CAUSES AND EFFECTS OF COST OVERRUN ON PUBLIC BUILDING CONSTRUCTION PROJECTS IN ETHIOPIA

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DECLARATION

I declare that this thesis entitled "**CAUSES AND EFFECTS OF COST OVERRUN ON PUBLIC BUILDING CONSTRUCTION PROJECTS IN ETHIOPIA**" is my original work. This thesis has not been presented for any other university and is not concurrently submitted in candidature of any other degree, and that all sources of material used for the thesis have been duly acknowledged.

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Abstract

Many projects experience cost overrun and thereby exceed initial contract amount. In Ethiopia, the number of public building construction projects is increasing from time to time. However, it becomes difficult to complete projects in the allocated cost and time. Taking into account the scarce financial resources of the country, cost overrun is one of the major problems in Ethiopia. Therefore, this research was carried out to dig-out information on the factors that cause cost overrun during construction and their effects on public building construction projects in Ethiopia. Questionnaire survey together with desk study was used to collect data on cost overrun. A total of 42 questionnaires from clients, consultants and contractors were collected and a desk study of 70 completed public building construction projects in Ethiopia were investigated and analyzed using both descriptive and inferential statistics. From the results it was found that 67 out of 70 public building construction projects suffered cost overrun. The rate of cost overrun ranges from a minimum of 0% to the maximum of 126% of the contract amount for individual projects. In this research it was found that the rate of cost overrun decreases with the increase in contract amount.

Respondents identified 39 causes of cost overrun for Ethiopian case. The most important causes of cost overrun were found to be inflation or increase in the cost of construction materials, poor planning and coordination, change orders due to enhancement required by clients, excess quantity during construction.

Spearman rank order correlation analysis was used to evaluate whether consensus of opinions exists between groups of respondents (client versus consultant, client versus contractor and consultant versus contractor). From the analysis of the results it was found that consensus of opinion exists between respondents on the factors that cause cost overrun and on their rate of occurrence.

The most common effects of cost overrun identified by this research were delay, supplementary agreement, adversarial relations among stakeholders, and budget shortfall of project owners. It is hoped that these findings will guide efforts to improve the performance of the construction industry in the future.

Key words: cost overrun, cause, effect, rate, public buildings.

CHAPTER 1 INTRODUCTION

1.1. The Study Overview

The construction industry has a great impact on the economy of all countries [Leibing, 2001]. It is one of the sectors that provide crucial ingredients for the development of an economy. According to Chitkara, (2004), the construction industry in many countries accounts for 6-9 % of the Gross Domestic Product (GDP); and according to Bhimaraya, (2001), it reaches up to 10 % of the GDP of most countries. In Ethiopia its percentage of GDP amounts to 3%, considerably lower than the sub-Saharan average of 6% [MoWUD, 2006]. The construction industry is a vital element of the economy and has a significant effect on the efficiency and productivity of other industry sectors. One cannot think of widespread investment in manufacturing, agriculture, or service sectors unless the construction results of infrastructure facilities are in place. In some of the developing countries, the growth rate of construction activity outstrips that of population and of GDP [Chitkara, 2004].

1.2. Construction Industry in Ethiopia

Ethiopia has a rich history of magnificent construction endeavors. The ruined palace of Queen Sheba at Yeha, the Obelisks of Axum, the rock-hewn churches of Lalibela, and the castles of Gondar are few examples of these expertises. With the advent of modern civilization, especially during the late 19th and early 20th century, there have been some significant developments in this regard. Even though, the development of the construction industry in Ethiopia is slow, it plays a key role in the development of the national economy.

The role the construction industry plays in socio-economic development is significant. It provides the basis upon which other sectors can grow by constructing the physical facilities required for the production and distribution of goods and services. The construction industry has a significant multiplier effect on the economy as a whole [MoWUD, 2006].
According to MoWUD, (2006), the interrelationship between the construction industry and the broader economy largely emanates from three of the industry's characteristics namely:

- The public sector is its major client;
- It's large size, ability to produce investment or capital goods which contribute significantly to national GDP; and
- It is a major source of employment, directly and indirectly by its multiplier effect.

Public construction projects in Ethiopia are parts of the country's development initiative. It shared considerable amount of the country's scarce financial resources. In Ethiopia, the construction industry is the highest recipient of government budget in terms of government development program. Consequently, public construction projects consume an average annual rate of nearly 60%, according to MoWUD, (2006), and 58.2% according to Wubishet, (2004), of the government's capital budget.

1.3. Challenges of Construction Projects

Construction Projects can be marvelous in their breadth and complexity from the Egyptian pyramids, Lalibela's rock-hewn churches, and Gothic Cathedrals to soaring skyscrapers and enormous bridges. It is obvious that the construction industry has special features that are not usually encountered in other industries. Usually in construction, when conditions in the field turn out to be more complex than what was anticipated in the planning and design phase, additional costs and time are needed. Any extremes can affect productivity level, damage materials and work in place. Moreover the industry, most of the time, is custom oriented, meaning that it is difficult to use mass production techniques. Because of all these factors and others, it is difficult to predict accurately how much money will be necessary to complete construction projects [Gould, et al, 2002]. Creating a large facility takes a long time and usually involves a large capital investment. Cost overruns, delays and other problems tend to be proportionally monumental [Gould, et al, 2002].

Cost is one of the primary measures of a project's success. This is true, especially for public projects in developing countries like Ethiopia, because public construction projects in theses countries are executed with scarce financial resources. Most literature review on

construction projects suggested that the common criteria for project success are generally considered to be cost, time and quality [Arditi et al, 1997; Frimpong et al, 2003]. Atkinson (1999) called these measures as the 'iron triangle'. Songer and Molenaar (1997) considered a project successful if it was completed on budget, on schedule, conformed to user expectations, met specifications, attained quality of workmanship and minimized construction aggravation. Generally, a project is considered successful if the project is completed within a stated cost or budget, getting the project into use by a target date, meets the technical specification, and if there is a high level of satisfaction concerning the project outcome among the project participants.

Completion alone does not constitute success for the project owner. For the owner, much of the success of a project depends on many factors, the most important of which is project completion within specified cost parameters (i.e. within a specified budget). The second most important factor affecting success is on time completion as delays in completion of facilities often directly equate to financial losses due to lack of revenue from facility operation [Darrell, 1995].

In Ethiopia, the present state of the construction industry falls short of meeting domestic and international quality standards and the performance demand expected from the sector [MoWUD, 2006]. Construction projects have problems with construction techniques and management as well as limitation of funds and time. The critical problems are inability to complete the projects on schedule, low quality work and cost overrun. In general, most (if not all), construction projects experience time overrun and cost overruns during their execution phase. An examination of the records of more than four thousand construction projects by Morris et al, (1998), showed that projects were rarely finished on time or within the allocated budget. Other researchers have also observed that time and cost overruns are common in the construction industry worldwide [Arditi et al, 1985].

1.4. Objectives of the Research

This study will be undertaken with the following main objectives.

1. Identifying the main causes of cost overrun and their overall effects for public building construction projects in Ethiopia.
2. Identifying the related responsible party to the causes of cost overrun.
3. Identifying the rate of cost overrun for various types of public building construction projects
4. Identifying the relationship between rate of cost overrun and contract amount.
5. Forwarding recommendations to minimize or to avoid cost overrun and frequency of its occurrence; and hence to reduce its consequential effects on public building construction projects in Ethiopia.

To assess the objectives, beneficiaries, and methodology of the research work it is diagnosed using a question and answer approach as shown in Table1.1 below

Table 1.1: The question and answer approach

1.5. The Research Motivations

N0.	Question	Answer
1	Why has the research been established?	Most Construction projects in this country suffer time and cost overruns.
2	What does the research try to achieve?	To contribute knowledge on problems of cost overruns their causes and their overall effects.
3	What are the important issues for the research?	Methodology and literature review together with distribution of questionnaire and desk study on public construction projects.
4	Who will benefit from or affected by this research?	Stake holders in construction industry and my self.
5	How can the research be done?	Literature review, distribution of questionnaires, and desk study on public building construction projects.

The initiation for the study of this research is largely due to personal observation and low performance of the construction projects in terms of cost and time. These include construction projects owned by the government and the private sectors. However, due to the limitation with regard to accessibility of data on private construction projects this thesis will focus on public building construction projects.

1.6. Overview of the Research Process and Study

This thesis will have the following broad categories.

Chapter I: Introduction/The research background
Chapter II: Literature review
Chapter III: The research design and methodology
Chapter IV: The research analysis and discussions
Chapter V: The research conclusions and recommendations

Each of the above chapters will contain the following contents as stipulated below.

Chapter I describes the research overview, its initiation and purposes. It also indicates the research objectives, how the research process is conducted and the contents of the research.

Chapter II covers the literature review part of the thesis; the literature review will include general information about cost, causes of cost overrun and their overall effects.

Chapter III covers the research methodology. The methodological approach consists of the overall research strategy; the research design, the analysis of the data and writing of the research paper.

Chapter IV contains the discussion and analysis part. It contains the findings on causes and effects of cost overrun; the rate of cost overrun on public buildings, the relationship between rate of cost overrun and contract amount and finally;

Chapter V in this part, the research conclusions and recommendations are presented. This will serve as an action guideline to stakeholders in the construction industry.

