



**JIMMA UNIVERSITY
JIMMA INSTITUTE OF TECHNOLOGY
SCHOOL OF GRADUATE STUDIES
FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING
CONSTRUCTION ENGINEERING AND MANAGEMENT CHAIR**

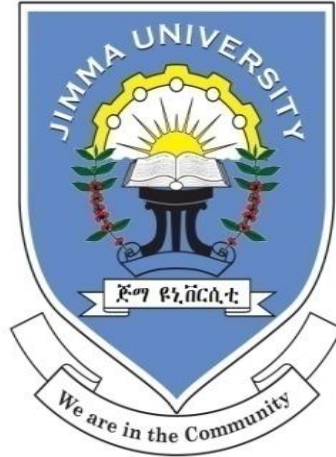
**INVESTIGATION OF PRICE ESCALATION AND ITS
MITIGATION MECHANISMS ON SELECTED BUILDING
CONSTRUCTION PROJECTS OF JIMMA UNIVERSITY**

By

Hamelmal Mekonen

A thesis report submitted to school of graduate studies of Jimma University
Jimma Institute of Technology Faculty of civil and Environmental
Engineering in Partial fulfillment of the requirements for the Degree of Master
of Science in Construction Engineering and Management

September, 2020
Jimma, Ethiopia



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Investigation of Price Escalation and Its Mitigation Mechanisms on Selected Building
Construction Projects of Jimma University

Declaration

This thesis is my original work and has not been presented for a degree in any other University

Hamelmal Mekonen

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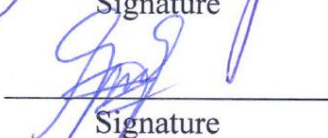
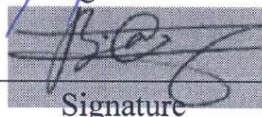


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Abstract

The construction industry in developing countries is the major contributor to the countries' overall economic development and hence requires huge investments. Project success is dependent on executing the projects within the planned time, cost and quality specifications. However, most construction projects are subjected to cost escalation from original approved cost. Price escalation in construction refers to the increase in the cost of any construction element of the original contract or base cost of a project. Price escalation is a serious issue for all parties of construction including clients, contractors and consultants. The cost monitoring of construction projects should be an ongoing process that should be applied every time in all projects since the causes of price escalation differs from project to project and according to stages of construction.

The objective of this study was to assess the price escalation, factors responsible for escalation and mitigation mechanisms in selected construction projects.

Questionnaire survey of twelve workers, interview of seven key informants and a detail case study of one project have been conducted from February 01 to 30, 2020 G.C on four selected Jimma University construction projects which were labeled from Project A to Project D. The main outcome variable, price escalation, was measured as the difference between the actual cost and adjusted bid cost. Data was entered and analyzed using SPSS version 20 and excel. Descriptive statistics like frequencies, percentages, ranges and mean was used to summarize the data. Relative importance Index scores have been generated and ranked for each of the factors affecting price escalation to see their relative importance.

In this study it has been obtained that there was a moderate level of price escalation. Different factors were responsible for the price escalation. The prominent factors that are responsible for the observed price escalation were delay, price increase of construction inputs/inflation, decision delays, delayed material delivery, variation orders, foreign exchange rate/devaluation as well as poor planning and estimation. Majority of the factors were controllable with the due efforts of the contracting parties. The mitigation modalities the projects have been following included inserting escalation clause in contractual agreements, adjustment and claiming for finance and time extension. But they were seemingly not proper ways since they only give the legal basis for decisions and solving legal disputes rather than mitigating the escalation. Therefore, it is recommended that project scope determination, design approval as well as forecasting of feasible time and cost of the projects should be done before contract is signed. After work is started fast decision and approval of requests, close monitoring of progress of work as per predetermined work schedule and in advance procurements can have significant effect on mitigating the price escalation.

Key words: *Actual Cost, Adjusted Bid Cost, Escalation, Mitigation, Price*

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Acronyms

ABC	Adjusted bid cost
AC	Actual cost
BC	Bid cost
CPI	Consumer Price Index
EBR	Ethiopian Business Review
ETB	Ethiopian Birr
F/PPA	Federal/Public Procurement Agency
G/SCC	General/specific condition of contract
HCB	Hollow concrete block
OPC	Ordinary Portland cement
PE	Price escalation
PPC	Portland Pozzolana Cement
PVC	Polyvinyl Chloride
RII	Relative Importance Index
URS	United Research Services

CHAPTER ONE

INTRODUCTION

1.1 Background

The construction industry is a major contributor of the economy in developing countries. This is because the construction industry builds the infrastructures for other sectors, creates employment opportunities, transfers technology and entrepreneurship since construction in developing countries takes place in all parts of the countries [1].

Ethiopia is a developing country where huge development activities are remained to be done. One of the key factors that facilitate the realization of a desired level of development in a developing country like ours is investment in the infrastructure development where by the construction industry is a front-line role player [2].

It is always important to understand and measure the concepts and various aspects of cost escalation so that different remedial actions would be taken to reduce the effects of escalation. To effectively measure and manage of cost escalation one needs to thoroughly understand the deriving factors [3].

Cost escalation is defined as ‘changes in the cost of specific goods or services in a given economy during the execution of a project’. It occurs when actual costs of a project or any of its components exceed the previously estimated values which, in most cases, is the bid price. Bid prices may not reflect actual needed prices because there are always fluctuations in the cost of materials and labor. Besides it is good to understand construction or buildings as a commodity in itself, not a collection of commodities. Referring this some scholars argue that “cost escalation comes from the combination of real or predictable changes, input costs, and observation of risk and perception of competition” [3].

A Pakistani study, citing different researchers as a source, described that cost escalation is inevitable in large construction projects. Cost escalation usually counterbalances the contributions of the construction industry to the economy. Because of the multitudinous of factors causing price escalation it is always advisable to conduct studies that will help to identify factors responsible for price escalation [6].

Price escalation could be prevented and its effects can be minimized by making the client, consultant, and contractors aware of it, reducing delays, maintaining stable work force and establishing partnerships with subcontractors. Three different reasons have been reported, in the case of transport related infrastructure projects, as factors causing price escalation. One of the main reasons was found to be the length of the implementation phase of the project. Size of the project was the second reason. Thirdly it was found that private ownership was effective in curbing cost escalation whereas public ownership is problematic. In other way factors like lack of equipment, lack of software, lack of experience, inaccurate time and cost estimate, equipment breakdown and material shortage were reported as the reasons for cost overrun of construction projects. Minimization of internal administrative problems like reducing payment delays, developing good communication between construction parties and good decision making at the right time can narrow down the gap of the construction cost overrun [3].

One study revealed that the construction project management in Ethiopia with regard to application of general project management procedures, project management functions, tools & techniques is unsatisfactory. Specifically risk and time management practices are very low and there is significant deviation of schedules, costs and qualities from predetermined requirements [7]. This report has provoked the interest of the researcher about the need of this research. Because if there are these problems, it is highly probable that there would be price escalation among construction projects. Hence the presence of price escalation, its magnitude if any, and related factors needs proper exploration and investigation.

Therefore, the main purpose of this research was to synthesize general understanding about problems related to price escalation among construction projects with the goals of uncovering the status of prices escalation, the reasons why escalations occurred and how the contracting parties were responding to or mitigating it.

1.2 Statement of the Problem

Scholars described an Ideal type of construction project as the one which is competitively bid, constructed with no change orders and without increase of cost above

the original bid cost [28]. If projects fail to address these issues, it refers to the presence of some sort of problem/s.

Price escalation is counted as a common problem and became a cause for projects completion with huge cost overrun (requiring higher budget than estimated), extended completion time or project delay, inferior quality deliverables and contract termination. In other way delay means a time overrun either beyond the contract date or beyond the date that the parties have agreed upon for the delivery of a project. When there is construction delay the client will face loss of revenue, diminished productivity, reliance on only the existing facilities, etc. As the same time contractor will suffer higher costs, extended duration of work, increased costs of labor, material and equipment and as a result reduced return to investment or poor profitability. Completion of construction projects on specified time or time agreed by the parties indicates their efficiency. The delays in construction projects happen because of various factors or causes. These causes lead to the delay in construction completion, and this delay ultimately leads to negative effects on the construction project. A study in Japan stated that when cost escalates, it would result in chaos of budgetary and fiscal plans and unpredictability of the construction market [4].

In Ethiopian construction practice, it is very rare that construction projects are completed on the time specified or agreed upon. Today's construction projects require modern construction technique, technological equipment's, qualified professionals and large amounts of modern construction materials. Therefore, too much amount of money is required and invested to implement the projects. In addition to this much money fall under risk since construction business is risky one. This statement is highly supported by a report of the Ethiopian Business Review (EBR) magazine. The EBR, referring the report of the office of the Auditor General, has reported that delays of 290 mega projects in the country has forced the nation to suffer 44.2 Million Ethiopian birr (ETB) as an additional spending. Reporting the details, the EBR has further indicated that 32 projects have been delayed for more than five years, 54 projects were suspended for up to five years, and while another 208 were delayed up to three years. Top on this what is very annoying is that 16 projects have been terminated, according to EBR, after 246.5 million birrs have been invested of them. The EBR, seemingly indicating the causes of this uncertainties, has further

mentioned that the construction projects were started without proper feasibility studies [5]. A professional statement about the construction sector indicated that in the study area there is shortage of construction inputs like aggregate, cement and fabricated walls because of which the cost overrun of construction projects reach up to 28% [20].

Hence unless a project is not successfully implemented in quality, cost and time, it may cause serious damage (moral as well as financial) among the contracting parties. Evidences on the construction projects in Ethiopia showed that there are 61 -80% of schedule deviations and 21-40% deviations with regard to cost and other variables such as risk, quality, resources utilization and safety [7].

In Ethiopia few researches have been conducted on cost escalation and cost performance of projects. But these researches either mainly focused on the road sector or those which was on the construction sector used only a survey of experienced professionals, considering only those professionals who had five and more years of experience. The problems of prices escalation in the building construction sector is not well studied as to the researcher's knowledge. The focuses of this study were, therefore, to assessment of price escalation, to explore reasons for price escalation and identify mitigation mechanisms for price escalation.

1.3 Research Questions

1. Was there price escalation among building construction projects? If yes how much was the escalation? If no what can be learnt from how the projects achieve this?
2. What were the major factors contributing for price escalation?
3. What mechanisms did the projects use to mitigate the price escalation they faced?

