GM/ Manager	2	5.00	5.00
Project Manager	2	5.00	10.00
Office Engineer	27	67.50	77.50
Site Engineer/ RE	9	22.50	100.00
Total	40	100.00	

Table 3.3 Experience of Respondents in Construction Industry

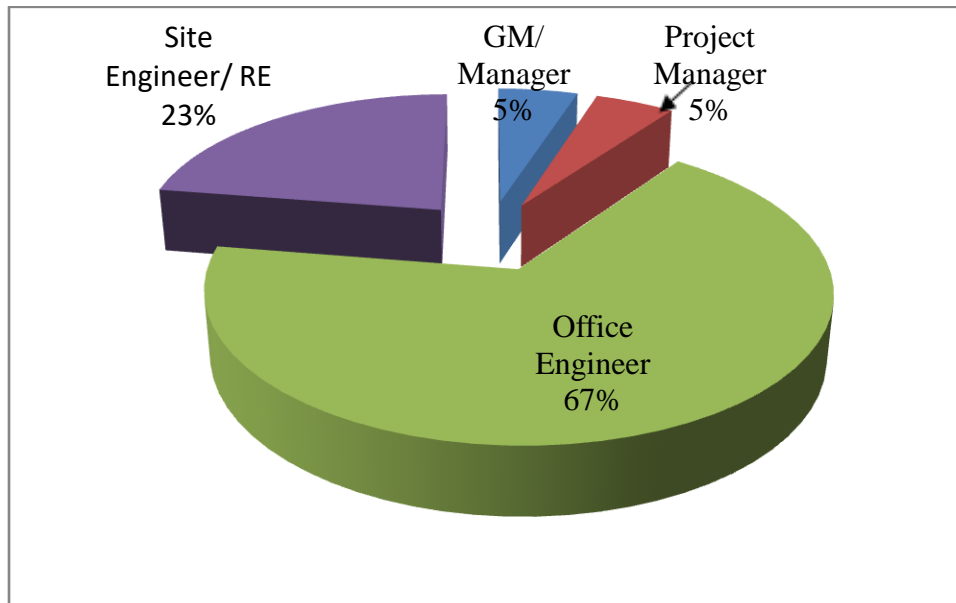


Figure 3.3 Percentage of the Respondents Based on their Position

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3.2 Findings

Based on data, the understanding of the stakeholders /sample professionals in the industry/ towards the practice of price adjustment and price adjustment formula was evaluated and discussed as follow.

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Questions	Likert Scale					Total respondents
	Very Low	Low	Moderate	High	Very High	
Are you familiar with price adjustment process?	5	18	9	5	3	40
Do you think that engineers are given sufficient education about dealing with price adjustment process?	13	14	7	5	1	40
Do you think that there is a standard procedure and guide line of calculating the price adjustment formula on FPPA's works contract (Works Contract of the FDRE Public Procurement Agency)	4	8	11	8	9	40
Do you always notice the price movement of different construction inputs on market?	5	14	8	9	4	40
Is it important to include clauses for provision of price adjustment during tender preparation stage?	1	9	5	9	16	40
Does the inclusion of price adjustment clause in the FPPA works contracts support the problem of financial flow of a project?	2	3	8	11	16	40
Do you think that the bid amount can go higher in the absence of price adjustment clause in the contract?	7	9	8	9	7	40
Do you think that price adjustment clause is an effective method of dealing with risk associated with price fluctuation?	3	6	9	10	12	40
Do you think that Time and Cost management of a project minimize the effect of price escalation?	0	4	5	18	13	40
How frequently have you worked with FPPA's price adjustment formula? (Works Contract of the FDRE Public Procurement Agency)	12	20	5	2	1	40
Is escalation in prices of construction material, labor & equipment, a major cause of cost over-run of projects?	4	7	6	16	7	40

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Questions	Likert Scale					Total respondents
	Very Low	Low	Moderate	High	Very High	
Do you think that the price adjustments through the Index Formula (FPPA works contract) truly replace the amount of change of price of inputs?	5	12	14	6	3	40
Is the “Invoice Method” (in which the contractor submits the actual purchase invoices of the material on which he will be paid the cost difference of the current rate and the rate at the time of tender) more effective than the Price Adjustment Formula method currently applied on the FPPA’s works contract?	12	13	9	3	3	40
Do you think that the contractor could get unfair advantage by manipulating with the purchase dates, when using the “Invoice Method”?	5	13	7	13	2	40
Do you think that the “Invoice Method” cannot be effectively applied in Ethiopia because of less government control on proper invoices?	2	9	7	13	9	40
Could it be difficult for clients/consultants to check & verify the invoices submitted by the contractors?	8	7	9	11	5	40
Does the price Adjustment Formula currently applied on the works contract of FPPA provide fair environment to all the parties?	9	7	13	6	5	40
Do the parameters on the formula clear and data available to deal with?	8	10	9	5	8	40
Do you think that price adjustment formula of FPPA Works contract simple and clear?	7	11	8	9	5	40
Is it right that the contractors have more advantage by the application of price adjustment formula?	10	10	12	5	3	40
Do you think that client/owner have more advantage through the price adjustment formula?	11	19	4	3	3	40

Table 3.4 Respondents Reply to the Likert Scale Questionnaire

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Based on the assignment of a numerical value for the Likert Scale (Weightage given to each factor by the respondents and ranges from 1 to 5 where '1' is 'Very Low' and '5' is 'Very High') in which case a highest numeric value (i.e. “5”) reflects the highest level of agreement in each question, the following table has been produced to identify the questions with the lower points of likert scales (specially Very Low/Low) for further discussion.