CHAPTER 2 Literature Review

2.1. General

Construction project is a mission, undertaken to create a unique facility, product or service within the specified scope, quality, time, and cost [Chitkara, 2004]. In practice, however,

some construction projects encounter cost overrun, delay on completion time or poor workmanship upon completion. Cost overrun, poor quality workmanship and delay of construction projects require an in-depth investigation to improve the outputs of the construction industry.

It is not uncommon to see construction projects failing to achieve their mission of creating facilities within the specified cost and time. Hardly few projects get completed on time and within budget since construction projects are exposed to uncertain environments because of such factors as construction complexity; presence of various interest groups such as the project owners, end users, consultants, contractors, financiers; materials, equipment, project funding; climatic environment; the economic and political environment and statutory regulations.

The successful execution of construction projects, keeping them within estimated cost and the prescribed schedules, primarily depends on the existence of an efficient construction sector capable of sustained growth and development in order to cope with the requirements of social and economic development and to utilize the latest technology in planning and execution. According to Chalabi, et al, (1984), adequate planning at the early stages of a project is crucial for minimizing delays and cost overruns.

Cost overrun is common in infrastructure and building construction projects. Researches on construction projects in some developing countries indicate that by the time a project is completed, the actual cost exceeds the original contract price by about 30 % [Al-Momani, 1996]. One of the most comprehensive studies of cost overrun that exists found that 9 out of 10 projects had cost overrun. Overruns of 50 to 100 % were common [Flyvbjerg, et al, 2003]. Studies of construction projects in India, for example, found that more than 60 % of projects experienced up to 200 % time overrun and 75 % cost overrun [Chandra, H. 1990].

According to Peter Hall, (1982), the Sydney Opera House in Sydney sets some kind of a world record for time delay and cost overrun. Originally estimated in 1957 to cost just

A$7.000.000.00 and to be completed in January 1963, it was in fact finished in October 1973 at a cost of A$102.000.000.00. This makes final costs about 14 times the original estimate.

2.2. Cost Overrun

The sad truth about construction cost overrun is that they have been a fact of life since Biblical times "*For which of you, intending to build a tower, sitteth not down first, and counteth the cost, whether he have sufficient to finish it?" Luke, 14:28;* quoted by L. Powers, (2006). The problem of cost overrun, especially in the construction industry, is a worldwide phenomenon, and its ripples are normally a source of friction among clients, consultants and contractors on the issue of project cost variation. Project cost overruns create a significant financial risk to clients. However, in spite of the risks involved, the history of the construction industry is full of projects that were completed with significant cost overruns [Garry, 2005].

2.2.1. Definition of Cost Overrun

a) **Costs overrun**: An instance in which the provision of contracted goods or services are claimed to require more financial resources than was originally agreed between a project sponsor and a contractor [User Guide, 2005].

b) **Cost overrun**: The amount by which actual costs exceed the baseline or approved costs [Wideman, 2002].

c) **Cost overrun**: The difference between the original cost and the actual cost when the project is completed [Avots, 1983]. Actually, Avots, (1983) used the word cost growth instead of cost overrun.

For the purpose of this research cost overrun is defined as the difference between the final actual cost of a construction project at completion and the contract amount, agreed by and between the client (the project owner) and the contractor during signing of the contract.

2.3. Causes of Cost Overrun

Angelo and Reina, (2002), stated that cost overrun is a major problem in both developed and developing countries. Several studies of major projects show that cost overruns are common. The causes of cost overrun in construction projects are varied, some are not only hard to predict but also difficult to manage [Morris and Hough, 1991]. According to a study made in Turkey by Arditi, et al, (1985), the important sources for cost overruns were found to be inflationary pressures, increases in material prices and workmen's wages, difficulties in obtaining construction materials, construction delays, deficiencies in cost estimates prepared by public agencies and unexpected sub soil conditions were the most important sources for cost overruns. Kaming, et al, (1997), studied the factors influencing construction time and cost overruns for high-rise projects in Indonesia, and pointed out that the major factors influencing cost overrun were material cost increase due to inflation, inaccurate material estimating and the degree of project complexity. Mansfield, Ugwu, and Doran, (1994), found that cost overrun is attributed to problems in finance and payment arrangements, poor contract management, material shortages, changes in site conditions, design changes, mistakes and discrepancies in contract documents, mistakes during constructions, price fluctuations, inaccurate estimating, delays, additional work, shortening of contract periods, and fraudulent practices and kickbacks.

Stewart, (1982), attributes cost overruns to several factors that are either not controllable or that to a varying degree are unmanageable. They include the accuracy of original cost estimate, degree of government regulation and control, construction completion delays, number of design changes, and labor related matters such as their availability, skills, and increases in fringe benefits.

According to Robert F. Cox, (2007), project owners identified five reasons for project cost overruns: these reasons were, incomplete drawings, poor pre-planning process, escalating cost of materials, lack of timely decisions and excessive change orders.

According to User's Guide, (2005), the following are the factors that change the cost of the construction projects through time: poor project management, design changes, unexpected ground conditions, inflation, shortages of materials, change in exchange rates, inappropriate contractors, funding problems and force majeure.

In developing countries the lack of proper phasing of construction projects can contribute to the economy to become 'overheated'. This leads to shortage of construction materials as the demand will exceed the supply, this in turn leads to a climb in the cost of construction materials; this inevitably gives rise to project cost overruns, with consequential effects on inflation and a decline on efficient activity in the construction industry [Mansfield, Ugwu and Doran, 1994].

According to Jahren, et al, (1990), on their research on predictors of cost overrun rates they found the following factors to influence the cost overrun rates; the size of the project, the difference between lowest bid and engineer's cost estimate, the type of delivery method, the level of competition, quality of contract documents, and the nature of interpersonal relations on the project.

Studies have shown that the size of a construction project influences the rate of cost overrun. Large projects are generally more complex, and in complex projects some items are fraught to be missed out or may be forgotten during planning and design stages hence the complexity may increase the rate of cost overrun. However, since the stakes are higher on larger projects, more care may be exercised from conception of the project until completion. Review of some literatures indicates support for both of these conflicting views. Randolph, et al, (1987), found that cost overrun rates decreased as the contract amount increased, while Rowland, (1981), found that cost overrun rates increased with increase in the contract amount of construction projects.

Factors that could influence construction costs are numerous. Chan and Park, (2005), stated that the cost of a construction project is affected by a large number of factors because of the fact that construction is a multidisciplinary industry and its work involve many parties such as the project owner and various professionals, contractors and suppliers. Thus, a construction project cost not only depends on a single factor but a cluster of variables that are related to the characteristics of the project and to the construction team as well as the market conditions.

In the following section of this research, factors which affect the cost of a construction project will be dealt in detail.

i. Poor Project Management

The role of the project manager or project management team is probably the most important element in controlling and/or managing the costs of a construction project. It is often true that a good project, if combined with poor project management, will usually face serious difficulties.

According to User's Guide, (2005), a poor project management structure will have an impact at all stages of the construction process leading to:

- ✓ Lack of planning and coordination;
- ✓ Poor communication between members of the project team and the project sponsor;
- ✓ Failure to identify problems and institute necessary and timely design and programming changes;
- ✓ Lack of control over time and cost inputs;
- ✓ Lack of end user involvement

Good project management manages costs by estimating, scheduling, accumulating and analyzing cost data, and finally implementing measures to correct problems related to cost.

ii. Unexpected Ground Conditions

Ground conditions can be assessed by the use of trial pits and borehole sampling onsite or by using hi-tech equipment. However, the actual site conditions for the full extent of a project are not usually determined until excavation is completed. It is sometimes possible that those difficult conditions are overlooked by the initial review or conditions have changed due to adverse weather conditions or changes in sub-soil conditions. Unexpected sub surface conditions can, at times, require fundamental redesign of projects at great expense. Changes in surface ground conditions can lead to problems for moving machinery and supplies around the site, and in undertaking excavations and laying foundations. This can also increase costs and add to the construction time required.

iii. Shortage of Construction Materials

During periods of high development where the level of construction activity is unusually high in a particular region, there may be shortages of some construction materials. Some times the local market may not be able to supply the full demand of these construction materials; hence, a need may arise to import these construction materials from abroad. If this was not anticipated in the original cost estimate, delays may occur and/or the prices of these elements may increase which consequentially lead to delay and cost overrun for the project.

iv. Change in Foreign Exchange Rates

The change in foreign exchange rate is particularly relevant if materials or other elements of the construction project are being purchased from foreign countries. If the foreign exchange rates change beyond the expected level; then the cost of the project may increase which automatically leads to cost overrun.

v. Inappropriate/Inexperienced Contractors

Contractors are selected on the basis of price, experience in undertaking particular types of construction project and their reputation or track record in producing high quality work

within budget and on time. In most cases there is a trade-off between price, experience and track record but the desire to accept the lowest tender does not always lead to a project that is completed within time and budget. According to Yates et al, (2003), in contracts where the Engineer's estimate is at least 15% greater than the contractor's bid amount there is a strong likelihood of cost overruns. Therefore, these projects need to be carefully tracked and documented.

There are cases where the prime contractor and sub-contractors go into bankruptcy during the construction period. This can lead to significant delays and extra costs arising as the project owner has to re-tender the remaining work to be undertaken by another contractor.

vi. Force Majeure

This term covers a range of events which are also commonly referred to as "Acts of God". They include revolution, war, riot, earthquake, landslide, fire, political and economic instability, projectile missile, hostilities, contamination and other such risks. Where they do occur, they will normally lead to significant delays and cost overrun to construction projects.

vii. Construction Cost Underestimation

A more serious situation can confront an owner when there has been deliberate underestimating of costs in order to obtain project approval or for fraudulent practices. According to studies made by Flyvbjerg, (2003), large projects have been intentionally underestimated in order to obtain voter support for the financing approvals. He sated that whatever the cause, almost all large public projects contain initial cost estimating errors that result in the need for increased funding to complete the projects.