1.4 Objectives

1.4.1 General objective

The main objective of this study was to investigate price escalation and mitigation mechanisms on selected building construction projects of Jimma University

1.4.2 Specific Objectives

1. To assess price escalation problems on selected building construction projects of Jimma University
2. To investigate reasons for price escalation on the selected construction projects

3. To identify escalation mitigation mechanisms on the selected construction projects

1.5 Significance of study

This study was conducted with the aim of generating evidence of price escalation, reasons for price escalation and escalation mitigation mechanisms on building construction projects. The main utilizers of the findings of this study include the different stakeholders of the construction industry like clients, contractors and consultants. Therefore, the study is significant for the following reasons:

- It may benefit the different stakeholders involving in construction projects in general and particularly building construction projects by providing price escalation and related information for their decision making and operation.
- It helps owners, contractors and consultants to know what price escalation related problems mainly occur in building construction projects and to take remedial measures to reduce its impacts once the problems occurs.
- It identifies the factors which lead to the occurrence of price escalation problems and what advisable methods are available to manage price escalation in Building construction projects.
- It may relieve the problem from failure of construction buildings due to unsuitability of materials and equipment which has low quality of materials. It can also serve as a basis for further studies on the topic or related developmental issues of the construction industry.

1.6 Scope of the Study

This particular research was conducted on investigation of price escalation, causes of escalation and its mitigation mechanisms. The study focused on construction projects in Jimma University which includes a total of four projects, three of which were ongoing and one completed, which were selected to represent the different construction projects under the University. The projects were selected because they were very huge projects which are owned by one public client, Jimma University. They were geographically very related and their starting time was similar, hence it is logical to study these projects together. Generally, the scope of information was obtained from questionnaire survey, In-depth interview and document review of built in data of exiting construction project. Some detail information

was obtained by in-depth interview from key informants. That means the study incorporated both cross sectional data and longitudinal data as well as opinions of workers and raw facts from documents. Therefore, both primary and secondary data were utilized.

1.7 Limitation of the Study

Since this study is limited to few projects which are owned by one client it may not represent the total situation of projects in the study area. Moreover, since only descriptive study is used the factors identified it did not assess statistical association even if the factors have practical significance. Besides, since the studied projects are mainly ongoing projects and the study design is a cross sectional study the level of price escalation reported showed only the current status. That means the figures do not represent the future values that appear when the projects will be complete.

CHAPTER TWO

LITERATURE REVIEW

2.1 Price Escalation and Construction

Cost escalation has been defined by different scholars like Ali Tourna et al [21] and Charistoper H Kiwus et al [28] in a similar way. The former defined cost escalation as the increase in the cost of any construction elements of the original contract or base cost of a project. The latter defined the term in similar way except adding that passage of time is a defining variable, i.e. the change in cost of construction elements as time passes [8].

Project success, and hence the aim of project management and need of clients, is completion of projects within time, budget and with required qualities [9]. Construction projects are very complicated, dynamic, full of uncertainties and prone to cost escalation. They are either late, exceed budget or fail to meet clients' expectations. There are always competing pressures between time and budget [2, 9].

According to a study done in Ghana, cost escalation is very sensitive in developing countries since there is scarcity of resources [10].

2.2 Price Escalation

2.2.1 Definitions

In this study the term price is preferred than cost. Because the two terms are substantially different. While cost refers to the market monetary values of the construction inputs price refers to the selling price of the project or a cost-plus value. Price includes, in addition to the cost, the profit and opinions of the contractors, including opinions on the change in market price of inputs, opinions on other competitors price and opinions on other uncertainties. Generally speaking, cost can be equated with the level of the floor while the price is the ceiling [29].

Different definitions of price escalation have been provided by many researchers in construction industry and some examples are presented as follows.

- Price Escalation in one research has been defined as an increase of cost of any construction elements from its original contract and base cost of a project in response to passage of time (30).

- In another way escalation can also be defined as the change in price, over given period of time, of goods and services operating in an economy. Construction price escalation is therefore understood as the situation when the money required to construct a project exceeds the original budgeted value [31].
- Others defined it as the economics-driven changes in price levels (of construction inputs). It occurs in response to change of economic conditions or price drivers like technology and productivity as well as conditions of the market like increased demand, shortage of labor and profit margins. Escalation also includes effects of, but are not similar, inflation or price change as a result of devaluation debasement of currency [33].

Most researchers used different words like price escalation, price overrun, cost escalation and cost overrun interchangeably. For this research price escalation is the preferred term and it can be understood as difference of final cost of the project that the contractor received and the base or contract cost of the project because of an increase in the cost of equipment, material, labor, as well as other factors of production due to ongoing price changes over time.

2.2.2 Measurement

The measurement of price escalation in the construction sector uses different approaches. One way is elicitation of the perception of construction workers which is done by asking the different workers like different professionals, the contractor, the client, the technicians and materials suppliers using a structured questionnaire [12, 15].

Another way might be conducting intensive literature review to identify factors associated with cost escalation of construction projects which then be followed by categorization of the factors. These two steps will be followed by asking construction stakeholders to rate which factors they think are very important [13].

A study suggested that the magnitude of price escalation can be calculated as percentage using the formula $\Delta = \{(TEPC - TBC) / TBC\} * 100\%$ where by Δ is the percentage of price escalation, TEPC is the total escalated program cost (or we can say the final actual cost) and TBC is the total base cost that is the budget or we can take it as contract cost [21].

2.2.3 Magnitude

As cited in Malaysian study, only 46.8% of public and 37.2% of private projects have completed their project with budget. This implies that more than half of the public projects and nearly two third of private projects experience price escalation. It has been reported that the magnitude of price escalation among construction projects in Malaysia ranged from 0.03% to 72.88% [14].

A study done on road construction projects in Ethiopia showed that the price escalation among the studied projects is very magnificent. The price escalation ranged from 4.16% to 83.2%. The average magnitude of price escalation of among the studied projects was found to be nearly 21.52% [15].

2.3 Factors Causing Price Escalation

Different literatures show that wide varieties of risk factors influence construction costs and result in substantial increase of project costs than originally budgeted. Expressed as a percentage of estimated cost, this is often termed cost escalation, cost overrun or cost growth, and occurs as a result of many factors some of which are related to each other, but all are associated with some forms of risks [11].

One study done in Nepal showed that 27% of price escalation in construction is the result of escalation in construction inputs [2].

A study in Pakistan identified that a number of factors play a role in determining cost escalation. In this study cash flow and financial difficulties, slow payments, inflation, fluctuation in material prices, and number of change/extra work orders were considered as major factors responsible for cost escalation [6].

Price escalation is a major problem in both developed and developing countries. Several studies of major projects show that price escalation is common. The causes of price escalation in construction projects vary, some projects are as difficult to manage as it is hard to predict. Price escalation does not occur only during the planning and design phases of a project. It often manifests itself during construction. Focusing early on internal factors will reduce cost growth at bid time or during construction [11].

One literature, mentioning URS Corporation, indicated that inflation and escalation, though related, are not interchangeable. While escalation can be driven by

general inflation related to the money supply, escalation is also driven by changes in technology, practices, and particularly supply-demand imbalances that is specific to a good or service in a given economy. For example, while general inflation reflected in the Consumer Price Index (CPI) in the US was less than 5% for 2003- 2007, steel prices escalated by over 50% because of supply-demand imbalance [11].

According to Queensland Government Department of housing and public works, market forces that are reflected as increases in the cost of labor/materials and higher levels of construction activity are determinant factors of building projects' price escalation [16].

There is similar evidence in Ghana which indicated that determinants of price increase like crude oil prices, energy cost, local taxes and charges, cost of fuel and power supply, high running cost, high prices of raw materials, cost of transportation and the high cost of labor are the characteristics of the construction market [17].

Another study done among capital projects in Ghana has identified five top factors responsible for cost overrun. These factors were price fluctuations, late material delivery, changes in the scope of work, fluctuations in the market demand, and changes in design. All the clients, contractors and consultants consistently rated the first two as first and second top priority factors respectively [18].

A study done among workers of building construction in Nigeria identified underestimation of actual cost during the budgeting, Inflation, not completing the project on time, within budget and with the appropriate technical or quality performance, extra cost incurred beyond the contractual cost as factors of cost overrun. Additionally, difficulty in obtaining construction materials, deficiencies in prepared cost estimates, unexpected subsoil conditions, problems in finance and payment arrangements, design changes and availability of skilled labor are the identified causes of cost overrun [12].

2.4 Mitigation Mechanisms

One study done among one hundred building construction workers in Nigeria came up with five important techniques to reduce or respond to price escalation. These mechanisms are application of project management scheduling tools, proper planning before execution of projects, working within the predetermined scope of the project, good

communication among construction project stakeholders and selection of contractors with experience and good financial capacity [12].

One paper described that every stakeholder (contractors and sub-contractors, consultants, clients etc.) in construction has roles in the mitigation of price escalation. It also narrated that even if there are different techniques of mitigating price escalation the application might differ. One technique working properly for one project may not be applied in another project in a similar way. But generally, it is possible to propose seven price escalation mitigating techniques namely contract, prequalification, schedule, purchasing, materials pre-purchase, value engineering alternates, and awareness of safety code, or project certification requirements during estimating [19].

A study done in Malaysian construction projects concluded that project delay and design change are two main causes of cost overrun. To mitigate cost overrun it suggested techniques that will prevent cost overrun and design change. The strategies recommended include ensuring detail project designs, making design changes with authorization of relevant project parties, having detail information on the complicated part of the project, and preparing detail material scheduling to prevent premature delivery of materials before due date [14].

When we summarize the literature review it revealed that price escalation is one and common uncertainties of construction projects. More over the reasons/causes of price escalation vary from project to project and they are numerous in number. But after reading the details of these different factors and their relationship with price escalation, the factors are crudely classified into three categories and depict their association with price escalation using the conceptual framework in the following page.