No.	Questionnaires	Sum of ranked Score ΣR_i	Mean of the Ranks \bar{R}_i
01	Are you familiar with price adjustment process?	103	2.575
02	Do you think that engineers are given sufficient education about dealing with price adjustment process?	87	2.175
03	Do you think that there is a standard procedure and guide line of calculating the price adjustment formula on FPPA’s works contract (Works Contract of the FDRE Public Procurement Agency)	130	3.25
04	Do you always notice the price movement of different construction inputs on market?	113	2.825
05	Is it important to include clauses for provision of price adjustment during tender preparation stage?	150	3.75
06	Does the inclusion of price adjustment clause in the FPPA works contracts support the problem of financial flow of a project?	156	3.9
07	Do you think that the bids can go higher in the absence of price adjustment clause in the contract?	120	3

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No.	Questionnaires	Sum of ranked Score ΣR_i	Mean of the Ranks \bar{R}_i
08	Do you think that price adjustment clause is an effective method of dealing with risk associated with price fluctuation?	142	3.55
09	Do you think that Time and Cost management of a project minimize the effect of price escalation?	160	4
10	How frequently have you worked with PPA's price adjustment formula? (Works Contract of the FDRE Public Procurement Agency)	80	2
11	Is escalation in prices of construction material, labor & equipment, a major cause of cost over-run of the construction projects?	135	3.375
12	Do you think that the price adjustments through the Index Formula (FPPA works contract) truly replace the amount of change of price of inputs?	110	2.75
13	Is the "Invoice Method" (in which the contractor submits the actual purchase invoices of the material on which he will be paid the cost difference of the current rate and the rate at the time of tender) more effective than the Price Adjustment Formula method currently applied on the FPPA's works contract?	92	2.3

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No.	Questionnaires	Sum of ranked Score ΣR_i	Mean of the Ranks \hat{R}_i
14	Do you think that the contractor could get unfair advantage by manipulating with the purchase dates, when using the “Invoice Method”?	114	2.85
15	Do you think that the “Invoice Method” cannot be effectively applied in Ethiopia because of less government control on proper invoices?	138	3.45
16	Could it be difficult for clients/consultants to check & verify the invoices submitted by the contractors?	118	2.95
17	Does the price Adjustment Formula currently applied on the works contract of FPPA provide fair environment to all the parties?	111	2.775
18	Do the parameters on the formula clear and data available to deal with?	115	2.875
19	Do you think that price adjustment formula of FPPA Works contract simple and clear?	114	2.85
20	Is it right that the contractors have more advantage by the application of price adjustment formula?	101	2.525
21	Do you think that client/owner have more advantage through the price adjustment formula?	88	2.2

Table 3.5 Ranked Score of the Likert Scale Questionnaires

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3.2.1 Familiarity with Price Escalation Process

The First question was designed to know that how much familiar the different categories of stakeholders are with price adjustment process. The results show that almost 42 % of the respondents are on the higher level of agreement (“High/Very High”) in their familiarization with the price adjustment process and the remaining 58 % do not have frequent exposure to the price adjustment process.

Familiarity with Price Adjustment Process			
Likert Scale	Frequency	Percentage	Cumulative % age
Very Low	5	12.5	12.50
Low	18	45	57.50
Moderate	9	22.5	80.00
High	5	12.5	92.50
Very High	3	7.5	100.00

Table 3.6 Familiarity with Price Escalation and Price Adjustment Process

Study on the Practices of Price Adjustment in Ethiopian Building Construction

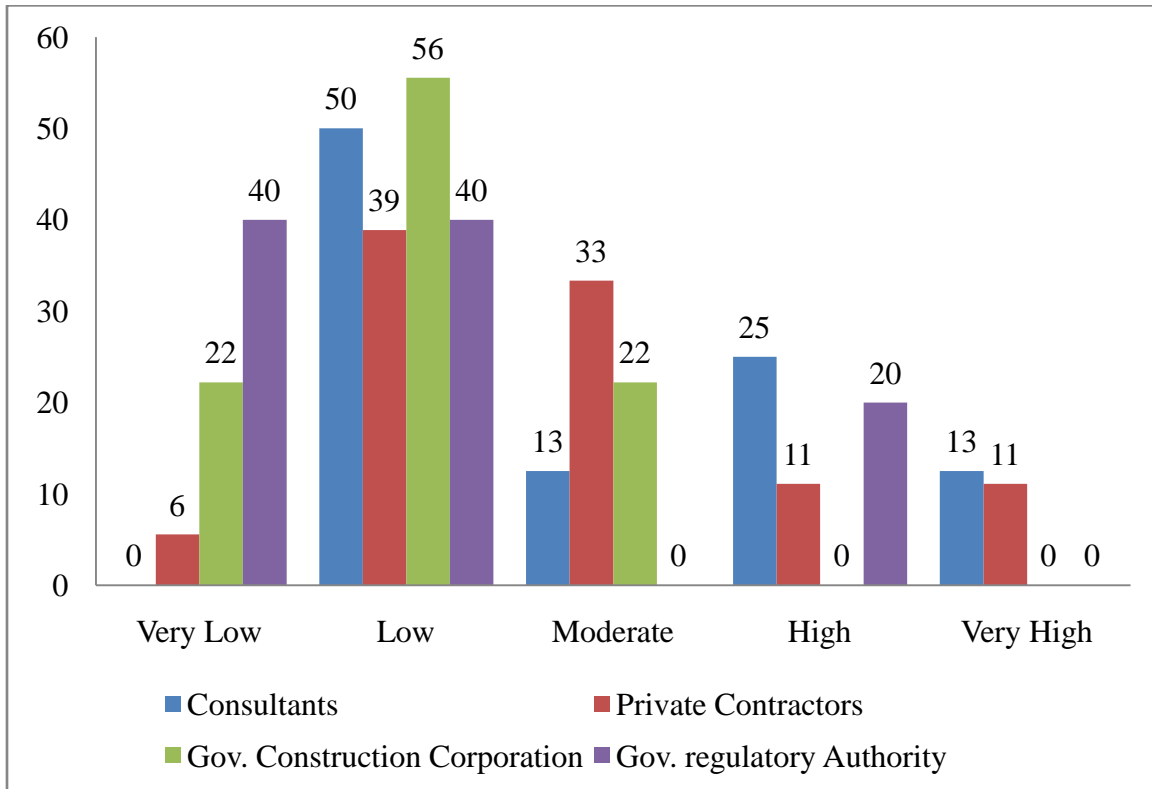


Figure 3.4 Familiarity with Price Escalation and Price Adjustment Process

3.2.2 Knowledge of Dealing with Price Adjustment Process

The respondents were asked about the education, engineers are provided during their studies, regarding price adjustment process. The results show that almost 68 % of the respondents are on the higher level of disagreement (“Very Low/Low”) in the provision of sufficient education on price adjustment process during their studies and the remaining 32 % agree in the provision of sufficient education in the price adjustment process.