Construction cost increases seem to materialize after the commencement of the construction but the problem is deep-rooted during contract cost estimation and tendering stage [Abukar Warsame, 2006].

According to Flyvbjerg, (2003), explanations of cost underestimation come in four types:

- ✓ Technical
- ✓ Economic
- ✓ Psychological, and
- ✓ Political

a) Technical Explanations

Most studies that compare actual cost at completion and estimated costs at the beginning of bid award of construction projects explain what they call "forecasting errors" in technical terms, such as imperfect techniques, inadequate data, honest mistakes, inherent problems in predicting the future, lack of experience on the part of forecasters, etc. [Wachs, 1990].

b) Economical Explanations

Economic explanations consider cost underestimation in terms of economic rationality. According to Flyvbjerg, (2003), two types of economic explanations exist; the first explained in terms of economic self-interest, the other in terms of the public interest. As regards self-interest, when a project goes forward, it creates work for engineers and construction firms, and many stakeholders make money. If stakeholders are involved in or indirectly influence the forecasting process, then this may influence the outcomes.

As regards the public interest, project promoters and forecasters may deliberately underestimate costs in order to provide public officials with an incentive to cut costs and thereby to save the public's money. Empirical studies by Wachs, (1990), have identified promoters and forecasters who say they underestimate costs in order to save public money. The argument has also been adopted by scholars, for instance Merewitz (1973), who explicitly concludes that "keeping costs low is more important than estimating costs correctly".

Both types of economic explanation account well for the systematic underestimation of costs. Both depict such underestimation as deliberate, and as economically rational.

c) Psychological Explanations

Psychological explanations attempt to explain biases in forecasts by a bias in the mental makeup of project promoters and forecasters. Politicians may want a monument complex or museums, and transportation officials sometimes have the mentality of building roads and bridges. The most common psychological explanation is probably "appraisal optimism." According to this explanation, promoters and forecasters are held to be overly optimistic about project outcomes in the appraisal phase, when projects are planned and decided [Fouracre et al., 1990]. An optimistic cost estimate is a low one. The existence of appraisal optimism in promoters and forecasters would result in actual construction costs being higher than estimated costs.

d) Political Explanations

Political explanations interpret cost underestimation in terms of interests and power [Flyvbjerg 1998]. A key question for political explanations is whether forecasts are intentionally biased to serve the interests of project promoters in getting projects started. For legal, economic, moral, and other reasons, if promoters and forecasters have intentionally fabricated a deceptive cost estimate for a project to get it started, they are unlikely to tell researchers.

viii. Change Orders or Variations Orders

Change orders are common in all types of construction projects [O'Brien, 1998; Ibbs et al, 2001]. Changes in construction projects can cause substantial adjustment to the contract duration and construction cost [Ibbs et al, 1998]. Changes can be deleterious in any project and can cause cost overrun, if not considered collectively by all project participants [Ibbs et al, 2001].

The most common effect of change orders, during the construction phase, is the increase in project cost [Construction Industry Institute, 1990]. Change orders have been found to be a major contributor to time and cost overruns [Jahren and Ashe, 1990].

Changes and variations are inevitable in any construction project [Ibbs et al, 2001]. In an ideal world, changes will be confined to the planning stages. However, late changes often occur during construction, and frequently cause serious disruption to the project**.** Project variations were identified as a major source of conflicts and disputes in the construction industries of many countries [Yates and Hardcastle, 2003]. The need to make changes in a construction project is a matter of practical reality. Even the most thoughtfully planned project may necessitate changes due to various factors [O'Brien, 1998]. Needs of the owner may change in the course of design or construction, market conditions may impose changes to the project, and technological developments may alter the design and the choice of the engineer. Furthermore, errors, additions and omissions during construction may force a change.

Changes can be originated from numerous factors pertinent to the construction projects. According to O'Brien, (1998), causes of change orders include the following:

- ✓ Additions and/or enhancement required by owners
- ✓ Accident or damage
- ✓ Force Majeure
- ✓ Unforeseen conditions
- ✓ Change in Plans and/or specifications
- ✓ Value engineering
- ✓ Acceleration

Changes in designs and contract documents usually lead to a change in contract price or contract schedule. Typically, change orders and variations present problems to all parties involved in the construction process. Usually, these design changes require additional time

and cost inputs which ultimately lead to time overrun and cost overrun. The impact of change orders or variations varies from one project to another. However, it is generally accepted that change orders or variations can affect construction projects with unpalatable consequences in time and cost [Ibbs et al, 1998; Ibbs et al, 2001]. Change orders that are imposed when construction is underway, usually lead to reworks, cost overrun and delays in project completion [Construction Industry Institute, 1990]. Rework and demolition are potential effects of changes in construction, depending on the timing of the occurrence of the changes, which ultimately lead to time and cost overrun.

Researches in construction projects in some developing countries indicate that by the time a construction project is completed change orders or variations result in an 8.3 % cost overrun [Al-Momani, A., 1996]. According to Michel Gibeault, (2007), change orders typically average between 2-5 % of construction costs, but can easily soar to more than 10 % depending up on the degree of changes.

ix. Inflation

Adamson (1996) defines inflation as the rate of increase in general price level in an economy. Generally, inflation is the term used when paper money loses value, or the buying power of money becomes less.

Inflation can act to increase the construction costs. If the rate of inflation increases above the predicted level during the construction period, then the original cost estimate will be exceeded. Obviously any factor that delays a construction project will expose the project to the risk of further inflationary cost increases.

Due to the nature of the process and the rate of return for work undertaken on construction projects, the effects of inflation can cause loss of profit to contractors and higher cost overrun to project owners.

Cost estimates for construction work are produced at a specific point in time and the prices used therein are relevant only for that time and for short near future. This is because prices for items supplied and work undertaken are continually subject to market forces.

In a study carried out by Pohl and Mihaljek (1992) in which they surveyed 1,015 World Bank projects, it was found that the nominal cost overruns were primarily due to unexpected inflation.

x. Acceleration Costs

Acceleration occurs when a project has been delayed, yet the owner demands that the contractor complete the contracted work before the contract completion date, or agreed-upon changed completion date, or when the contractor wants to complete early.

When acceleration occur the contractor typically will incur additional direct and indirect costs. While direct costs are relatively easy to quantify, indirect costs are difficult to identify and quantify [William C. Last, 2002]. If the contractor establishes a valid acceleration claim, it is entitled to recover the costs incurred. These costs may include increased mobilization and demobilization costs due to the need to commit additional resources in terms of labor, equipment and supervision at the project than originally contemplated by the original schedule; specifically, direct labor costs include such items as increased wage costs for additional workers, overtime pay and rental costs for additional equipment. Further, the contractor may incur additional costs for inefficiencies in labor. These inefficiencies may include congestion or fatigue from extensive overtime work. Labor inefficiencies are a hidden but very expensive cost of an acceleration. Nevertheless, while labor inefficiencies are a very real part of an acceleration cost, they are extremely difficult to quantify.

xi. Delay on completion Time and Delay on Payments

Delays defer income, while interest and interest of interest, keep accumulating. Long delays may result in projects ending up in the so-called 'interest trap' [Flyvberg, et al 2004], where a combination of escalating construction costs, delays and increasing interest payments result in cost overrun. According to Arditi et al, (1985), lengthy delays in inflationary environments increase cost overruns tremendously.

The overall lack of finance to complete a project, or delays in the payments for services by the project owners or clients can lead to significant problems. If the costs of a project have increased significantly beyond the original estimate, then work on the project may have to be stopped or be delayed until additional funds can be found. Delays on payment may some times provoke the contractor to claim for interest rates. If the payment by a project owner is slow, the contractor may begin to commit fewer resources to a project, and may even cease work if cash flow becomes a problem.

xii. Late Site Hand Over or Change of Location of Construction site

Late hand over of construction sites, some times may happen and substantially increase the cost of construction projects. In most international projects in Ethiopia late site hand over is a common form of claim source for compensation for contractors [Girmay, 2003]. For example, the Addis Ababa Bole International Airport Project has suffered an additional cost of about $1,000,000.00 USD due to late site hand over [Girmay, 2003]. Fortunately, domestic contractors do not ask for compensation due to late site hand over.

Sometimes the owner may decide to change the location of the project after the award to the winning contractor. This is a rare phenomenon but it does happen due to sudden and unavoidable circumstances. The change of location of a project might extensively change the entire character of the work that was initially required under the (awarded) contract or the new location of the construction site may have different sub surface condition that may necessitate the structure to be redesigned. In such cases it is rightly alleged that the changes do alter the "general scope of work" and therefore, the final cost of the project might exceed the original contract amount.

xiii. Provision of Clauses in FIDIC and MoWUD Standard Conditions of Contract Related to Cost

In construction contracts the contracting parties agree on conditions of work for the construction project to be carried out. Conditions of contract in the construction industry are prepared to be implemented according to the accepted practices. These conditions are intended to govern and regulate the obligation of each party that participates in the contract. It helps the parties to perform their part and facilitate the overall accomplishment of the projects. Federation International Des Ingenieurs Conseils (FIDIC) 1987, and Ministry of Works and Urban Development (MoWUD) 1994, standard conditions of contract are very widely used conditions of contract in the Ethiopian construction industry. They define the responsibilities of the parties involved in the contract and describe the guide lines to be followed for the contract administration. In Ethiopia, FIDIC 1987 standard conditions of contract have usually been used for international construction projects, while MoWUD 1994 standard conditions of contract have been usually used for domestic public construction projects.