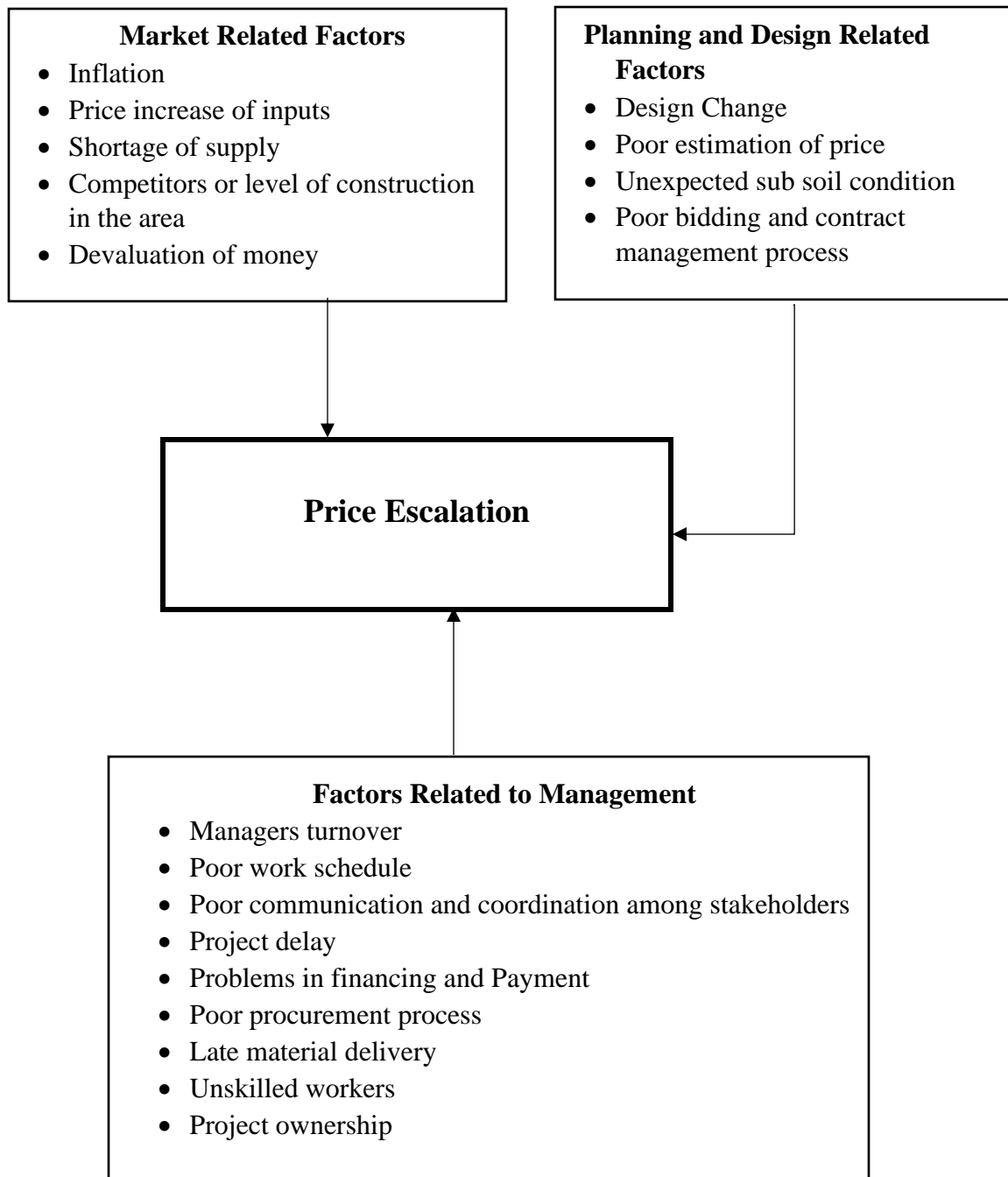


Figure 1- Conceptual framework of factors affecting price escalation in building construction projects which was developed after review of different literatures.

CHAPTER THREE

METHODS AND MATERIALS

3.1 Study area and period

This study was conducted in Jimma Town which is located at 352 KM distance to South West direction from the capital city Addis Ababa with a Latitude of $7^{\circ} 41' 3.59''$ N and Longitude $36^{\circ} 49' 31.79''$ E. In Jimma town different building constructions are underway. Among the major public owned building constructions in the area are the different construction projects of Jimma University. This study is conducted on four building construction projects owned by Jimma University. The study was conducted (data collection period) from February 01 to 30, 2020 G.C.

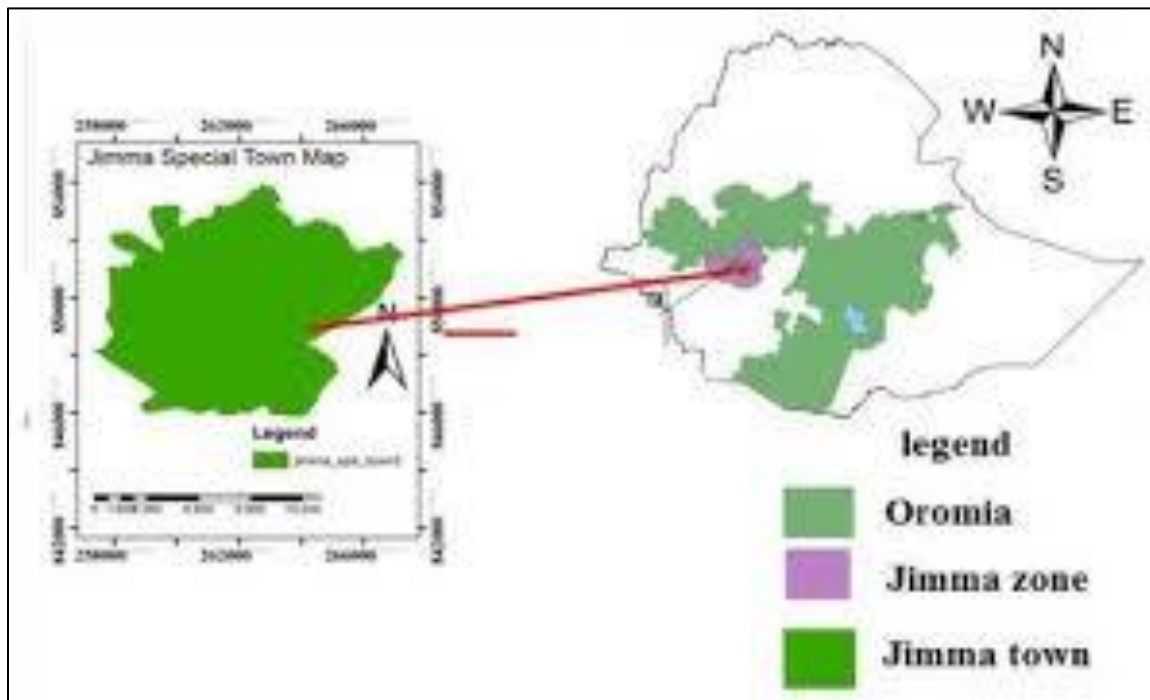


Figure 2- Map showing the location of the study area, Jimma town.

3.2 Research design

Both cross sectional and case study designs were employed in this research. The study involved both quantitative and qualitative data (concurrent mixed method).

3.2.1 Cross sectional study

This is a type of study design when the collected data reflected the reality of an event, situation, phenomenon or projects at a particular point in time (cross section of time). The reality may be different at another time. This research used survey and interview at February 2020, to obtain information about cost escalation, factors causing the escalation and mitigating mechanisms. The information obtained through these methods reflected only the situation of the specified time.

3.2.2 Case Study

Regarding the concept of case study Claire Davis and Aman Yadav asked a question as “What are ‘cases’ or ‘case studies’?” and they themselves gave the answer as “Cases are narratives that present real-life scenarios/problems and allow students to experience how professionals address problems encountered in the field.” These scholars mentioning another reference (Merseeth, 1994) put three main elements of cases: Cases

1. are based on real life events or realistic situations
2. present both contextual and technical information, therefore requires careful examination
3. may present no clear-cut solutions, hence helps to develop different perspectives or views as a solution

They further defined engineering case as “written account of an engineering job as it was actually done, or of an engineering problem as it was actually encountered . . . [and] it involves not only quantitative relations amenable to computations, but other subtler factors such as the interaction of people, the malevolence of inanimate objects, and the pressures of time and resources under which engineers work” [24].

Other group of scholars also described that case study is the study of phenomenon in real life contexts specially when it is difficult to identify boundaries between the phenomenon and the context [25]. Another group of researchers still mentioned that case study requires multiples variables and data sources [26].

Considering the above concepts this research employed a case study design. The case is one of the four projects under study (Project A). This research well explored the price escalation status, factors causing the escalation and the escalation mitigation

mechanisms in project A. Data were triangulated from different sources including different archives of the project like the contract document, the different financial reports, work schedules, different letters (like letters about time extension and variation orders), proforma sheets in addition to survey and interview. The case was selected because it better represents the other projects because it is a huge project both with regard to the cost and volume of work and its' work progress is substantially completed.

3.3 Population and Participants

This particular study focused on four selected projects of Jimma University which are labeled from Project A to Project D for the purpose of this study only. Mainly they are huge projects, geographically they are close to each other and their starting times were nearly similar. Besides they are owned by one public sector client, Jimma University. If they are studied separately without adding other projects, they will provide a clear and complete picture about the objective of study.

The population of the study included different stakeholders of the building construction projects. These different parties of these construction projects who were included as respondent of the survey questionnaire included representatives of contractors, consultants and clients. All the professionals from these three stakeholders can be considered as study population. Generally, they were twenty in number without including administrative staff like staffs of finance and human resource offices and subcontractors. The administration staff were not included assuming that they do not have much information about the price escalation, factors affecting escalation and mitigation mechanisms. The number was few because two of the projects are run by a single contractor and the other two projects by another contractor. For the case study the different working documents of project A can be regarded as a study population.

3.4 Sampling Technique

To obtain adequate information from different perspectives surveying of different respondents was issued. In each of the selected projects all site, construction and office engineers, surveyors, project managers, consultants and two representatives of the client were included to give a total of 20 survey respondents. Since their number is few questionnaires were distributed for all of them. For in-depth interview a total of 7

respondents including project managers, consultants and office engineers from each project were taken purposively. This sampling was with the assumption that they are richer in information about the study topic than other professionals in the respective projects. From voluminous working documents contractual papers, general Bill of Quantity (BoQ), claim of variation orders and time extension, schedules, the financial summary report from the last Interim Payment Certificate (IPC 39), proforma report sheets and salary increment letters were reviewed for the case study. Generally, the samples for each method of data collection are depicted in the following table.

Table 1- Samples taken for price escalation study, Jimma, Ethiopia, February 2020

Survey	In-depth Interview	Archive Search /Case study
<ul style="list-style-type: none"> • Project managers • Site engineers • Project engineers • Construction engineer • Quantity surveyors • Office engineer • Consultants • Client’s representatives <p style="text-align: center;">20 in number</p>	<ul style="list-style-type: none"> • Project managers • Consultants • Office engineer <p style="text-align: center;">7 in number</p>	<ul style="list-style-type: none"> • Contractual papers • Bill of Quantity • Variation Orders • Time extension requests • Interim Payment Certificate • Proforma sheets • Some work schedule papers • Salary increment letters

3.5 Study variables

3.5.1 Dependent Variable:

Price escalation: Operationally in this study price escalation can be understood as the difference between the actual cost used for the work and adjusted bid cost. Generally, escalation was calculated in two ways.