Study on the Practices of Price Adjustment in Ethiopian Building Construction

Knowledge of Dealing with Price Adjustment Process			
Likert Scale	Frequency	Percentage	Cumulative % age
Very Low	13	33	33
Low	14	35	68
Moderate	7	18	85
High	5	13	98
Very High	1	3	100

Table 3.7 Provision of Enough knowledge on Price Adjustment Process

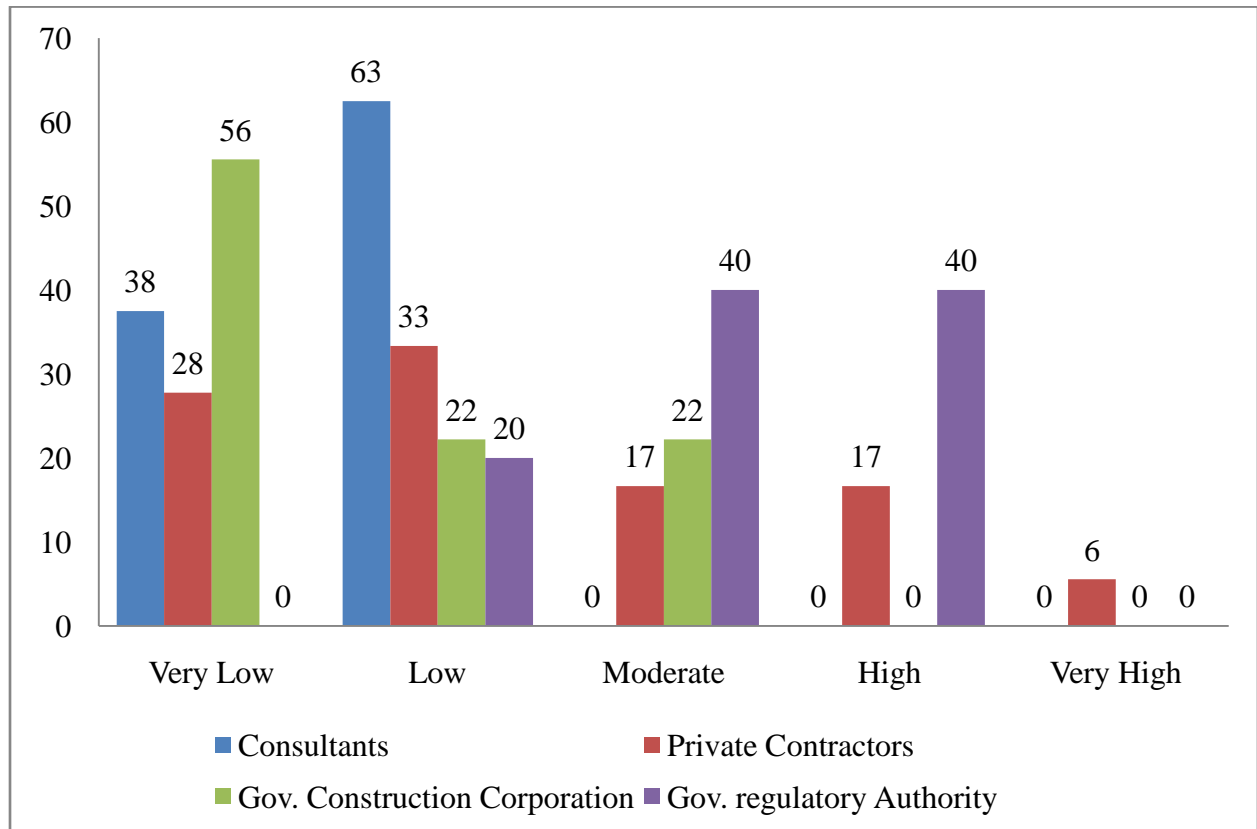


Figure 3.5 knowledge of Dealing with the Price Adjustment Process

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3.2.3 Respondents Practice on PPA's Price Adjustment Formula (Works Contract of the FDRE Public Procurement Agency)

The respondents were asked if they have ever been practiced on price adjustment formula with PPA's works contract. The results show that almost 68 % of the respondents are on the higher level of disagreement ("Very Low/Low") in the provision of enough knowledge on price adjustment process during their study and the remaining 32 % agree in the provision of enough knowledge in the price adjustment process.

Knowledge of Dealing with Price adjustment Process			
Likert Scale	Frequency	Percentage	Cumulative % age
Very Low	13	33	33
Low	14	35	68
Moderate	7	18	85
High	5	13	98
Very High	1	3	100