The following FIDIC 1987 and MoWUD 1994 standard conditions of contract clauses are related to costs, they can consequentially alter the construction cost of projects unless and otherwise they are deleted or replaced by some other sentences in the particular condition of the contract for the specific construction projects.

FIDIC 1987 Clauses.

1. Cost incurred by the contractor due to delay of drawings and/or instructions for which notice has been given by the Contractor in accordance with Sub-Clause 6.3 (Clause 6.4)
2. Costs associated with the encountering of physical obstructions and conditions which would not have been foreseeable by an experienced contractor (Clause 12.2)

3. Errors in setting out which are based on incorrect written data supplied by the Engineer (Clause 17.1)
4. Loss or damage due to employer's risks (Clause 20.3)
5. Indemnities that the employer has contractually undertaken to assume (Clause 22.3)
6. Fossils or discovery of things of geological or archeological interest (Clause 27.1)
7. Cost associated by other interfacing contractors and workmen of the employer (Clause 31.2)
8. Cost associated with test of samples not provided in the contract (Clause 36.5)
9. Uncovering of works that has already been completed, but they are found to be executed in accordance with the Contract (Clause 38.2)
10. Suspension of work ordered by the Engineer (Clause 40.2)
11. Late possession of the site, which is as a result of a failure of the employer to give the required handover (Clause 42.2)
12. Remedying defects not the responsibility of the contractor (Clause 49.3)
13. Searching for defects which are not the fault of the contractor (Clause 50.1)
14. Additional costs due to variations works (Clause 51.1)
15. Interest on late payments due to failure of the employer to make payment within the times stated (Clause 60)
16. Costs due to special risks which very often include out break of war, projectile missile, hostilities, contamination and other such risks (Clause 65)
17. Contractors entitlement to suspended works due to employers failure (Clause 69.4)
18. Fluctuations in the cost of labor and/or material or any other matter affecting the cost of the execution of the works and subsequent legislation that affect the project (Clause 70)

MoWUD 1994 Clauses.

1. Cost incurred by the contractor due to ambiguities or discrepancies of documents which could not have been foreseen by the contractor (Clause 5.2)

2. Cost incurred by the contractor due to delay of drawings and/or order requested by the contractor in accordance with Sub-Clause 6.3 (Clause 6.4)
3. Costs associated with the encountering of physical obstructions and conditions which would not have been foreseeable by an experienced contractor (Clause 12)
4. Errors in setting out which are based on incorrect written data supplied by the Engineer (Clause 17)
5. Loss or damage due to excepted risks (Clause 20)
6. Indemnities that the employer has contractually undertaken to assume (Clause 22.2)
7. Fossils or discovery of things of geological or archeological interest (Clause 27)
8. Cost associated by other interfacing contractors and workmen of the employer (Clause 31)
9. Cost associated with test of samples not provided in the contract (Clause 36.4)
10. Uncovering of works that has already been completed, but they are found to be executed in accordance with the Contract (Clause 38.2)
11. Suspension of work ordered by the Engineer (Clause 40.1)
12. Costs incurred by the contractor due to failure on the part of the employer to give possession of the site in accordance with the terms of the contract (Clause 42.1)
13. Costs for the execution of work of repair not the responsibility of the contractor (Clause 49.3)
14. Searching for defects which are not the fault of the contractor (Clause 50)
15. Additional costs due to variations works (Clause 51.1)
16. Costs due to special risks which very often include out break of war, projectile missile, hostilities, contamination and other such risks (Clause 65)
17. Fluctuations in the cost of labor and/or material or any other matter affecting the cost of the execution of the works and subsequent legislation that affect the project (Clause 70).

2.4. Effects of Cost Overrun

The global construction industry is plagued with cost overruns in project delivery. This development has brought about loss of clients' confidence in consultants, added investment risks, inability to deliver value to clients, and disinvestment in the construction industry [Mbachu and Nkado, 2004].
Cost overruns in public and in private construction projects are often the stuff of scandal in the news media. Typically owners and contractors are treated as eager participants in bribes, illegal financing and other forms of corruption and waste [Oberndorfer, 1994].

Cost overruns have obvious effects for the key stakeholders in particular, and on the construction industry in general. To the client, cost overrun implies added costs over and above those initially agreed upon at the onset, resulting in less returns on investment. To the end user, the added costs are passed on as higher rental/lease costs or prices. To the professionals, cost overrun implies inability to deliver value for money and could well tarnish their reputations and result in loss of confidence reposed in them by clients. To the contractor, it implies loss of profit for non completion, and defamation that could jeopardize his/her chances of winning further jobs, if at fault. To the industry as a whole, cost overruns could bring about project abandonment and a drop in building activities, bad reputation, and inability to secure project finance or securing it at higher costs due to added risks [Mbachu and Nkado, 2004]. All these consequences undermine the viability and sustainability of the construction industry.

According to Arditi, et al, (1985), the effects of cost overrun are not confined to the construction industry but are reflected in the state of the overall economy of a country. They state that delays and cost overruns in construction projects prevent the planned increase in property and service production from taking place, and this phenomenon in turn affects, in a negative way, the rate of national growth.

Angelo and Reina, (2002), state that the problem of cost overrun is critical and needs to be studied further to alleviate the problem in the future. Project cost overruns can cause a

slower payout and reduce an early return on the client's or project owner's investment [Ritz, 1994].

2.5. Cost Management

Managing construction costs includes estimating, scheduling, accumulating and analyzing cost data, and finally implementing measures to correct construction cost problems. Throughout a project's planning, design, and construction phases, cost management is employed as a means of balancing a project's scope, expectations of quality and budget. The approach can be summarized as requiring the following three steps:

1. Define the scope, the level of quality desired, time for completion and the budget,
2. Ensure that the scope, quality, time and budget are aligned,
3. Monitor and manage the balance of these components throughout the life of the construction project.

Project cost management begins with the identification of the owner's objectives and ends when those objectives have been met. The purpose of project control is to guarantee that the project's design, budget, and schedule are met by the project team. If any objective begins to slip, the control system will identify this deviation early so that the appropriate correction can be made timely. Project cost control provides management with cost related information for making decisions with a view to complete the project with specified quality, on time and within budgeted costs [Bill, et al, 2006]

In construction projects, generally, there are two parties whose investments are involved; the project owner (or client) and the contractor. This section of the research paper will focus on the cost management objective of the client. Client's investment starts with his decision to go ahead with the project. His expenses continue during design, execution and commissioning stages. After taking into considerations the contract commitments, he

formulates his cost budget for the project. Clients try to reduce their budgeted costs by various measures such as economizing the scope of work and offering incentives to contractors for early completion, which may yield them early revenue from the project than the originally planned completion time.

2.5.1. Controlling construction Costs

In civil engineering, cost control is the periodic auditing of actual costs for the construction and commencement of operations of an engineering project [Oberndorfer, 1994]. Cost control during the construction process is vital to ensure the success of a project. As a project progresses more information becomes available to allow costs to be calculated to a greater degree of accuracy, and these information helps for controlling costs. However, most construction projects share the common theme that they are fraught with risks and uncertainty that can cause cost overrun. For example, Laufer, A. et al, (1993), found that about 80% of all projects begin the construction process with a high level of uncertainty.

Many aspects in construction process remain uncertain and normal costing practice is to include an extra element to provide "insurance" against cost overruns. The word "contingency" is usually used to describe this additional cost element. The contingency is typically based on a "rule of thumb" calculation, as a certain percentage of the estimated cost. A figure of 10% of gross costs is a common allowance. The use of a better specified contingency will only be effective if suitable project control procedures are in place to control all aspects of project performance. However, it should be noted that improved contingency planning can never be a substitute for good project cost management.

2.5.2. Phases in Building Construction for Cost Management

According to Bill, et al, (2006) there are three phases for construction cost management theses are: Planning phase, Design phase and Construction phase.

i) Planning Phase

This is a critical stage in the cost management process; an inaccurate planning can doom a project to continual stress and compromise, neither the client, end-user nor design team being completely satisfied at the end. A common mistake at this stage is to apply those historical data without making adjustments for the myriad factors which affect construction costs such as size of the project, location, price increases, delivery system, overall quality of the project envisioned, etc [Bill, et al, 2006].

Early cost estimates are employed in the early planning phases of a proposed project to match an owner's needs, expressed as written programmatic requirements, with budget constraints in order to establish its overall scope and quality expectations. Value Engineering should also be considered at this stage. Any changes to the program at this early phase have very little, if any, impact on schedule and redesign costs, but the benefits in terms of solidifying the program and establishing project goals can be huge.

Most owner and designer cost control problems are created at the planning stage of a project. At this time, client needs sometimes are understated in order to justify a project. More often than not, client needs are not fully known and thus are oversimplified [Donald E. Parker, 1984].

ii) Design Phase

Once an initial budget has been established, the scope set and the quality expectations documented, it is important to monitor the estimated cost of the project by employing a series of increasingly precise cost estimating techniques that coincide with further development of design and construction details.