1. To calculate the magnitude of escalation

$$\text{Price Escalation (PE)} = \text{Actual Cost (AC)} - \text{Adjusted Bid Cost (ABC)} \text{ ---Equation 1}$$

2. To calculate the percentage of price escalation [21]

$$PE = \frac{[AC-ABC] \times 100}{BC} \text{----- Equation 2}$$

Where

- AC is the actual cost that is consumed to execute the current stage/volume of work cost. That means the current executed budget. This refers to the total amount of money delivered to the construction contractor; this would include the amount that the contract was awarded for originally, plus or minus the amount of each contract modification, if any (28).
- ABC= the bid cost as adjusted to the stage of work executed. That means the cost necessary for building the specified volume of work as estimated during the bidding/contract time which implies expense equivalent to work progress. For example, if the construction is executed 40% the ABC will be 40% of the Bid Cost. For completed project the ABC is equal to bid cost.

$$ABC = \frac{[BC * \% \text{ of work executed}]}{100} \text{----- Equation 3}$$

- BC = The Bid Cost that is the contract cost.

3.5.2 Independent Variable:

Independent variables were identified by three methods. Firstly, the variables were identified from literatures and respondents were asked to rate each of the factors based on the frequency of occurrence of the factors in their projects. Variables were categorized as client, consultant, and contractor related as well as internal and external factors based on literature sources. Then the categorized items were listed and respondents were asked to assign score for each of them from 0 to 4 (from very low frequency to Very high frequency) based on their frequency of occurrence.

That is as follows: 0=Very low, 1=Low, 2=Medium, 3=High, 4=Very high.

The second method was that the respondents were asked open ended questions about what factors were responsible to price escalation. Thirdly, some factors were identified through case study: that is by review of the project's documents. Some of the identified variables from the literatures include the following lists.

- contractual agreements
- inflation

- price increase of construction inputs
- delay of construction supplies
- poor estimation of project cost
- design change
- poor scheduling practices
- delay in projects
- unexpected sub ground conditions
- addition or omission of work
- Escalation Mitigation Mechanisms

3.6 Data collection

The data used for this study included both primary and secondary data.

3.6.1 Primary data collection

The major primary data collection method was questionnaire-based survey and interview. The survey was a self-administered questionnaire that was distributed for 20 respondents from Customer/clients, Consultants and Contractors sides. The interview included selected seven key informants of project managers and consultants. Interview guide was used to key informant interview.

3.6.2 Secondary data

The secondary data for this study included literature review from published and unpublished (white papers) text such as journals, reports, text books, thesis documents and government publications. More over reviewing of different working documents of the studied projects was used as secondary data (as a case study).

3.6.3 Data collectors and tools

The data collection was done by two experienced data collectors to facilitate the distribution and recollection of the questionnaire and the overall data collection process was supervised by one supervisor. The contents of the data collection tools generally addressed general information about respondents and projects, the project prices (both bid and actual cost), factors affecting price escalation and the escalation mitigation methods. Both open ended and close ended questions were employed. The tools were designed using English language. For more details about the tools see the Annexes at the end of this paper.

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Table 2- Information matrix of the price escalation study at Jimma University building projects, Ethiopia, February 2020.

Variables	Data collection methods	Data sources	Data collection tools
Cost/Price data	Document review	Different archives/ documents	Data extraction checklist
Factors affecting escalation	<ul style="list-style-type: none"> • Literature review • Survey • Interview • Document review 	<ul style="list-style-type: none"> • Literatures • Survey respondents • Key informants • Archives/documents 	<ul style="list-style-type: none"> • Note books • Questionnaire • Interview guide • Data extraction checklist
Escalation mitigation	Survey Interview	Survey respondents Key informants	Questionnaire Interview guide

3.7 Data processing and analysis

Both the primary and secondary data was first prepared, coded and entered to SPSS (statistical packages for social sciences) version 20 as well as Excel sheet. The SPSS was used to run general descriptive statistics and the excel to compute common arithmetic calculations and construct graphs. Magnitude of price escalation was calculated and expressed in terms of number, percentage and average. To determine the importance of identified factors associated with price escalation Relative Importance Index (RII) scores were calculated. The RII was calculated from respondents actual scoring of the frequency of occurrence of the factors as follows [22].

$$RII = \frac{\sum w}{N \times A} \text{ ----- Equation 3}$$

Where:

W= weight given for each factor of escalation by respondents, ranges from 0 to 4.

A is the maximum value out of 4 that the variable/factor has got

N is the number of respondents who rated the factor/variable.

Qualitative data was put thematically and triangulated to related quantitative data. Finally, the results are presented in text forms, tables, and figures.

3.8 Ethical considerations

Ethical clearance was obtained from Jimma Institute of Technology Institutional Review Board. Then submission of the Ethical clearance letter and explanation of the aim

of the study were done to the project manager to secure permission. Oral informed consent was obtained from each respondent. All privacies and confidentiality of information was kept by securely storing and retrieving the collected information in a personal computer and folder with no third-party sharing. The collected information is used only for the purpose it is collected, that is for only this research. Whenever personal information is mentioned in this study it is expressed anonymously without disclosing personal identifiers like names of individuals and projects.

3.9 Data quality assurance

The study used both primary and secondary data. Triangulation of different methods like questionnaire survey, interview and case study strengthens the validity of findings. More over the data collection process was supervised daily to check and fix problems at a spot. In order to obtain quality data, the researcher has given attention to the following points. First the tools were prepared after extensive literature review and it has been tried to make all the questions to be put in simple & clear ways. This is important for two reasons: It would increase understandability of the questions to the respondents so that they can provide clear answers and it would assure the compliance of the study to current available knowledge. Secondly willingness of the respondents to answer the questions was asked which would increase the utilization of the findings to improve the studied projects. It has been tried to follow scientific recommendation in all the steps of conducting the research.

Therefore, it is assured that the data are true, the processes followed were according to scientific procedures, and hence the findings of these research are highly valid.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

This section of the study generally presents and discusses the major findings about the study objectives. The discussion raises core ideas from the result, compare it with findings from literature and explain the observed similarities and differences.

4.1 Respondents Profiles

A total of 20 questionnaires have been distributed and 12 of them returned. These respondents are working in either of the four construction projects of Jimma University selected for this study. Just half of the respondents were first degree holders. The experience of study participants ranged from 4 years to 30 years with a median of 8 years. Six, ten, fifteen and thirty years of experiences was rated by one respondent each.

A significant number of respondents have ever worked in more than 2 projects and only one person has experience only in the current project. One person had experience of working in 50 projects with an experience of 30 years. This implies that the individual had frequency of shifting from project to project and less likely to work in projects for long period of time or else it may mean that the individual has been working in different projects at the same time. This can be a cause for poor productivity and as a result it can lead to price escalation. One third of the study participants were workers of a foreign organization, foreign contractor. The respondents' position in their organization includes Office engineers, project manager, site engineer and consultant.

Table 3- Profiles of respondents working in Jimma University selected construction projects.

Variables	Category	Number	Percentage
Education Status	Masters	5	41.7
	First Degree	6	50.0
	Diploma	1	8.3
Position	Project manager	3	25.1
	Construction Engineer	1	8.3
	Office Engineer	4	33.3
	Consultant	4	33.3
Type of organization the respondents are working in	Local Client	2	16.7
	Local Contractor	2	16.7
	Foreign Contractor	4	33.3
	Local Consultant	4	33.3

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On the other hand, interview was conducted with seven respondents including three project managers, three consultants and one office engineer.

4.2 Description of the Projects

The study included four construction projects labeled as Project A, project B, Project C and Project D since for the sake of privacy it would not be good to mention them by name. Two of them were being constructed by one foreign contractor and the other two by another local contractor.

With regard to contract price project B was the most demanding that required 791,244,083.85 ETB whereas project D was the least expensive (144,323,492.00 ETB). Considering the stage of work progress to date, project D was a completed project and the other three were ongoing. Project D was completed on March 2019 after nearly 4 years of delay. Some additional details of the projects are reported in table 4 and table 5.

Table 4- Contract price and time of Jimma University Selected Construction Projects.

Projects	Contract price	Starting Time	Expected End time
Project A	686,511,964.39	June, 2015	Nov, 2017
Project B	791,244,083.85	Mar ,2015	Aug, 2017
Project C	596,878,190.41	Mar ,2015	Feb,2016
Project D	144,323,492.00	Sep, 2014	Jun, 2015

4.3 Assessment of Price Escalation

Price escalation in the construction projects of Jimma University was computed by comparing contract or bid price that is adjusted for the stage/phase of work progress and actual expensed money.

Table 5: The current work progress and budget utilization status of Jimma University Construction Projects as of February 2020.

Projects	Current Executed Budget (AC)		Work progress (%)	Expense Equivalent to work (ABC)	Escalation Birr Escalation %	
	Amount	%			Amount	%
Project A	578,081,649.08	84.21	81	556,074,691.2	22,006,957.92	3.21
Project B	245,360,116.25	31.01	32	253,198,106.8	-7,837,990.58	-0.99
Project C	633,820,142.20	106.19	94	561,065,499	72,754,643.21	12.19
Project D	150,801,486.33	104.49	100	144,323,492	6,477,994.33	4.49

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As it is clearly depicted in table 5, except project B which was only 32 % completed the other three projects have experienced price escalation. To put quantifications, project A experienced a 3.21% price escalation (22,006,957.92 Ethiopian birr), Project D a 4.49% (6,477,994.33 ETB) and Project C a 12.19% (an Ethiopian birr of 72,754,643.21) in an ascending order. The arithmetic mean of price escalation of the three projects was 6.63% and 4.73% when project B was considered. When we calculate the total escalation in Ethiopian birr it was about 93,401,604.88 ETB (for all projects) and 101,239,595 ETB when we consider only the three projects excluding project B.