Table 3.8 Practices on the PPA's Price Adjustment Formula

Study on the Practices of Price Adjustment in Ethiopian Building Construction

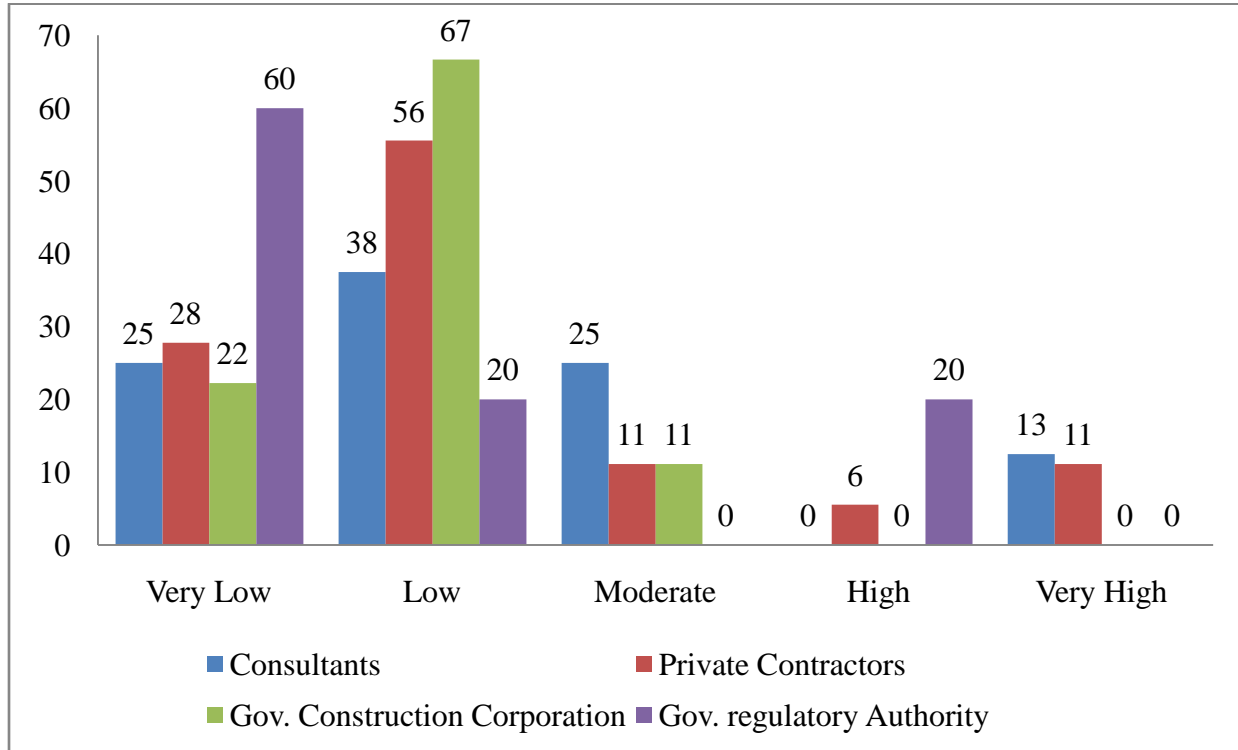


Figure 3.6 Practices on the PPA's Price Adjustment Formula of Each Category

3.2.4 Opinion of Respondents on the Application of the FPPA's Price Adjustment Formula

In the part of the questionnaire where respondents were provided with multiple choice 47.5% of the respondents replied that application of the price adjustment to be effective, and 10% of them have responded to be not effective and the remaining 42.5% of the respondents replied that the formula is complicated. This shows that a significant percentage of the respondents need simple and clear approach on the formula.

Choices	Frequency	% age	Cumulative % age
Effective	19	47.5	47.5
Not effective	4	10	57.5
Complicated	17	42.5	100

Table 3.9 Respondents' Opinion on the FPPA's Price Adjustment Formula

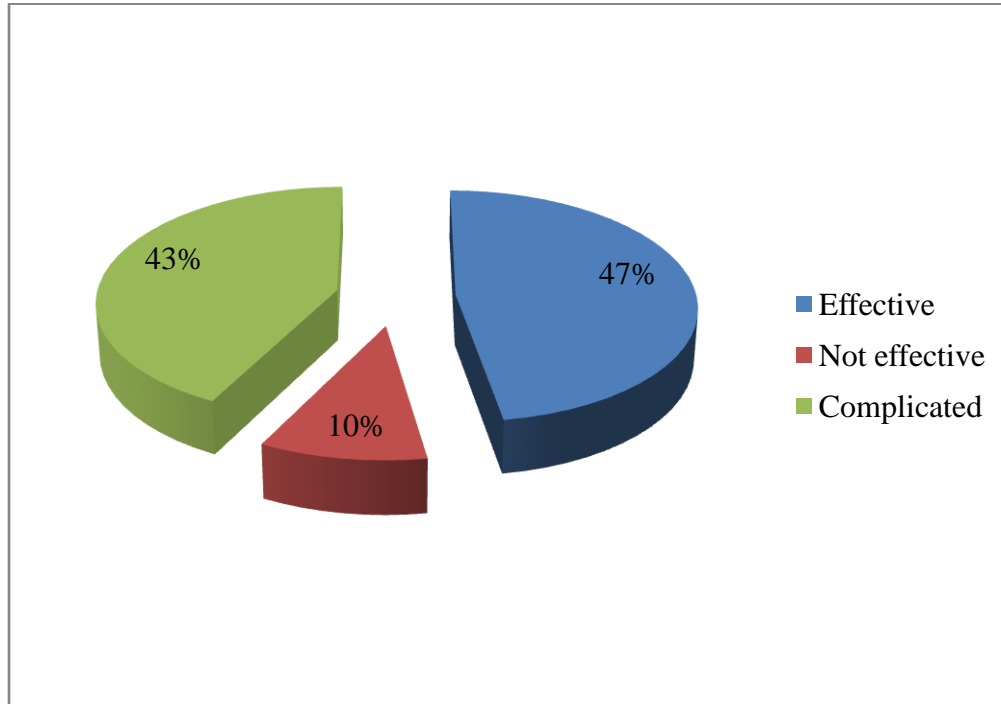


Figure 3.7 Respondents' opinion on the FPPA's price adjustment formula

3.2.5 Respondents reply to the type of price document used during adjustment

In the part of the questionnaire where respondents were provided with multiple choice for the question on the type of price document used during the process of the price adjustment 17.5% of the respondents replied that “price indices published by the Ethiopian central Statistics Agency” are being in use, 25% of the respondents replied that “Invoices/ Receipts from suppliers submitted by the contractors within the project period” are being in use, 12.5% responded that “Current prices published by Contractors’ association or construction magazines” are being in use and the remaining 37.5% of the respondents replied that any one of available document from all the listed here are being in use.