Estimates are employed at various stages of project design development as part of ongoing cost management, and as a means of evaluating competing alternatives. The drawings and specifications should also go through a constructability review, wherein the construction documents are analyzed for completeness, coordination between activities, cost effective designs, and general code compliance. The specifications should also be

reviewed to ensure that the general requirements included are not overly restrictive (e.g. working hours, noise restrictions and so forth).

iii) Construction Phase

At the bid stage, drawings should be nearly 100% complete; however, in many instances this does not happen, leading to addenda being issued to clarify details, resolve conflicts or to complete the design. The preparation of the bidding documents is also crucial in an overall cost management strategy. Consideration should be given to contract clauses that govern changes in the work and how they will be valued; allowable mark ups on changes by the various levels of contractors and sub-contractors; notice requirements for delays; the use of unit prices for changes and any other clauses that may affect the final cost of the project.

During construction, usually, the focus shifts from predictive cost estimating to reactive cost control of any changes in the work. Changes arise from a number of different sources; unforeseen conditions, owner generated changes, drawing errors and omissions, code issues or contractual claims, etc. In addition, changes can arise from ongoing proactive cost management, generated either by the consultant, the client or by the contractor, where one of the parties proposes a better value substitution.

2.5.3. Construction Cost Estimate

Ahuja, (1994), states that estimating is the primary function of the construction industry; the accuracy of cost estimates starting from early phase of a project through the tender estimate can affect the success or failure of a construction project [Ahuja 1994]. He also states that many failures of construction projects are due to the result of inaccurate estimates. A study conducted in United Sates of America on cost estimation problems associated with pioneer energy projects and process plants revealed that 74% of cost growth was caused by underestimation, that is, improper estimation (Merrow, 1988).

Cost is a major factor in most decisions regarding construction; since construction cost estimate is prepared before the actual construction of the project, much study and thought must be put into the construction documents. However, estimates made in the early phases of a project are particularly important because they affect the most basic decisions about a project: whether it will be undertaken at all; how large it will be; how elaborate, sophisticated and durable it will be.

As projects develop, there is continual competition among issues of quality, size, performance and cost. Owners want the biggest building with the best finishes and systems that will perform over time for the least amount of money. With these criteria, conflicts are bound to arise. The design and construction team uses estimates to insure that good cost information is developed and a feed back loop established so that these conflicts can be addressed as quickly as possible. Estimates are products of information supplied by the designer, the owner, and the suppliers. Estimates are not guarantees of costs; used properly, however, they can be important tools in bringing a project under or at budget with the appropriate features for the owner. The costs developed during design stage and even at the bidding stage are almost never the final and complete costs of a construction project. In theory, the unknowns (i.e. the risks associated with a construction project) can be shown to decrease as the project progresses to completion. The question of accuracy is often raised; the best possible estimate will always contain a number of key risks. The goal of the estimator is a practicable level of accuracy. An estimate can only be as accurate as the information upon which it is based.

2.5.3.1. Cost Estimating at different Stages of a Project

All projects begin with an idea and end by filling a need. As a project is proposed and then developed, through time the estimate preparation and information will change based on the needs of the owner or the designer. Generally, cost estimating is a dynamic process that begins in the early stages of a project and ends when the project is completed and turned over to the owner.

It is important to consider the project stages at which estimates can realistically and usefully be produced so that there is a sound basis for deciding whether or not to proceed to the next stage. The number of stages in a project is influenced by the project delivery strategy adopted. According to Nigel J. Smith, (1995) traditional civil engineering projects can be divided into six stages: Identification, Appraisal, Definition, Approval, Implementation and Operation.

These stages may not be appropriate for every project and cannot be adhered to exclusively, but they do offer a rational and structured approach which is applicable to many construction projects. Figure 2.1 shows the sequence of these project stages and indicates the types of estimate used in each stage.

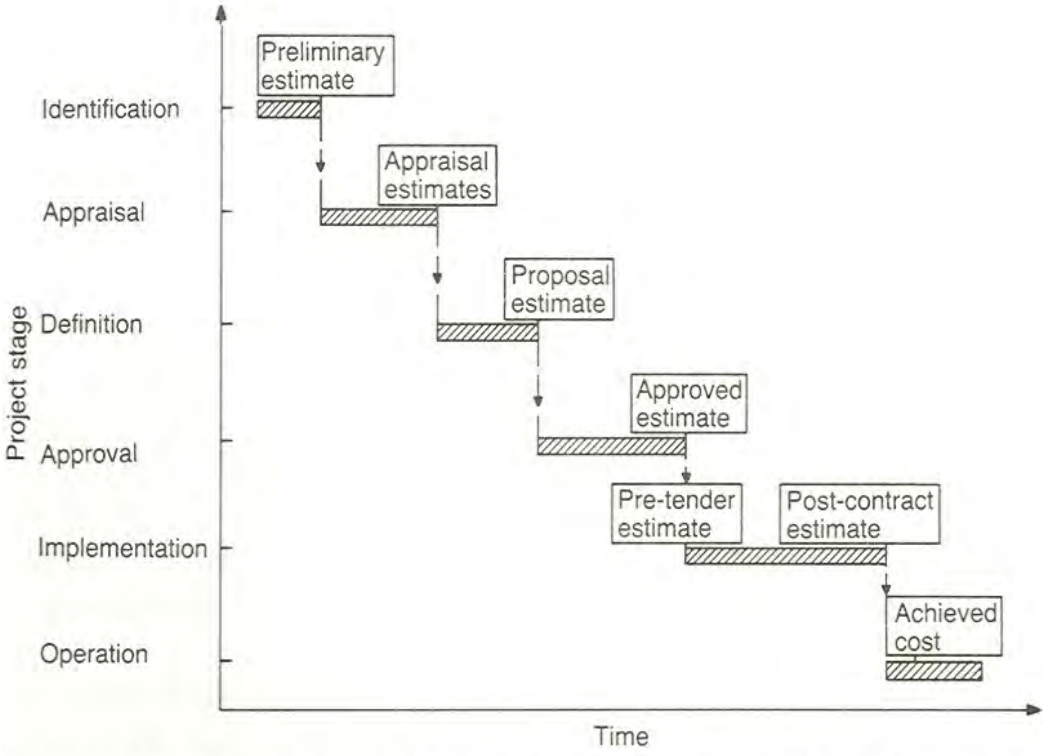


Fig. 2.1 Construction cost estimate with changes in the project stage: (Nigel J. Smith, 1995)

i. Preliminary estimate:

This is an initial estimate at the earliest possible stages. It is likely that no design data will be available and that there will be only a crude indication of the project size or capacity. The preliminary estimate is likely to be of use in the provisional planning of capital expenditure program.

ii. Appraisal estimates:

Sometimes known as feasibility estimates; these are directly comparable estimates of the alternative schemes under consideration.

iii. Proposal estimate:

This is an estimate for the selected scheme. A proposal estimate is usually based on a conceptual design and design study specifications.

iv. Approved estimate:

A modified version of the proposal estimate to reflect the client's views, which is intended to provide the basis for project cost control.

v. Pre-tender estimate:

A refinement of the approved estimate based on the definitive design work using the information provided in the tender documents which should be used during bid evaluation as a marker against which bids can be assessed.

vi. Post-contract estimate:

Once the design documents are complete, companies interested in actually performing the work price the project. At this level the cost estimate is made by contractors who want to execute the project. This estimate is the most important. It carries with it legal implications;

if the bid is accepted, a construction company is legally bound to a specific price for a specific scope of work.

This estimate serves as a base-line cost for comparing the deviation of the actual cost from the initial contractors estimate. It also serves for controlling and managing costs during construction phase.

vii. Achieved cost (Actual Cost):

This is a record of the actual costs of the job in order to review performance and provide data for future projects. It is useful to compare the actual use and expenditure of allowances and contingencies with those included in the various estimates.