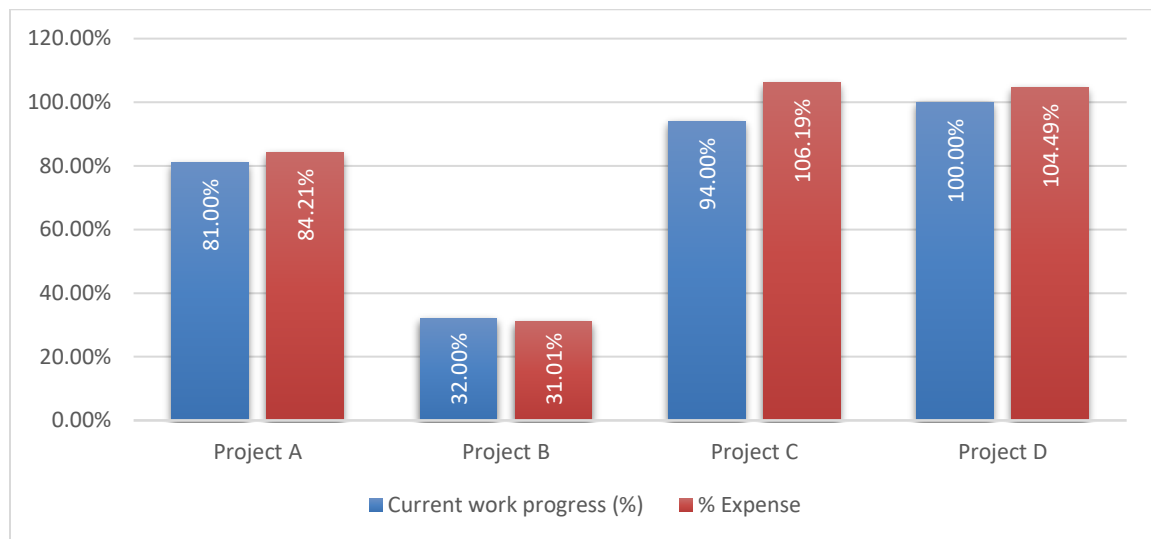


Figure 3- The percentage of work and financial expenditure in Jimma University construction projects.

Project B let alone experiencing price escalation it did not fully used its allotted budget. Because the actual cost used to complete the work done is lower that the budget allocated for the completed work. However, it is more probable that even this project will experience price escalation in the future for two very important reasons. For one thing the phase of construction or work progress is only one third (32%) which implies that it is only in its early phase of construction given that it is the largest of all the studied projects with regard to budget. Another reason for the presumed price escalation is delay. The project was assumed to be completed in 2017. But even at this time, February of 2020, the construction is still ongoing which means that until this time there are two and half years of delay. If it continues with this speed, assuming that the reasons are constant and not yet

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solved, the project will face nearly 8 years of delay when it will be completed. Therefore, these evidences inform that it is highly probable that the project will experience price escalation in its remaining works. Because literatures stated that in the construction industry price escalation is almost inevitable, especially in large complex projects. Larger projects are more prone to delay, addition of volume of work and uncertain conditions and hence it is more likely that they experience escalation [13, 30]. If so, we can generalize that almost all of the projects experienced prices escalation.

From the twelve survey respondents nine of them believed that there is price escalation in their project while the three one of them did not. It was those respondents who were working in Project C and Project D who believed that their organization did not experience price escalation. Probably this may be because projects C and D were nearly completed and completed projects, respectively, which has raised the respondents' morale to say that their project is successful.

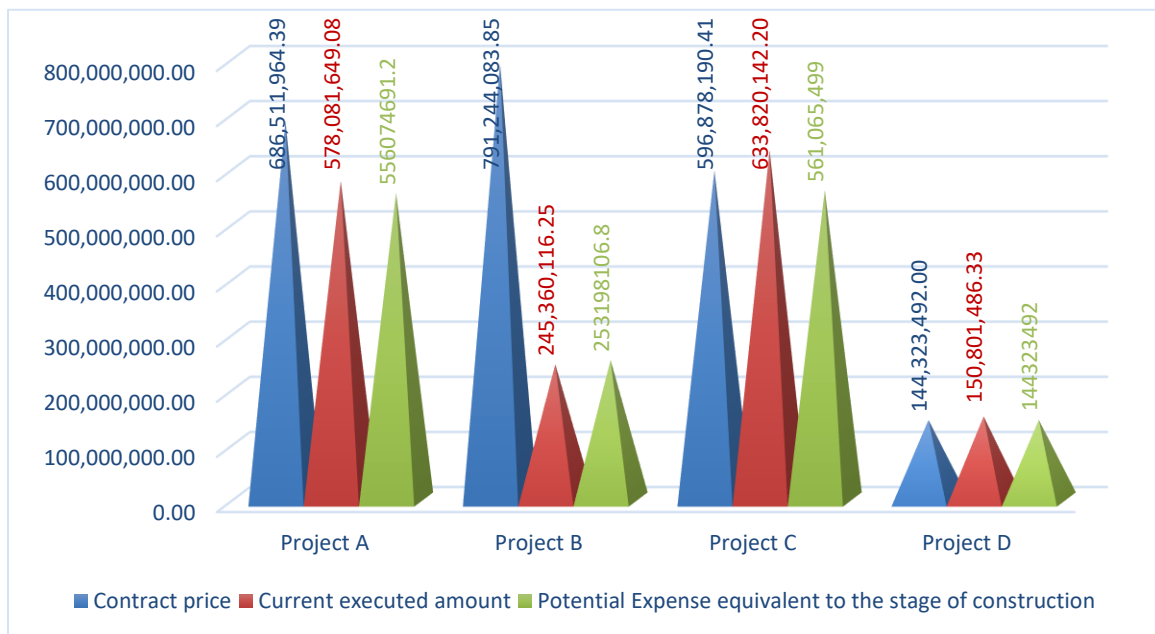


Figure 4 - The bid and executed budgets of Jimma University Construction Projects.

Generally, it can be said that there was price escalation in all of the studied construction projects which ranged from 3.21% to 12.19%. But since the projects are ongoing projects the escalation may exceed these figures when the projects will be completed. Because as it will be discussed in the case study (project A) even if the project

is at its' 81% of work completion at the time of study, it is estimated that the final price escalation will reach nearly 9.70% at the completion of the project. When we infer from this statement all the ongoing projects will have additional escalations.

As compared to other study findings and reports in Ethiopia, these figures can be considered as not warranting; it is justifiable. Because Ethiopian literatures reported that up to 83.20% of escalation has been registered among road projects with an average of around 21% [15]. Another professional report in Ethiopia stated that there is shortage of some construction inputs in the study area leading projects to experience price escalations of up to 28% [20]. When we compare the escalation of price obtained from the current study to these Ethiopian sources, the current finding is moderate. This may be for different reasons. For one thing three of the projects for this study are ongoing projects which are yet to face escalation in the future since all of them have delays. Another reason for the observed variation may be because the previous studies and reports are not specific to the building construction projects probably implying that there may be escalation differences based on the type of projects. Another plausible explanation is that of time variation between the previous studies and the current. As time went on projects' parties may learn from their experience about good project management. The capacity of contractors may be another reason. Both of the contractors of the projects selected for the present study had many years of experiences and good material and equipment capacities.

4.4 Factors Affecting Price escalation

Many variables were mentioned as a mediating factor for the observed price escalation in the studied construction projects. These were assessed in many ways. The respondents were asked to mention factors that they think were responsible for the observed price escalation. Accordingly, as it can be observed from figure 5, inflation, price escalation of construction materials and project delay were the three top factors.

From tables 4 and 5 we can understand that in all of the projects there exists a time overrun (projects delay). The respondents also confirmed, as presented in figure 5, that delay is one of the major factors contributing for escalation. From theoretical evidences it has been reported that one of the factors for price escalation is delay [5]. When there is delay, the values for cost escalation is uncertain [21]. If the duration of project development

is longer it is highly probable that the project experiences price escalation [30] because when there is delay the cost would be subjected to inflation [8]. Therefore, based on both theoretical and empirical evidences we can infer that one of the contributing factors for the observed price escalation in the studied projects, is project delay.

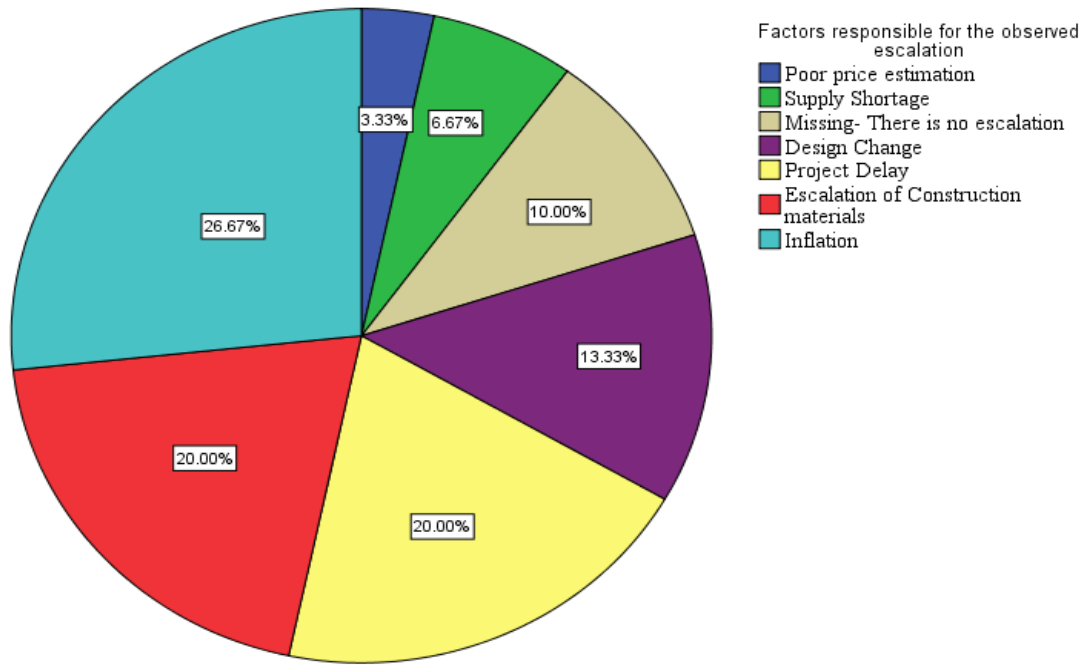


Figure 5- Variables mentioned as factors of price escalation among Jimma University Construction Projects, February 2020.

The above figure also supported that inflation and escalation in the price of construction materials were among the major contributing factors for price escalation. Even if the two concepts can be used interchangeably some articles reported that while inflation is caused by debasement of value of money and change in monetary policy the increase in price material is caused by market forces or temporary demand-supply disparity, demand-pull inflation or cost-push inflation. These two factors are highly correlated. When there is inflation there is a high probability of increasing in construction materials' prices, labor wages and machinery hire [36, 37]. These increases in turn would lead to escalation of project price [36].