As per this finding the respondents inclined to the use of Invoices/receipts from suppliers i.e $25\%+37.5\% = 62.5\%$ and the use of current prices published by contractors’ association or construction magazines i.e 8%, which show that professionals either are not in a position of using proper document as per the GCC 62.2 and 62.3 of the FPPA’s works contract or unaware

Study on the Practices of Price Adjustment in Ethiopian Building Construction

of the non-compliance of use of these documents as far as the General Conditions of Contract is concerned.

Choices	Frequency	% age	Cumulative % age
Price Indices produced by the Ethiopian Central Statistics Agency	7	17.5	17.5
Invoices/Receipts from suppliers submitted by the contractors within the project period	10	25	42.5
Invoices provided from producers	5	12.5	55
Current prices published by local Associations or construction magazines	3	7.5	62.5
Any of the above available documents can be used	15	37.5	100

Table 3.10 Respondents Reply to the Type of Price Document Used during Adjustment

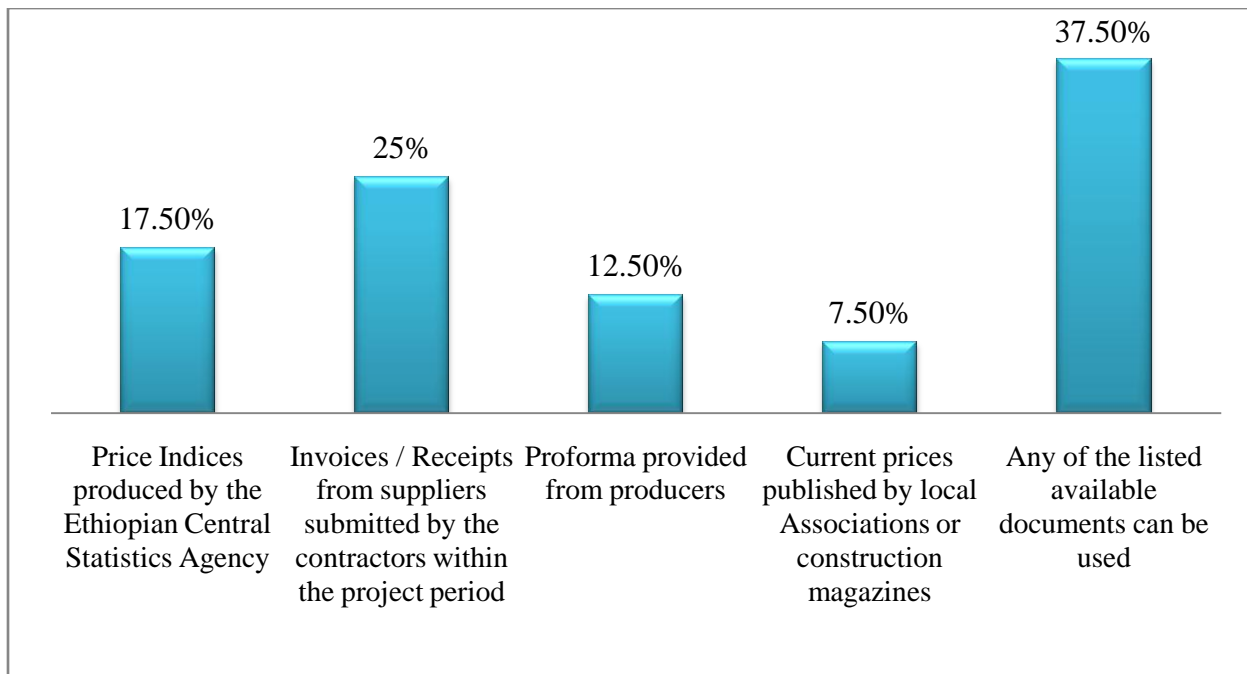


Figure 3.8 Respondents Reply to the Type of Price Document Used during Adjustment

4. Conclusions and Recommendations

4.1. Conclusion

The conclusion of this research is drawn based on the primary and secondary data analysis and discussion made in the previous sections.

The objectives of the research were to comment on the practices and procedures during implementation of price adjustments in Ethiopian Building Construction and develop a draft standard procedure for the price adjustment through literature review, desk study and questionnaire survey as a research instruments.

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

- The research has shown that there is a gap in the professionals' knowledge acquired during their study in the institution in the area of the price adjustment process.
- Experience of the professionals in the area of price adjustment process and the use of the price adjustment formula is lesser.
- The major problems faced by the professional towards the use of the price adjustment formula are:
 - ✚ Secondary data reveals that there is no uniformity in application or regulations set on the selected category of inputs that need compensation.
 - ✚ Even though issuance of the price indexes or price indicators has been given to Ethiopian Central Statistical Agency or Public Procurement and Property Administration Agency (General condition of contract of the FPPA works contract ,GCC 62.2) , there is still a big problem in finding of indices from similar sources to implement on the building construction industry.
 - ✚ The other provisions for the use of price indices from a renowned local producer or competent foreign institution (GCC 62.3) on top of the above provision still do not give solution for the building industry as the stakeholders mostly use inputs from the suppliers.