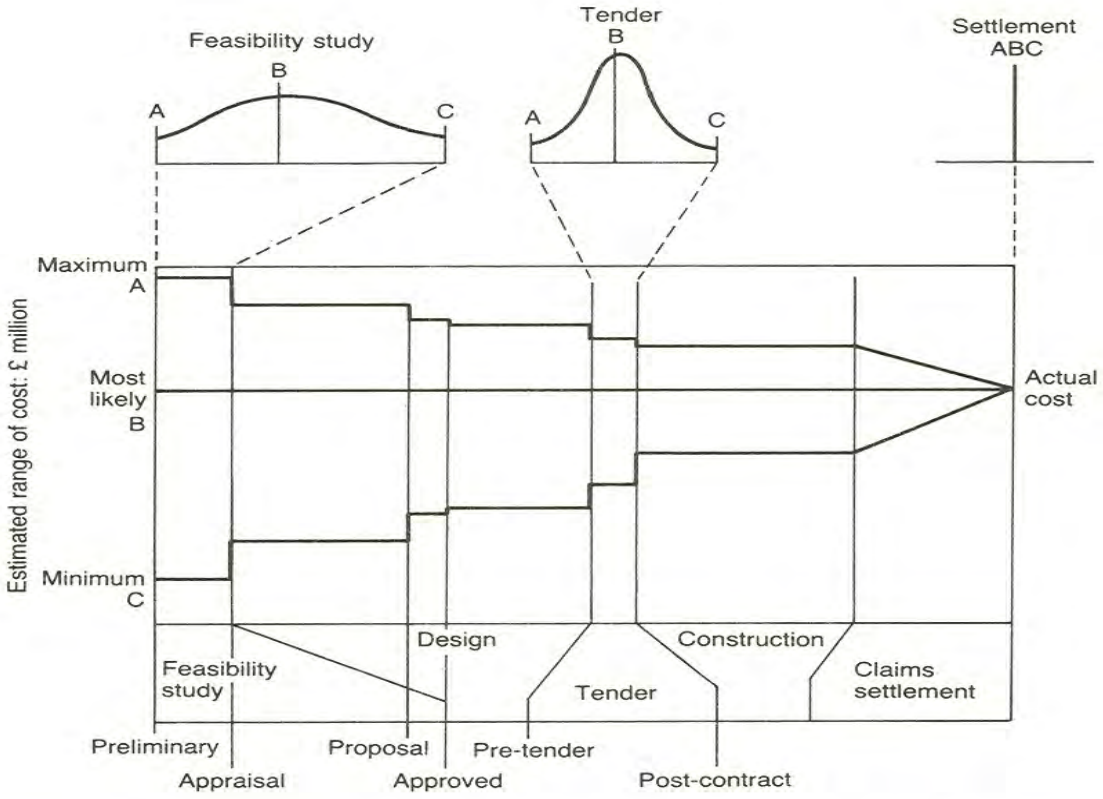


Fig. 2.2 Estimated Envelope Stepped: the estimated value does not follow a continuous evolution but is refined in stages when the estimates are produced: (Nigel J. Smith, 1995)

Every estimate, whether prepared in the early phase of the project or at tender time considers the same basic issues. Project price is affected by the size of the project, the quality of the project, the location, construction start time and duration, and other general market conditions, etc... The accuracy of an estimate is directly affected the availabilities of data and by the ability of the estimator to properly analyze these basic data.

CHAPTER 3 The Research Design and Methodology

3.1 The Study Approach and Research Type

Kumar, (1999), considers research as a process of collecting, analyzing and interpreting information to provide solutions to questions. For the purpose of this thesis, research is defined as a practical investigation or exploration to find out new facts or assemble old facts by scientific ways for the purpose of developing existing theory or its application for real problems. Research can either be a theory based (deductive), or a problem initiated for theory contribution (inductive), or a mixed approach to research.

3.1.1 The research type

The research is a practical problem developed from the observation of construction projects and the research questions are oriented to investigate the cause of cost overrun and their effects.

This research can be categorized as applied, exploratory, descriptive and co-relational type. It is applied and exploratory because the research was initiated from practical problems and finds whether there exists cost overrun or not. It is also descriptive and co-relational because it tried to describe the actual rate of cost overrun and the variables of cost overrun and tries to draw relationship between contract amount and rate of cost overrun in the Ethiopian public building construction projects.

3.2 The study scope and limitation

Cost overrun in building construction projects are caused by many factors. Each causes of cost overrun have different rates of occurrences and their impact on the final cost of the construction project also varies. Therefore, it is important to identify both key causes of cost overrun based on their occurrence and their impact on building construction projects. The effects of cost overrun on the stakeholders, on the construction industry, and on the national economy of the country will be identified.

The research work was not with out its problems and limitations which were encountered throughout the preparation of this research. Its limitation is the unavailability of adequate documented information in the field of the study, and the reluctance of some stakeholders in the construction industry to provide information related to cost.

3.3 Data Source and Collection

The study has used the data sources to produce the following basic documents: respondents' documents and archival documents. The respondents' documents were collected using questionnaires from clients (project owners), contractors and consultants. There are two basic types of survey questions from which to choose: open-ended and closed-ended. This questionnaire survey has both open-ended and closed-ended questionnaires. Archival documents were mostly from completed projects, in which contract documents, project reports, correspondence letters and payment certificates were investigated thoroughly which were very important in identifying the recurrent problems

related to cost in the Ethiopian building construction sector. In addition, they helped to judge how problems on causes of cost overrun arise and how they are documented.

Data collection part of the research is the most tiresome part; the most difficult one is the respondents' reluctance to react as per their promised schedule. The time schedule that was allocated to the research and respondents reluctance not to respond quickly made the research stressful for the period of data collection.

Owing to the large number of public agencies that own construction projects and the large number of contracting and consulting companies that undertake work for public agencies a survey by questionnaire was found appropriate in addition to the desk study. The questionnaire was carefully designed in light of getting high response rate from respondents.

The answers for the structured part of the questionnaire are based on Likert's-scale of five ordinal measures of agreement towards each statement (from 0 to 4) as shown in the following sections. The reasons for adopting this simple scale are:

- To provide simplicity for the respondent to answer, and
- To make evaluation of collected data easier

Likert's-scale is important to know respondents' feelings or attitudes about something. The respondents must indicate how closely their feelings match with the question or statement on a rating scale.

After the variables of cost overrun in building construction projects are identified; respondents are asked about their agreement on these variables in causing cost overrun. Accordingly the respondents choose one of the following based on their feeling.

0- I strongly disagree

1- I don't agree
2- Neutral
3- I agree
4- I strongly agree

After expressing their agreement and/or disagreement on the variables of cost overrun respondents are asked about the chances of occurrences of these variables based on the following choices.

0- Not at all = 0% probability to happen
1- Unlikely = 0% - 25%
2- Likely = 26% - 50%
3- Almost certain = 51% - 99%
4- Certain = 100% probability to happen

After identifying the chances of occurrence of the cost overrun variables respondents were asked about the impacts of each causes of cost overrun based on the following choices.

0- No significance
1- Minor significance
2- Average significance
3- High significance
4- Extreme significance

After data is gathered on causes of cost overrun, the responsible party from stakeholders in the construction industry has to be identified for the cause of cost overrun; the questionnaires are prepared in such a way that detailed information can be gathered in a systematically prepared matrix table.

3.4 The Research Population

The research samples are taken from stakeholders in the construction industry which are clients (project owners), contractors and consultants, that are selected depending on their direct exposure to building construction activities. Project owners are selected from both the Federal and regional public agencies, project owners from Addis Ababa, Amhara and Oromia were selected. Consultants were selected based on their class categories, such as consultants above category 4 are selected. Their lists were taken from MoWUD office and the research samples were selected randomly from the list. Contractors were also selected based on their grade categories, General contractors (GC) and Building Contractors (BC) above grade GC/BC 5. Their lists were taken from MoWUD office and the research samples were selected randomly from the list. Building projects with contract amount greater than or equal to one million birr are surveyed in the desk study.

3.5 Method of Analysis

Both descriptive and inferential statistics are employed in the data analysis. In the analysis the "Mean Score" method is adopted to establish the relative importance of the causes of cost overrun for public building construction projects in Ethiopia. As discussed earlier Likert's scale of five ordinal measures of agreement towards each statement (0, 1, 2, 3 and 4) is used to calculate the mean score for each factor that is used to determine the relative ranking.

The mean score (MS) for each variables of cost overrun is computed by using the following formula;

$$MS = \frac{\sum (f \times S)}{N} \quad \text{---------- [3.1]}$$

Where:

MS – Mean Score

f – Frequency of responses for each score

S – Scores given to each factor (from 0 to 4)

N – Total number of responses concerning each factor

The Spearman (rho) rank correlation coefficient is used for measuring the differences in ranking between two groups of respondents scoring for various factors (i.e. clients versus consultants, clients versus contractors, and consultants versus contractors).

The Spearman (rho) rank correlation coefficient for any two groups of ranking is given by the following formula.

$$\text{Rho } (\rho_{cal}) = 1 - \frac{\mathbf{6 \times (\Sigma d_i^2)}}{\mathbf{N \times (N^2 - 1)}} \quad \text{---------- [3.2]}$$

Where:

Rho (ρ_{cal}) – Spearman rank correlation coefficient

d_i – The difference in ranking between each pair of factors

N – Number of factors (variables)

Procedure for hypothesis testing:

1. Define the null hypothesis (H_0) and the alternative hypothesis (H_A)
2. Choose a value for ρ. (i.e. choose the significance level)
3. Calculate the value of the test statistic, Rho (ρ_{cal}).