Respondents were further asked about on which category of construction inputs the projects experienced price escalation. Accordingly, all of the respondents mentioned that

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they experienced price escalation in construction materials and five of them (41.7%) said that there was escalation of labor price. But only three (25%) and two (16.7%) respondents mentioned that there was escalation on the construction equipment and overhead costs respectively.

Table 6- The relative importance Index scores of factors affecting price escalation based on survey of study participants from Jimma University construction projects, February 2020.

S. no	A. Client – related factors	Rating of Factors			
		W	RII	Rank	Mean
1	Unrealistic schedule	26	0.72	1	0.65
2	Slow decision making	33	0.69	2	
3	Number of change / Extra work orders	30	0.63	3	
4	Delay in handing over of site	30	0.63	3	
5	Delay in contract award	22	0.61	4	
B. Contractor – related factors					
1	Financial difficulties	32	0.67	1	0.59
2	Low bid	30	0.63	2	
3	Planning and scheduling deficiencies	27	0.56	3	
4	Non-availability of sufficient amount of skilled labor	20	0.56	4	
5	Lack of coordination between project participants	25	0.52	5	
C. Consultant-related factors					
1	Slowness in giving instruction	25	0.69	1	0.62
2	Poor coordination /communication between consultant & parties	23	0.64	2	
3	Poor inspection plan by consultants	22	0.61	3	
4	Poor site management	20	0.61	4	
5	Lack of sufficient experience of consultants	20	0.56	5	
D. Internal factors					
1	Project schedule change	24	0.67	1	0.56
2	Engineering and construction complexity	23	0.64	2	
3	Ambiguity of contract provision	28	0.58	3	
4	Delivery/procurement approach	21	0.53	4	
5	Poor estimating	23	0.48	5	

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6	Inconsistence in application of contingencies	23	0.48	5	
F. External factors					
1	Fluctuation in money exchange rate	37	0.77	1	0.62
2	Increase in demand for construction materials	34	0.71	2	
3	Increase in material cost	34	0.71	2	
4	Shortage of labor/skilled	24	0.67	4	
5	Local concern	20	0.61	5	
6	Limited capacity of material producers	29	0.60	6	
7	Bad weather condition	21	0.58	7	
8	Change in Legislation	18	0.55	8	
9	Environmental impact	19	0.53	9	
10	Site conditions	18	0.50	10	

A similar evidence from the in-depth interview was also stated in similar way. One respondent from ‘project A’ mentioned that “delay on the project completion time and local price increase” were major factors for the observed price escalation. Another respondent from the same project listed the major factors as “country currency shortage, delaying the project due to additional/extra quantity of work added and also delay of decisions of material selection and items”. Other respondents did not mention specific factors rather they generally state that all labor, material and equipment related factors mediated the escalations and some others deny the existence of escalation at all.

In another way, survey respondents were further asked to rate the frequency of occurrence in the current project of different empirically known factors. Based on the frequency of occurrence of known factors, which were classified as Client related, Contractor related and Consultant related or as Internal and External, Relative Important Index (RII) was calculated for each of the factors. Table 6 indicates the categories of factors of escalation that are classified as stated above and ranked based on their RII score that is rounded to two decimal points.

When we compare the importance of different factors of price escalation based on their Relative Importance Index score some major findings are the following. From simple observation of the scores we can say that client related factors are more dominant followed by consultant related factors and then contractor related factors. This is verified by the

support of the descriptive statistics which yields mean relative importance index scores of 65%, 62% and 59% respectively. From client related factors unrealistic schedule were rated as the top important factor (RII=72%) followed by slow decision making whereas extra work order and delay in handing over site were equally ranked as the third important factors (RII=63%). On the other hand, 'delay in contract award' was ranked by the respondents as the least important (with RII=61%) client related variable.

When we analyses the contractor related factors similarly the top most important factor was found to be 'financial difficulties' (RII=67%) and 'lack of coordination between project participants' was ranked as the least important variable (RII=52%).

Likewise, among consultant related factors 'slowness in giving instruction' was rated as the top important (RII=69%) while 'lack of sufficient experience of consultants' the least important (RII=56%).

When comparing the internal and external factors of price escalation it is clear that external factors weighted more than the internal factors with the mean relative importance index score of 62% and 56% respectively. To describe the two categories of factors separately we can scan from the table that 'project schedule change' with a RII score of 67% was ranked as the first most important internal factor. Among the internal factors 'poor estimating' and 'inconsistence in application of contingencies' were equally valued as lest important factors for the observed price escalation (RII= 48%). From the ten external factors 'fluctuation in money exchange rate' was top on the list (RII=77%). 'Increase in material cost' and 'increase in demand for construction materials', both of which can hinder supply of construction inputs timely and sufficiently, were ranked as the second most important external factors (RII= 71%). It seems that 'site condition' was not a difficulty as compared to other external factors since it was rated as least important with RII of just 50%.

When we examine the mentioned variables very critically it is easy to classify them into two as delay related to schedule problems and delay related to money exchange problems. Because it is easy to understand that when there is unrealistic schedule, slow instruction provision, schedule changes and financial difficulties there would be delay in completion of works.

Whereas factors like delay in contract award, lack of coordination between project participants, lack of sufficient experience of consultants, inconsistency in application of contingencies, environmental impact and site conditions seemingly did not have much impact on price escalation. Because they are on the bottom of the list based on their Relative Importance Index (RII) score.

The observed price escalation was mediated by major factors obtained from both survey and interview as well as case study which will be discussed later on this chapter. It seems that the findings of all the survey, interview and case study are consistent.

These findings are supported by both Ethiopian and other countries literatures that delay and financial difficulties or money exchange problems (devaluation) are important factors of project cost escalation [5,6,18]. Because Increment of foreign exchange (devaluation of money) will lead to escalation of price and shipment of imported goods. In addition to the foreign exchange rate, price escalation of the construction items directly leads to price escalation of overall project. This is also supported by a literature which discovered that price increase of materials is the most significant contributing factors of escalation [34].

4.5 Price Escalation Mitigating mechanisms

From nine of survey respondents who believed that there was price escalation in their project, eight of them stated that the action taken to mitigate the escalation was ‘claiming for compensation’ while one respondent replied that the action taken was ‘absorbing the effect in the profit margin’.

According to the survey, the major way of mitigating the price escalation was ‘claiming for compensation’. It is in line with what literatures recommended. One of the mechanisms that literatures suggested as a mitigation mechanism of price escalation is contracting or ‘asking if consideration should be made to including concessions around escalation in the owner contract’ [19], which the survey respondents called as compensation. Accordingly, both the interview and case study findings showed that one of the major mechanisms the projects used was incorporating escalation clauses in contract agreements and claiming for financial compensation for the escalation.

It was only one respondent who stated as if the mitigation mechanism was ‘absorbing it in the profit margin’. This is not surprising since this view of surveyed workers coincide with the general truth that contractor’s goal of working is maximizing their profit.

When survey respondents were asked about on which of the construction materials escalation mitigation measures were taken, they mentioned cement (26.3%), reinforcement (23.7%) and fuel (21.1%) as three top priorities.

The interview respondents were asked to suggest what intervention their project should take to mitigate the observed price escalation in construction materials. The following were the major statements which show the workers’ perception on how their project can mitigate material price escalation. One consultant described the measures to be taken as *“first prepare schedule for overall works for the project and list out major items of material and purchase early stage of work and reduce extra cost of material purchasing price”*. Another respondent who was a project manager stated the necessary measure as *“completion of the project with in the given time. I mean helping the contractor to get the necessary payments....., drawings etc. on time so that there will be no delay”*. These two statements imply one major solution to mitigate price escalation. That is solving delay which was the major cause of escalation. The statements further pointed out that the mechanisms of mitigation should also focus on addressing the causes of delay like late material delivery and schedule problems, which can be considered as root causes of price escalation, by proper scheduling and early purchasing.

In line with the above standing other respondents mentioned the solutions of price escalation like ‘training of staff and reducing turnover for increasing effectiveness or productivity, proper monitoring based on schedule, efficient resource planning, and incorporating price escalation clauses in contract agreement’.

Interviewees have said that their project have been asking for financial claims to mitigate price escalation stating that the contracts allow price escalation. Accordingly, one interviewee stated the mitigation mechanism as *“by adapting price escalation formula which is stated on GCC for Items stated on FPPA”*. In a similar way another respondent took note of that claiming for financial extension is possible to mitigate price escalation

mentioning a legal basis saying “*using the formula of PPA 2006(GCC and SCC) ...*”. Other Interviewee state the situation very clearly by saying “*Our contract document permits price escalation so we submit the claim and waiting for approval*”. Therefore, projects were responding to the price escalation by financial claims and using financial adjustment.

Contrary to this one interviewee suggested another way of controlling price escalation recommending “*reduction of costs of goods, lowering tariffs and lowering distribution costs*” to mitigate the price escalation.

Furthermore, respondents replied that the price mitigation mechanisms need to focus on averting delay by addressing the causes of delay like improper schedules, addition and change of work, delay in decisions, timely payment as well as proper monitoring based on work schedule.

For the cost escalation of construction inputs, interviewees recommended lowering of cost of inputs by properly determining the scope of work and purchasing early. This is supported by state-of-the-art recommendations which stated that proper scheduling and if escalation is likely advance purchasing can prevent or mitigate price escalation [23].

4.6 Case Study

4.6.1 Description of the Project

The project is a building construction work which was started at June 2015 with bid/contract cost of 686,511,964.39 ETB. The contract time of completion was Nov, 2017.

4.6.2 Current Status and Overall Trend of the Project

This part examines the current financial and work execution of the project, the escalation status, the market prices of inputs as well as the reasons for the escalation. When we see the current status of the project it is progressing with 81% of work completion. Until the time of the study the project used 84.21% (578,081,649.08 ETB) of its budget which implies that it has just experienced a 3.21% of price escalation.