Study on the Practices of Price Adjustment in Ethiopian Building Construction

- ✚ Despite the directions set to the sources for price indices to be used on the FPPA's works contract (GCC 62.2 & 62.3), the industry still uses the prices from invoices of the suppliers which as per the secondary data analysis (letter from the FPPA regarding the use of price indices from the suppliers) is strictly forbidden by FPPA. However, such use of price indices from the suppliers or whole sellers and use of indices from foreign institutions has been seen in ERA's projects.
- ✚ The fraction for each specified element and exact combination of elements (weightings or coefficients of the inputs) are not usually predefined in the tender document (GCC 62.13) and this gives rise to non-uniform application of price adjustment formula in most government projects. The client shall provide this based on appropriate rate analysis.
- ✚ There is no developed guide line which shows the detail of qualifications and procedures that illustrates the application of the formula for the professionals.
- ✚ The FPPA's works contract specifies the adjustments of contract prices to 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. However, in some Fixed Contract projects like Universities, (due consultation, permission and prior approval given from FPPA), a price adjustment clause will be considered on the contract even if the contract period is below 18 months>

Study on the Practices of Price Adjustment in Ethiopian Building Construction

4.2. Recommendations

As the goal of this research was to study the practices of application of price adjustment formula in the construction of buildings under the FPPA works contract, some recommendations are listed below which can be useful for the industry and are results of the questionnaire survey and desk study.

- To provide professionals with sufficient knowledge of price adjustment processes, application of the clauses and the formula. Professionals Associations and Educational Institutions may hold seminars, trainings and workshops.
- Consultants / clients shall give special attention for the clauses and all the associated factors to be set during the tender preparation stage if the contract is proposed / subjected to price adjustment.
- The ranges of construction inputs admissible for price adjustment shall be sufficiently elaborated on the General/Special Conditions of Contract of the FPPA's works contract or through proclamation by the authorized public body for the proper and consistent use of the price adjustment processes.
- The problem of source of price indices could be minimized if the authorized public body (i.e Central Statistics Authority) timely publish the price movements of the construction inputs in Ethiopia (which it fails to provide sufficient information) or support the industry in getting price indices from competent international institutions.
- Care shall be taken by the entire stake holders on the success of projects for prices of construction inputs are very volatile with changes in dollar value in the context of Ethiopian Building industry. Failing to have proper system, procedure and data of the price adjustment process could affect delays in the payment processes and influence the financial flow of contractors which resulted in project delay.
- The rejection of price document (Invoices/Receipts) from suppliers for the use of price adjustment in governmental building construction projects for it is not mentioned in the clauses of FPPA's works contract need a strong justification and a clear direction may be important from the public body (FPPA) for the industry. Such price documents from the suppliers, Associations, Zonal Administration offices (for the case of local materials and labor), regional construction office are still in use for price adjustment.
- Provisions of weightings and coefficients (fraction of each specified elements and exact combination of elements, GCC 62.13) by the client during tender processing shall be exercised for the uniformity and ease of the price adjustment process.

Study on the Practices of Price Adjustment in Ethiopian Building Construction

- A record of the measurements of the works done is to be properly maintained to apply the corresponding monthly rates of the items on which price adjustment is to be paid. Payment request periods might not reflect the exact period of the works done.
- Further studies shall be carried out on the areas of determination of fraction of each specified elements and exact combination of elements (weightings), the non-adjustable and adjustable portions of the formula for different types of buildings and a standard set in this manner could help the consistent application of the price adjustment process in the area of building construction sector.

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Appendices

Appendix I

Draft Procedure of Price Adjustment Formula

Appendix II

Questionnaire

Appendix III

Documents and Evidences

DRAFT PROCEDURE

FOR

**APPLICATION OF PRICE ADJUSTMENT FORMULA AS PER THE FEDERAL
PUBLIC PROCUREMENT AGENCY WORKS CONTRACT
(SBD Works (NCB) version 1, August 2011)**

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DESCRIPTION

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I. The Formula

To determine the adjustment on each item any such price variation shall be calculated in accordance with the following formula (GCC Clause 62.12)

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

Where:

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

NV= The fraction which represents Non Variable element of the Contract Price that is free of contract price adjustment, as specified in the Contractor's Bid;

A = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Average Labor Category Earnings Index;

MLI = The most recently available selected Average Labor Category Earnings Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;

BLI = Benchmark Average Labor Category Earnings Index applicable to the Works either:

(a) at the bid closing date, or

(b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;

B = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Material Price Index

MMI = The most recently available selected Material Price Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;

BMI = Benchmark selected Material Price Index applicable to the Works either:

(c) at the bid closing date, or

(d) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;

C = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Equipment Price Index

MEI = The most recently available selected Equipment Price Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;

BEI = Benchmark selected Equipment Price Index applicable to the Works either:

(a) at the bid closing date, or

(b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;

D = The fraction of the Contract Price subject to adjustment in accordance with movements of the Average Fuel Price Index

MFI = The most recently available Average Fuel Price Index on the date on which the Public Body received notification of the proposed increased price from the Contractor;

BFI = Benchmark Average Fuel Price Index applicable to the Works either:

(a) at the bid closing date, or

(b) if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;

BC = Current Contract Price applicable to the Works

Q = Quantity;

And where:

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

II. Criteria & Parameters

Following criterion shall be furnished for application of the price adjustment.

1. The given contract shall be subjected to *price adjustment*.
2. The period of the project for a given contract shall be more than 18 months. (GCC Clause 62.1)
Note: Contracts below 18 months shall require an official permission from Federal Public Procurement Agency to incorporate a price adjustment clause at the time of tender preparation.
3. Adjustments of contract prices shall be allowed after twelve (12) months from the effective date of the Contract. (GCC Clause 62.1)
Note: Contracts below 18 months that have been given an official permission from Federal Public Procurement Agency to incorporate a price adjustment clause, adjustment shall be done based on the schedule given from the PPA.
4. *Contractor's Request:*
 - ✚ The Contractor may invoke price adjustment at any time during the Contract by notice in writing to the Engineer. (GCC Clause 62.3)
 - ✚ The Contractor submit to the Public Body for review and approval all calculations and *supporting information* necessary to determine the price adjustment.(GCC Clause 62.1)
5. All prices shall be firm unless the Contractor has provided claim for price adjustment.(GCC Clause 62.3)
6. If the completion of contract exceeds the original scheduled period: (GCC Clause 62.6)
 - a) **Case I:** *If the delay is due to the contractor,*
The rate of Price Adjustment will be frozen at the original scheduled date of completion and Price Adjustment will be applicable till actual completion.
 - b) **Case II:** *For no fault on the part of the contractor and an extension of time is given,*
The Price Adjustment will be payable in full for the extended period.
7. The price adjustment can only be done for specified items (inputs) listed on the special conditions of contract.