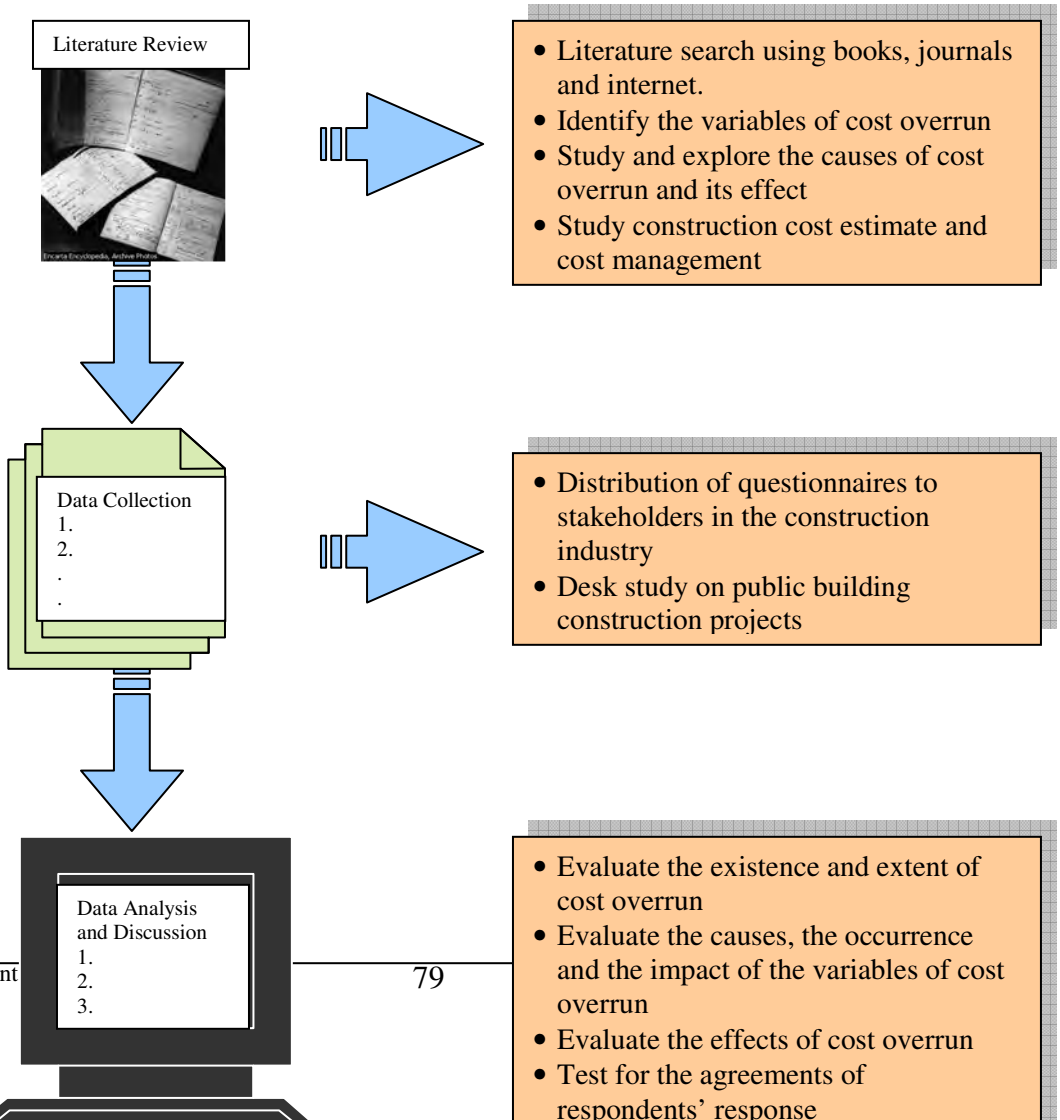
4. Compare the calculated value with a table of the critical values of the test statistic.

5. If the calculated value of the test statistic is less than the critical value from the table, accept the null hypothesis (H_0). If the absolute (calculated) value of the test statistic is greater than or equal to the critical value from the table, reject the null hypothesis (H_0) and accept the alternative hypothesis (H_A).

3.6 Writing of the Research

The research contains four main parts. These are the research proposal, the literature review part, the research methodology and analysis, and the final research writing. The research proposal writing was already taken place. The literature review part took the longest period of the research. During this period, different documents were collected and tested against the research objectives and the relevant information were taken. Finally all the notes taken down were linked to produce a document; the differences in perceptions between authors being noted down. The final research part was written after analyzing all primary and other support documents to test the actual existing situation of the construction industry towards the research objectives. Finally, the conclusions and recommendations part was written. The final research writing was classified into the following five major parts for final presentation.

Chapter I: Introduction
Chapter II: Literature Review
Chapter III: The Research Design and Methodology
Chapter IV: Data Analysis and Discussion
Chapter V: Conclusions and Recommendations


Literature Review
Literature search using books, journals and internet.
Identify the variables of cost overrun
Study and explore the causes of cost overrun and its effect
Study construction cost estimate and cost management
Data Collection
1.
2.
.
.
Distribution of questionnaires to stakeholders in the construction industry
Desk study on public building construction projects
Data Analysis and Discussion
1.
2.
3.
Evaluate the existence and extent of cost overrun
Evaluate the causes, the occurrence and the impact of the variables of cost overrun
Evaluate the effects of cost overrun
Test for the agreements of respondents' response

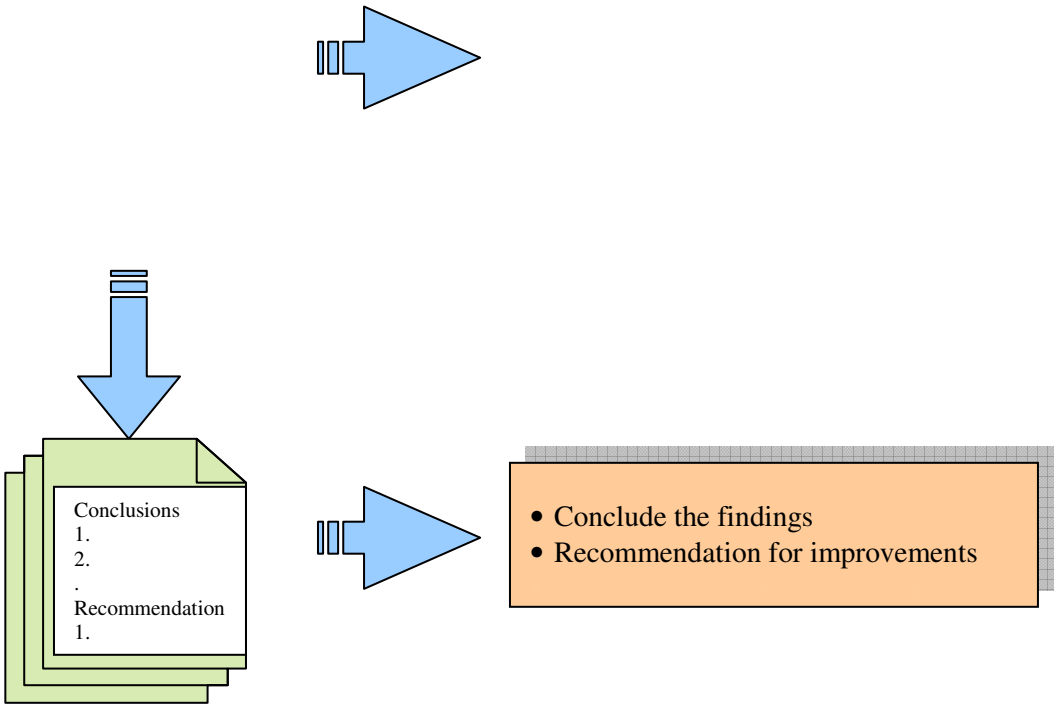


Fig. 3.1 Flow chart of research methodology

CHAPTER 4 Data Analysis and Discussion

4.1. Introduction

This part of the research deals with the analysis and discussion of the data gathered from the desk study and questionnaire survey. It includes the identification of the existence and extent of cost overrun, relationship between rate of cost overrun and contract amount, main causes of cost overrun, rate of occurrences of variables of cost overrun, the impact of the variables of cost overrun on the final/total cost of the project. Finally, the effects of cost overrun on the various stakeholders, on the construction industry, and on the national economy in general will be dealt.

The procedure used in analyzing the results was aimed at establishing the relative importance of the various factors responsible for cost overrun and their effects. The questionnaire gave each respondent an opportunity to identify the factor that was likely to cause cost overrun by giving the response “I strongly disagree”, “I disagree”, “I agree”, etc…; frequency occurrence of the variables of cost overrun ; and the impacts of each cost

overrun variables on the final cost of the project. For each variables of cost overrun, the percentages of respondents' response were ranked for analysis purpose. On the basis of the ranking of the variables by the various groups, it was possible to identify the most important factors that influenced cost overrun in public building construction projects in Ethiopia.

From the desk study a variety of completed public building construction projects throughout Ethiopia were surveyed. During the desk study all the documents of each project such as correspondence letters, project report, payment certificate, the contract amount, contract time during signing of the contract actual cost and actual completion time at completion of the project were thoroughly investigated. These help to understand the reasons behind each project for cost overrun, and to investigate how the actual cost at completion deviates from the contract amount. Collecting these data helped to analyze and draw the relationship between rate of cost overrun and contract amount.

4.2. Questionnaire Response Rate

Detailed questionnaires were designed and distributed for the assessment of cost overrun on public building construction projects in Ethiopia, for this purpose the questionnaires were distributed to major stakeholders in the construction industry; these are Contractors, Consultants and Clients (project owners). To make the analysis more comprehensive a total of 63 questionnaires were distributed to consultants, contractors and clients (project owners) out of which 42 questionnaires were filled and returned. Table 4.1 below shows the number of questionnaires distributed to clients, consultants and contractors and the number of questionnaires returned from these stakeholders including their percentage response rate.

Table 4.1: Summary of number and percentage of questionnaires distributed and returned; and response rate

4.3. Existence and Extent of Cost Overrun

The first step in this research is to check whether cost overrun in public building construction projects in Ethiopia had been found existent or not. On the basis of data gathered from the desk study, out of 70 public building construction projects investigated 67, (95.7%), public building projects suffered cost overrun. From this result, the number of construction projects that suffered cost overrun in Ethiopia are more than the number of projects that suffered cost

No.	Respondent	Questionnaire distributed		Questionnaire Returned		Response Rate
		No.	(%)	No.	(%)	(%)
1	Client	18	28.57	13	30.95	72.22
2	Consultant	23	36.51	15	35.71	65.22
3	Contractor	22	34.92	14	33.33	63.64
	Total/Average	**63**	**100.00**	**42**	**100.00**	**66.67**

overrun in other countries, as indicated in the literature review part of this thesis Flyvbjerg, et al, (2003), found that 9 out of 10 projects experienced cost overrun.