During its life time to date variation orders have been done six times even if it seems that some of them were not approved yet. Different reasons, fifteen in number, were mentioned in the variation orders. As listed below two of these reasons are about

demolishing/omission while the other reasons are additions. The reasons for the variations outlined in the summary of variation orders included:

- Xypex
- PVC Conduits
- New sanitary pipe line
- Demolishing existing manhole
- Demolishing HCB works
- Fine Coat Plastering
- Toilet Doors
- Sanitary Works
- Electrical Installations
- Site Electrical and Generator
- Granite Copping
- Granite paint work
- Key Stone and Logo
- water repellant
- Electro -Mechanical Installation

The cumulative contract cost of these variation orders was calculated to be 66,488,616.24 Ethiopian birrs including its' 15% VAT. After the variations and VAT were added to original contract of 686,511,964.39 ETB the total final contract cost has increased to 753,000,581 Ethiopian birrs. This implies the project will experience another additional price escalation since it is ongoing. If we assume that no further variations will be ordered and the project will be completed with the current budget, based on Equation 1 and 2, the overall price escalation would be 66,488,616. 24 (9.68%) as shown below.

$$PE = AC - BC \text{----- Equation 1}$$

$$PE = 753,000,581 - 686,511,964.39$$

$$= 66,488,616. 24$$

When we consider the percentage of price escalation, we use the following equation.

$$\%PE = \frac{[AC - ABC] \times 100}{BC} \text{----- Equation 2}$$

$$\%PE = \frac{[753,000,581.00 - 686,511,964.00] \times 100}{686,511,964.00} \approx 9.68\%$$

But it is difficult to assume that no further increase of additional cost will be incurred. Because at its 81% of work completion the project experienced 3.21% of escalation. So, when the project will be 100% complete additional escalations will be expected. There for the total final price escalation will be more than 9.68%.

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Time extension claim was asked two times with a total of 730 calendar days. Reasons mentioned for the time extension claim were the variation orders and some other delaying factors. The listed factors in the time extension claim included:

- Design delays and changes
- Changes in some of the works
- Variation Related
- Decision delay
- Approval Delay
- Bad Weather Condition
- Cement Shortage
- Foreign currency and shipment

When we see the work schedules of the projects it was generally allotted under two bills of quantities (BOQ). The bill of quantity one was the substructure and superstructure works and bill of quantity two was the site work as depicted in the following table.

Table 7: Budget utilization according to some budget items in Jimma University Construction Project A, February 2020.

Item	Description	Amount of Birr		
		Contract	Executed	%
BILL NO 1 MAIN BUILDING				
A-SUB STRUCTURE				
01	Excavation and Earth Work	19,855,757.49	23,368,310.82	118%
02	Concrete Work	71,623,584.25	56,646,589.66	79%
03	Stone Masonry Work	8,128,300.00	1,220,417.78	15%
	<i>Total</i>	99,607,641.74	81,235,318.26	82%
B-SUPER STRUCTURE				
01	Concrete Work	93,728,778.24	147,489,160.79	157%
02	Block Work	21,507,985.16	46,403,044.47	216%
03	Roofing	16,896,000.00	17,553,772.59	104%
04	Carpentry and Joinery	14,272,552.00	5,232,960.00	37%
05	Metal work	30,904,287.88	11,654,940.93	38%
06	Plastering and pointing	15,386,616.80	15,735,326.00	102%
07	Finishing	90,401,194.85	65,655,012.07	73%
08	Glazing	2,113,416.00	502,664.31	24%
09	Painting	12,576,167.00	6,814,325.27	54%
10	Sanitary Installation	11,593,528.00	8,832,630.02	76%
11	Electrical Installation	73,013,932.00	21,806,190.00	30%
	<i>Total</i>	382,394,457.93	347,680,026.46	91%

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Item	Description	Amount of Birr		
		Contract	Executed	%
BILL NO 2 SITE WORK				
01	Walkways & Fountain	7,924,133.70	2,929,705.75	37%
02	Site Sanitary	16,620,040.00	11,865,028.19	71%
03	Site Electrical & Generator	15,776,905.00	10,588,320.00	67%
04	Generator House	697,747.98	740,456.28	106%
A-SUB STRUCTURE				
01	Excavation and Earth Work	35,664.00	103,178.81	289%
02	Concrete Work	97,619.87	119,787.00	123%
B-SUPER STRUCTURE				
01	Concrete Work	126,536.31	517,490.48	409%
02	Roofing	74,126.00	144,489.72	195%
<i>Total</i>		41,278,646.86	27,008,456.23	65%

From the table 7 we can understand that the budget allotted for the original contract was underutilized for sub-ground works since the budget utilization was 82% and 91% for part A and B of BOQ 1 and only 65% for BOQ 2. In fact, the underutilization may be partly due to the fact that some of the original contracted works have been changed or omitted as stated in the variation order and the project is ongoing implying that some work is left. Therefore, it is not difficult to understand that the variation orders, that were not part of these original BOQs, had significant effect for the observed price escalation.

However, since all the subsurface works are finished it is easy to understand that the sub structure conditions were not problematic and thus the budget was under-utilized. Both raw facts from this data and the opinions from the respondents revealed that sub ground works were not factors for price escalation. Literatures postulate that since there are uncertainties in sub ground work it would induce change orders and consequently lead to price escalation, delay and increase of supervision efforts [28]. But in this specific project, by implication, there was no such uncertainties.

When we see the costs of construction items and foreign exchange it took the following shape. For understanding this, it is good to compare the base prices and the current prices with market values.

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Table 8 - The Base Price of Construction Inputs and Foreign Exchange Rate for Jimma University construction project A at 28 days before contract time at June 2015.

Items	Steel (in Kilogram (average))	Fuel (in Litters)	Cement (OPC Cement in Quintal)	Foreign Exchange Rate (\$USA)	Labor (Cumulative Increment Rate)
Price	21.903	16.910	237.600	18.9562	1.5834

It was true that labor and foreign exchange rates increased from time to time consistently. Because when we considered the labor, the project allowed salary increments three times during the life time of the project and the rate of increments were consistently increasing from base cumulative increment rate mentioned in the table above to 1.8367 at December 2015, 1.9929 at November 2016 and 2.1423 at February 2017. Similarly, the foreign exchange became 22.833 in Nov 2016 and it increased to 23.0742 at Feb 2017.

The market values of cement, steel and fuel have been fluctuating even if it was consistently higher than the base price. But, since the data were a sample from the year 2018/19, whereas the active construction period and the time when the project was expected to be finished were before these times, it may not fully reflect the overall trend. Table 9-The market price of Steel, Fuel and Cement for Jimma University Construction project one, at different times.

Table 9A: Market Price of Fuel for the year 2018/19

Item No.	Period	Unit Price (Birr/liter) for Gas Oil
1.	July 01/2018-November 12/2018	16.35
2.	November 13/2018-January 30/2019	17.78
3.	January 30/2019-Up to Date	18.08

When we compare the market values of fuel for the year 2018/19 (Table 9A) it was higher than its base price at 2015 (Table 8). There for there was an increase in fuel price.

Table 9B: Market price of Steel from July 01 to September 25, 2018

Size	July 1-August 6/ 2018	August 7- Sept 13/ 2018	Sept 14 -24/ 2018	September 25/ 2018
φ8mm	47.70	43.11	40.36	38.53
φ10mm	47.56	41.69	39.93	37.58
φ12mm	-	39.99	39.17	37.37

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Size	July 1-August 6/ 2018	August 7- Sept 13/ 2018	Sept 14 -24/ 2018	September 25/ 2018
φ14mm	-	40.00	38.33	37.25
φ16mm	-	-	38.52	37.38
φ20mm	-	-	39.61	38.14
φ24mm	44.50	-	41.44	38.13

The average has decreased from 64.59 at July 01-August 06, 2018 to 37.77 at September 25, 2018. Even if the trend was decreasing for the year 2018/19 it was consistently far higher than the base average cost at 2015.

Table 9C: Market Price of Cement from April 02, 2018 to February 28, 2019

Date	Ex-Factory		Total Selling Price (Birr/Quintal)
April 2, 2018 to Feb 22, 2019	Mugher	PPC Packed	215.00
	“	OPC Packed	285.00
	Addis Ababa	PPC Packed	230.00
	“	OPC Packed	300.00
	Tatek	PPC Packed	225.00
	Nazerith	PPC Packed	235.00
	“	OPC Packed	305.00

As depicted in table 9C, when we compute the average market price of OPC packed cement for the it was 296.6 Birrs per Quintal which is much higher as compared to its base cost of 237.6 Birr/Quintal at 2015.

The above tables ascertained that escalation was observed in all of the materials including steel, fuel, cement and labor. These empirical findings are similar to the result of the survey and interview.

It is also supported by literatures which mentioned that the materials listed in the table are major contributors of price escalation [35].

4.6.3 Price Escalation Mitigation: The case of Project One

When the documents were examined the project used three ways to mitigate price escalation (all of them are based on contractual clauses that have been included in the contract document). One way was estimating and adding financial contracts to mitigate the escalating effect of the variation orders, as mentioned in the previous sections. The second way was time extension agreements in response to different delaying factors and the

mentioned extra work orders (variations). But this way of mitigating price escalation is not recommended by literatures. Asking for time extension is not a straight forward method for mitigating escalation. It only gives time for contractors to complete their work and relieve the clients from incurring unnecessary expenses. It is erroneous to automatically link time extension with payment even in the case that there is a provision of time extension in contract agreement [32].

In addition to these two ways the third method of mitigation the project employed was price escalation adjustments. Adjustment was done for five identified variable cost items including cement, fuel, steel, labor, and foreign exchange rates. The overall and specific to item adjustment rates and formula were mentioned. For example, if we see the price adjustment index for March 2017 (done during the Interim Payment Certificate #13), It was mentioned in the following formula.

$$P_n = 0.2 + 0.1(L_n/L_o) + 0.1(C_n/C_o) + 0.15(S_n/S_o) + 0.05(F_n/F_o) + 0.4(Ex_n/Ex_o)$$

$$P_n = 0.2 + 0.1(2.142) + 0.1(0.952) + 0.15(0.936) + 0.05(0.931) + 0.4(1.21724) = 1.1834$$

$$P_n = 0.2 + 0.2142 + 0.0952 + 0.1405 + 0.0466 + 0.4869 = 1.1834$$

Where

P_n refers to Final Price adjustment index.

L, C, S, F and Ex means Labor, Cement, Steel, Fuel and Exchange rate respectively.

The letters 'n' and 'o' represents the current (at time of adjustment) and the base (28 days before the contract) market prices of the items.

From the formula it is easy to understand that the two highest weights were given for foreign exchange rate and Labor signifying that they are the two most important inducers of price escalation. The least scored factor was fuel.

When we compare it with the situation at January, just two months back, the order was different. The situation at January was that foreign exchange rate was the leading but the next one was 'non variable' costs. Labor was ranked as third and likewise fuel as least rated.