- 8. Sources of Price Indexes:** Only Indexes from following sources are allowed on the contract (GCC clause 62.8-62.9).
- a) The Federal Public Procurement and Property Administration Agency of Ethiopia:
 - b) The Ethiopian Central Statistical Agency:
 - c) When the above two sources are not in a position to issue current price indexes, following source can be used:
 - i. Price information available from a renowned Local Producers:
 - ✚ Price Index from a single source if the producer is a sole producer for that particular input.
 - ✚ Average of price indices if there are multiple producers of that particular input.
 - ii. Price information available from competent foreign institution

9. Coefficient (weightage) of specified Item of work

The fraction for each specified element and exact combination of elements that will be applied in the formula for price adjustment shall be determined in the Special conditions of Contract (GCC 62.13).

The coefficient for each specified element shall be calculated and given in the bidding or tender document (the proportions are commonly set in ranges) and the bidder will determine the coefficient for each adjustable element.

10. Base Date Price (Benchmark Price index applicable to the Works)

The base date price (or base date index) of any element shall be the price of the element

- at the bid closing date, or
- if the Contract Price has been adjusted previously, the date on which the Public Body received notification from the Contractor in respect of the last adjustment to effect the current Contract Price;

11. Current Date Price (The most recently available Price Index)

The current date price (or current date index) of any element shall be the price of the most recently available price of the element on the date on which the Public Body received notification of the proposed increased price from the Contractor;

III. Procedure

1. The billed amount of the works executed for each calendar month shall be timely collected from the Contractor and checked by the Consultant.

If the submitted bill amount is for more than one month, it shall be divided based on actual work executed in each month. During such situations, the consultant can use the monthly project report that is submitted to the Client.

Adjustment shall be done based on the period as specified on Section II (2 & 3) above.

2. Sources of prices will be as expressed on Section II (8) above.

The price adjustment will be done for each item of works based on the formula expressed on section I.

- a. Calculation of adjustable weighing coefficients :

Based on the type of item of work, one or a combination of the adjustable weighing coefficients of labor, material, Equipment and Fuel will be calculated.

These coefficient will be given on the contract document or will be calculated based on the cost breakdown used during tendering.

A = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Average Labor Category Earnings Index;

B = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Material Price Index

C = The fraction of the Contract Price subject to adjustment in accordance with movements of the selected Equipment Price Index

D = The fraction of the Contract Price subject to adjustment in accordance with movements of the Average Fuel Price Index

- b. Calculation of non-adjustable weighing coefficients :

NV= The fraction which represents Non Variable element of the Contract Price that is free of contract price adjustment, as specified in the Contractor's Bid;

The non-adjustable coefficient is either fixed and given on the contract document or will

be calculated based on calculated adjustable weighting coefficients as:

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

$NV= 1- (A+B+C+D)$

1.1. The Price Adjustment in the billed amount will then be calculated for the month under consideration in accordance with Formula for Price Adjustment.

IV. SAMPLE CALCULATION OF PRICE ADJUSTMENT FOR SELECTED
ELEMENTS IN A SINGLE ITEM OF WORKS WHEN PUBLISHED INDICES
ARE NOT AVAILABLE.

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1. SITE CLEARANCE

ANALYSIS SHEET FOR DIRECT & INDIRECT UNIT COSTS

PROJECT: EXCAVATION AND EARTH WORK.

WORK: 1' 20cm. Clearing on wet & black soil.

TOTAL QUANTITY: 1 m²

LABOUR HOURLY OUTPUT: 57.58 m²/hr.

EQUIPMENT: Tool 381.12

RESULT: 7.88 Birr/m²

Material Cost (1:01)				Labour Cost (1:02)				Equipment Cost (1:03)						
Type of Material	Unit	Qty *	Rate	Cost per Unit	Labour by Grade	No.	UF	Indexed Hourly Cost	Hourly Cost	Type of Equipment	No.	Hourly Rental	Hourly Cost	
				0	DL	4	1.00	10.50	42.00	Dozer	1.00	1912.15	1912.15	
				0	G.Chief	1	1.00	14.00	14.00	Tools	2.00	0.50	1.00	
				0	Foreman	1	0.10	40.38	4.04				0.00	
				0	Equipment	1	1.00	17.50	17.50				0.00	
				0					0.00				0.00	
				0					0.00				0.00	
				0					0.00				0.00	
				0					0.00				0.00	
				0					0.00				0.00	
				0					0.00				0.00	
Total (1:01)				0	Total (1:02)				77.54	Total (1:03)				1913.15

A= Mate 0 Birr/m²

B= Manpower Unit Cost 1.28432 Birr/m²

C= Equipment Unit Cost 5.02 Birr/m²

Total of (1:02)

Total of (1:03)

Hourly Output:

Hourly output

Direct Cost of Work Item = A+B+C =

6.30 Birr/m²

Over head cost:

0.15 0.95 *

Profit Cost:

0.10 0.63 *

Total Unit Cost:

7.88 Birr/m²

Remark

UF: UTILIZATION FACTOR

*: INCLUSIVE OF WASTAGE, TRANSPORTING, HANDLING, ETC.

** : INCLUSIVE OF BENEFITS, TRAVEL SUBSIDIES AND COST OF OVERTIME RELATED TO TARGETED OUTPUT.

7.878754

FN	DL	MASON	CARP	DIESEL
	0.7294674			
	0.2431558			1.51
	0.0701411			
	0.3039448			
SuM	1.3467091	0	0	1.61
Sum/Rate				
0.63	0.17	0.00	0.00	0.20

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Item no	Description	Unit	Contract Qty	Excuted Qty	Existing Unit Rate	Excuted Amount	Contract Amount	Adjusted Rate	Difference	Adjusted Amount	Formula	FN	DL	MA	Carp	Dise	Regu lar	Cem e	Sand	Grav	Refo 6-10	Refo 12-24	Ston e	Pla stic paint
			CQ	BQ	BC	EA	CA	PA=FX(BC)/Q	D=PA-BC	AA=DxQ	F=(N V+Ax (MLL/ RL)+	NV		A		D								
A-SUB STRUCTURE																								
1.0 EXCAVATION & EARTH WORK																								
1.01	Clear and remove top soil to an average depth of 200mm.	M ³	15,214.63	30,351.59	7.88	240,708.46	119,872.29	8.22	0.35	10,542.93	1.04	0.63	0.17			0.20								
1.02	Bulk excavation in ordinary soil from reduce level to a depth not exceeding 1500mm.	M ³	18,316.83	39,442.28	59.04	2,328,561.12	1,081,373.89	63.75	4.72	186,029.21	1.08	0.53	0.26			0.20								
1.03	Ditto to item No 1.02 but exceeding 1500mm but not exceeding 3000mm.	M ³	13,642.33	7,695.29	67.47	519,209.26	920,464.08	68.36	0.88	6,806.16	1.01	0.70	0.09			0.20								
1.06	Pit excavation in ordinary soil to a depth not exceeding 1500mm from ground level.	M ³	3,349.08	1,917.92	75.32	144,465.84	267,332.19	79.36	4.03	7,731.16	1.05	0.60	0.20			0.20								
1.08	Ditto to item No 1.06 but exceeding 1500mm but not exceeding 3000mm.	M ³	3,337.22	9,868.31	86.08	849,511.91	287,284.34	90.69	4.61	45,458.14	1.05	0.60	0.20			0.20								
1.11	Ditto to item No 1.06 but exceeding 3000mm but not exceeding 4500mm.	M ³	380.14	21,384.73	100.43	2,147,719.07	58,264.83	101.52	1.09	23,228.53	1.01	0.71	0.09			0.20								
1.15	Fill around foundation with imported selected material from quarry wast well rolled and compacted in layers not exceeding 200 mm thick.	M ³	6,016.02	31,840.13	301.87	9,611,523.83	1,816,046.24	313.73	11.87	377,796.31	1.04	0.62	0.16			0.22								
1.16	Fill under hard core in non expansive material from the quarry waste well rolled and compacted in layers not exceeding 200 mm thick.	M ³	4,181.71	4,328.14	301.87	1,306,528.68	1,262,326.81	313.73	11.87	51,355.20	1.04	0.62	0.16			0.22								
1.17	Load and cart away surplus excavated material to an appropriate tip.	M ³	41,149.04	86,418.84	61.44	5,309,573.74	2,528,196.84	61.58	0.14	12,500.95	1.00	0.39	0.14			0.46								
1.18	250mm thick basaltic stone hardcore well rolled, consolidated and blinded with crushed stone.	M ³	8,660.72	7,701.32	127.25	979,979.27	1,102,060.89	153.39	26.14	201,290.84	1.21	0.30	0.21	0.14		0.16								0.19
TOTAL CARRIED TO SUMMARY						23,437,781.17	9,443,222.40			922,739.42														

- Calculation of Weightages

Data on the cost break down

Types of labor: Daily Laborers, Gang Chief, Forman, and equipment Operator

The total labor hourly output = 57.58m²/hr (the crew output)

Hourly cost of each labor force:

DL (total number =4) =42 birr

Forman = 4.04 birr

Gang Chief = 14 Birr

Equipment Operator = 17.50 Birr

Calculation of Ratio (fraction) of daily Laborers

DL = 42/57.58 = 0.7295

Forman = 0.0701

Gang Chief = 0.2432

equipment operator = 0.3039

Sum of fraction of DL = 0.7295 + 0.0701 + 0.2432 + 0.3039=1.3467 B/m²

The fraction of the Contract Price subject to adjustment in this item of works in accordance with movements of the selected Average Labor Category Earnings Index;

A (DL Fraction) = Sum of fraction of DL / Rate = 1.3467/7.88 = **0.17**

Calculation of Ratio (fraction) of Diesel for Dozer

Type of equipment: Dozer

Hourly rental = 1912.15

Hourly cost = 1912.15

Equipment hourly output = 381.12

D (Diesel Fraction) = Diesel hourly cost/ Equipment Output *(Ratio of Fuel cost over sum of Fuel + Rental cost)

$$= 0.32*1912.15/381.12$$

$$= \mathbf{1.61}$$

The fraction of the Contract Price subject to adjustment in this item of works in accordance with movements of the selected Average Fuel Earnings Index;

D (Fuel Fraction) = Sum of fraction of Fuel / Rate = 1.61/7.88 = **0.204**

Calculation of Adjusted Amount (PA)

Adjustment factor $P_n = (NV + A * (\text{Base price}/\text{New price}) + D * (\text{Base price}/\text{New price}))$

Fraction of the Non Adjustable Factor, $NV = 0.63$

Fraction of the Laborers, $A = 0.17$

Fraction of the Fuel (Diesel), $D = 0.2$

Base Price /Current Price of DL = 1.4

Base Price /Current Price of Fuel = 0.88

$P_n = (0.63 + 0.17*(1.4) + 0.2*(0.88)) = 1.044$

Adjusted Rate = Base rate * $P_n = 7.88 * 1.044 = 8.22 \text{ B/m}^2$

Adjusted Amount ,PA = $P_n * \text{Executed Quantity} * (\text{Difference of Adjusted rate} - \text{Base rate})$

$PA = 1.044 * 30,551.59 * (8.22 - 7.88) = \mathbf{10,542.93 \text{ Birr}}$

Similarly, the adjustment is done for each item of works and a summary of payment for price adjustment will be summarized.