When we summarize the case study it is easily understood that the project used three very critical documented escalation mitigation methods. This includes claiming for finance, claiming for time extension and price adjustments. A total extension of 730

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calendar days have been asked for in two round time extension claims and a total of 66,488,616.24 ETB (including 15% VAT) financial claims has been requested. Price adjustments have been done for five main construction inputs including steel, cement, fuel, labor and foreign exchange rate. It was verified that all time extension, financial claim and escalation adjustment clauses have been included in the contract agreement.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

From the overall results and discussion points we can draw the following conclusions. Even if price escalation has occurred in three of the four studied construction projects so far, it is highly probable that escalation will occur in all of the projects when they will be completed. The magnitude of escalation varies among the construction projects but generally the level of escalation was only moderate. But since the studied projects were ongoing the escalation may increase when the projects will be completed.

Many factors were responsible for the observed price escalation. Majority of these causes of escalation are either in one way or another related to both justifiable and unjustifiable delays of the projects and price increase of construction inputs. These includes delays in decision making, change, addition or omission of work, financial difficulties and late delivery of materials, money exchange fluctuations, project schedule problems like schedule change and unrealistic schedules as well as slowness in giving instructions. Other very important factor was escalation in the cost of construction inputs or inflation. There were also some causes that can be considered as force majeure like weather condition problems.

On close examination of the findings it would be more likely to conclude that the project price escalation and majority of the factors are highly preventable or controllable. Some of the findings also suggested that there were problems in planning like scope determination and time forecasting as well as budget under estimation all of which can be considered as factors for price escalation.

The well-practiced escalation mitigation mechanisms were claiming for finance, time extension and doing of escalation adjustments whenever there were cost escalation of the construction inputs. For ensuring the legality of these actions the parties had included clauses in the contract document. Therefore, contractual clauses may be seen as one of the mitigation mechanisms applied. But this is not a guarantee to mitigating escalation rather it only governs the parties' behaviors or actions and solves legal disputes. Hence, it may

be difficult to consider it as escalation mitigation mechanism. Therefore, it is nearly plausible to conclude that there was poor application of escalation mitigation mechanisms.

5.2 Recommendation

Information or knowledge about escalation is required for all projects parties since it serves for three main important purposes. That means, knowledge of price escalation is required to: 1) adjust historical data, 2) calculate any reimbursement, and 3) forecast/estimate future costs (pricing) (24). Therefore, considering these theoretical facts about the importance of information on escalation and the conclusions made, it is a pleasure to suggest the contracting parties of the studied projects to practice the following recommendations.

General Recommendations

- Since the factors identified cannot be exclusively assigned to one party it would be always logical to consider an escalation clause in the contractual agreement.
- Since the major causes of escalation are within the parties control the mitigation of escalation relies on actions that parties execute their responsibilities timely which can prevent, reduce the magnitude or stop furthering of escalation before it become uncontrollable.
- They need to develop good planning and scheduling practices and proactive decision making will reduce delay and consequently price escalation. Therefore the clients, consultants and contractors should work very closely to address the major causes of price escalation.

In addition to the general recommendation, the following recommendations are reasonable to suggest and are workable.

For Clients

- To reduce the voluminous variation orders owners/clients should revise and properly examine bid documents and then as much as possible clearly determine the scope of the project before the original contract has been signed.
- Timely decisions and approval of requests that are based on the contract agreements should be done to reduce delay and consequently escalation.

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- Conducting strong feasibility analysis of projects by assigning adequate time and budget for the study and adopting good estimation models and methods so that there will not be underestimation of time and budget.

For Consultants

- Completing and getting approved the design and drawing works before the original contract.
- Closely supervising the work onsite based on the schedules set and continuous provision of instructions

For Contractors

- Proper preparation of detail bills of quantity and work scheduling which will be the basis for the volume and timing of materials required.
- In advance purchasing of materials and proper storage in cases when delay and inflation is expected.
- Equivalent to the increment of salaries for workers they must investigate and assure the productivity of workers.

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Annexes

Annex I: Consent Form

I am Hamelmal Mekonen, a graduate student of Construction Engineering and Management at Jimma University Institute of Technology (JiT). I am conducting my thesis work entitled “*Price escalation and mitigation methods among Jimma University Construction projects*”. The objective of the study is to assess price escalation and mitigating mechanisms among the different construction projects under Jimma University. Your project is selected as one of the study sites and hence you are assumed to be a key informant for this study. Please answer, the rate and tick (“√”) the questionnaire by choosing the appropriate choice. The questionnaire has three parts. Part one comprises of company and respondent information, part two deals with price escalation and factors causing price escalation, and part three is about mitigation of price escalation and possible remedial measures.

I realized that there are numerous demands on your time. However, your involvement in this study is vital. I am very grateful and appreciate your anticipated cooperation in answering this questionnaire, which may take less than about 20 minutes of your valuable time

Yes, I am volunteer ----- (proceed)

No, I am not volunteer----- (stop here)

Thank you for your earnest cooperation in advance

Best Regards

Sincerely yours

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Annex II: Survey Questionnaire

Part One: General /Companies' and respondents' information

1. Company name (optional): _____
2. What is the type of organization you are working in? (please indicate with "√" on a box)
A) Client Local Foreign
B) Contractor Local Foreign
C) Consultant Local Foreign
3. If foreign consultant/contractor, how long have your organization been involved in Ethiopian building construction sector? _____ years
4. What is your title/position?
Project manager Project engineer Construction engineer
Office engineer Design engineer Consultant
Others, specify _____
5. How many years of experience do you have? _____ Years
6. How many construction projects have you been involved in? _____ Projects
7. Educational status?
PhD Master's degree First degree/B.Sc. Diploma Others (specify)

Part Two: Price Escalation and Factors causing price escalation

1. Did your project experience price escalation? Yes No
2. If your answer to question number 1 is yes, what mitigation did you take?

3. What are the major factors responsible for escalation in your company? You can choose more than one answers
A. Inflation D. Late material delivery F. UN skilled workers
B. Design change E. Price escalation of G. Poor estimation of price
C. Project delay construction materials H. Shortage of supply
4. What are the factors influencing price increase, if any, of construction materials like steel, cement, bricks, fuel, Bitumen, coarse aggregate and sand?

5. What are the factors influencing the increase in wages (Salaries) of labors, if any?

6. Please indicate your response based on your experience in handling of the current construction Project you are working in. Please express your opinion on **rate of**

occurrence (frequency of occurrence) based on the representative numbers listed below and tick (√) at each preference.

Key: 0=Very low, 1=Low, 2=Medium, 3=High, 4=Very high

S.no	A. Client – related factors	Rate of occurrence				
		0	1	2	3	4
1	Number of change / Extra work orders					
2	Slow decision making					
3	Delay in contract award					
4	Delay in handing over of site					
5	Unrealistic schedule					
	B. Contractor – related factors					
1	Planning and scheduling deficiencies					
2	Non-availability of sufficient amount of skilled labor					
3	Financial difficulties					
4	Low bid					
5	Lack of coordination between project participants					
	C. Consultant-related factors					
1	Poor site management					
2	Lack of sufficient experience of consultants					
3	Poor inspection plan by consultants					
4	Poor coordination/communication between consultant & parties					
5	Slowness in giving instruction					
	D. Internal factors					
1	Delivery/procurement approach					
2	Project schedule change					
3	Engineering and construction complexity					

4	Poor estimating					
5	Inconsistence application of contagions					
6	Ambiguity contract provision					
F. External factors						
1	Local concern					
2	Change in Legislation					
3	Fluctuation in money exchange rate					
4	Increase in demand for construction materials					
5	Limited capacity of material producers					
6	Increase in material cost					
7	Shortage of labor/skilled					
8	Bad weather condition					
9	Environmental impact					
10	Site conditions					

Part Three: Mitigation of Price escalation

1. What actions did you take in the events of price escalation (Multiple response is possible)?

Please circle

a) Absorb the effect in the profit margin **b)** Claim for compensation payment **c)** Other (specify)

2. Among them which construction inputs have you encountered price escalation in your organization? Please express your opinion below by making (√) under each box.

Materials Labor Equipment Overhead cost Others (specify)

3. The following are lists of major construction materials. For which items price escalation mitigation is made?

Cement Stone Metals Reinforcement Brick

Aggregate Sand Fuel Others (please specify)

4. What is your suggestions for controlling the price escalation of construction materials?

5. What are your suggestions for controlling the price of labors?

6. What general mechanisms did your company used to mitigate the total price escalation of the project?

Annex III: Interview

- What looks like your material, labor and equipment capacity?

- If you didn't have any of the above capacities how do you fill this gap?

- How do you explain your experience in the construction industry? (Year of service, how many and what type of projects you work on, how many of them you execute with in time and budget?)

- How strong is your projects' financial management system?

- How do you explain the supply system of construction inputs to your project? (How frequent is the refill and was there any period of stock out and delay?)

- In the current construction project did you experience price escalation? a) Yes b) No

- If yes to question no 7, how much was the escalation? (Either the amount of money or the percentage of escalation)

- If yes to question7, what were the major factors/ causes for price escalation in your project?

- How did you mitigate the price escalation?

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- If no to question 7, will you expect price escalation in the remained work? (if possible, mention the expected amount of escalation)
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- How frequently did the management meet to monitor the progress of your project? And what major decisions do the management decide when it meets?
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- Was there any design change or change from the original contractual agreement after you started construction and does it affect the cost of your construction? a) Yes b) No
 - If yes to question 12, how did you mitigate its effect?
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- How many times did you ask for financial claim during the life time of this project? and how many times you claim got accepted.
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-
- When was the starting time of you project?
 - When was expected time (contractual time) of completion at the time of the start of the project?
 - At what percentage of completion is the project at this time? _____%
 - When will be the expected time of completion at when we forecast right now?
-
-
-

Thank you for your time and cooperation!

Annex IV: Case Study (project A)

This is a template to extract data from different archives of the project. It contains the main variables that should be obtained from the live archives reflecting the actual scenario/experience of the projects.

1. The bid Cost-----ETB.
2. The Actual executed budget-----ETB.
3. The budget utilization status according to the different budget items?
4. The volume of work done-----%
5. The starting time-----?
6. The expected/contracted time of completion-----?
7. The market price information about of the inputs:
 - a. Fuel-----?
 - b. Cement-----?
 - c. Steel-----?
 - d. Foreign exchange rate-----?
 - e. The salary of workers-----?
8. Any adjustment used-----?
9. Design and related issues (including variations and design changes) and its effect on the budget -----?
10. Decision delays-----?
11. Any Force majeure -----?
12. Any claim and reasons of:
 - a. Finance-----?
 - b. Time extension-----?