The total cost overrun ranges from the minimum amount of 0% to the maximum amount of 126% of the contract amount for individual projects; and the mean rate of cost overrun was found to be about 15.14% of the contract amount. These results show that the rate of cost overrun in Ethiopian public building construction projects is less than the values found by other researchers in different parts of the world. For example, Al-Momani, (1996), found that at project completion the actual cost exceeds the original contract price by about 30%.

Table 4.2, below shows the types of public building projects, contract amount, contract time, actual cost and actual time at completion, and rate of cost overrun.

Table 4.2: Summary of project type, contract amount and actual cost, contract time and actual completion time for public building construction projects

Item No.	Project	No. of Projects	Sum of Contract Amount, $x10^3$ (Birr)	Sum of Actual Cost at Completion, $x10^3$ (Birr)	Sum of Contract Completion Time (days)	Sum of Actual Completion time (days)	Sum of Cost Overrun, $x10^3$ (Birr)	Cost Overrun (%)
1	Educational Buildings	29	579,654.49	631,703.16	17,074.00	30,025.00	52,048.67	8.98
2	Office Buildings	15	81,602.00	93,714.40	7,462.00	12,860.00	12,112.40	14.84
3	Residential Buildings	10	149,574.00	171,906.75	4,856.00	7,545.00	22,332.75	14.93
4	Health Buildings	9	85,096.00	124,867.04	3,509.00	5,977.00	39,771.04	46.74
5	Industrial Buildings	4	68,705.00	85,219.42	1,630.00	4,090.00	16,514.42	24.04
6	Others	3	21,786.00	28,309.60	789.00	1,945.00	6,523.60	29.94
	Total/Mean	**70.00**	**986,417.49**	**1,135,720.36**	**35,320.00**	**62,442.00**	**149,302.88**	**15.14**

Source: various

From the above Table 4.2, it can be seen that the rate of cost overrun has significant variations for the different types of public building construction projects. From the desk study it was found that educational buildings projects have the lowest rate of cost overrun with 8.98% of the contract amount. Which means educational building projects required an additional cost of 8.98% to accomplish the project. The reasons for rate of cost overrun to be relatively low in these projects is that, for educational projects the type of buildings that are being built are similar in architectural, structural, electrical, and sanitary designs for different locations, hence scope of the works in these building projects are known very well and the change orders/variations are minimal, if any. The cost overrun in theses projects are most of the time due to increase in the cost of construction materials and due to unexpected or unforeseeable ground conditions, etc... Health buildings have the highest rate of cost overrun with 46.74% of the initial contract amount. Which means health buildings required an additional cost of 46.74% to accomplish the project.

4.4 Relationship between Rate of Cost overrun and Contract Amount

In the literature review part of this research paper it was indicated that the size of the project determines the rate of cost overrun, however, it is important to determine how rate of cost overrun varies with project size. As indicated in the literature review part of this thesis, there were two ideas which contradict each other; Randolph, et al, (1987), found that cost overrun rates decreased with increase in the contract amount of construction projects, while Rowland, (1981), found that cost overrun rates increased with increase in the contract amount of construction projects. This section of the thesis will identify the relationship between rate of cost overrun and contract amount; how the rate of cost overrun varies with contract amount.

The graph on Figure 4.1 shows that the rate of cost overrun decreases with the increase in contract amount. That is small projects, in terms of contract amount, have higher rate of cost overrun while large projects have low rate of cost overrun. This is in agreement with

Randolph, et al, (1987), who found cost overrun rates decreased with increase in the contract amount of construction projects.

Generally, one can conclude from the graph that the rate of cost overrun decreases with increase in the contract amount; that is rate of cost overrun is higher for small projects, and it is smaller for bigger projects. Thus, the size of estimated cost has a significant negative impact on percentage cost overrun rates indicating that percentage overrun tend to be lower the higher estimated costs are. Since cost overrun rate decreases with estimated cost of projects, this may indicate that larger projects generally are under better management as compared to smaller ones. For small projects the emphasis given is little, as the consultant and supervisor assigned for these small projects is not a well qualified one and the time allocated for planning and design of these small projects is short. Hence, there might be some mistakes in their design and contract document preparation that ultimately lead to changes or variations and consequentially these projects will face higher rate of cost overrun. For bigger projects the emphasis given is big, and the consultant hired and supervisor assigned for these projects is a qualified one and the time allocated for planning, design and contract document preparation of theses projects is enough to complete the whole design and contract document preparation accurately.

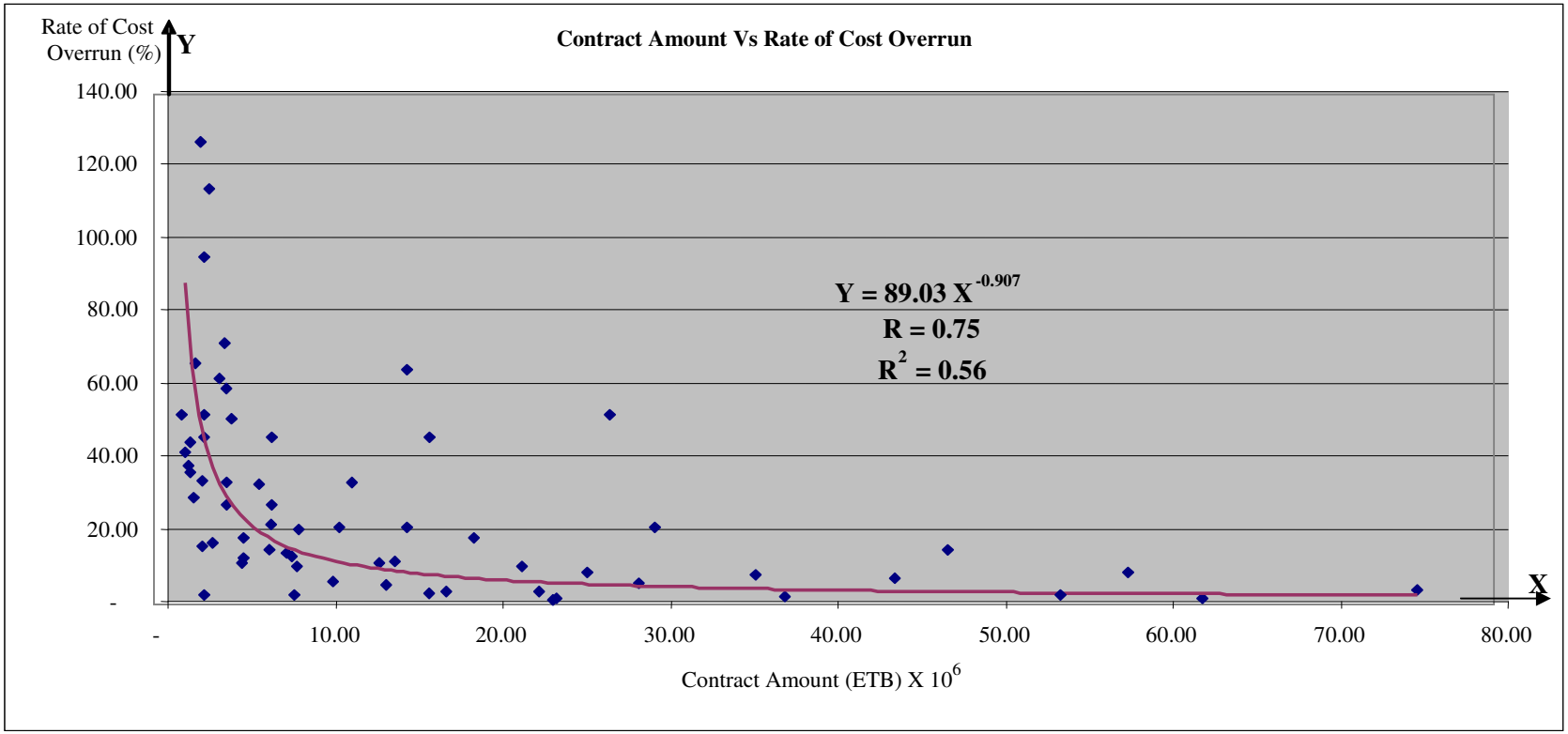


Fig 4.1 Contract amount versus rate of cost overrun

4.5 Causes of Cost Overrun from Desk Study and Questionnaire Response

It has been found from the desk study that the most common causes of cost overrun are supplementary agreement, price fluctuation of construction materials particularly cement, reinforcement bar, fuel, and asphalt; change orders or variations due to enhancement initiated by clients, excess quantity during construction, unexpected or unforeseeable ground condition, mistakes during planning, design and contract documents preparation, etc,… Most of the time site works, such as fence, site sanitary installation, site electrical installation, and internal access roads are forgotten in the original design, specification and/or contract document preparation. Furthermore, in some complex projects some items are fraught to be missed out; all these problems which were created during planning and design stage will lead to excessive cost overrun during construction phase.

When the cost of a project exceeds by more than 10% of the contract amount, consultants prepare the so called "supplementary agreement." In this "supplementary agreement" the prices for items of work, which were not included in the original contract documents are not accompanied with rebate and the unit price quoted for these new items of works will be relatively higher than the original unit price. This makes the cost overrun much greater than it should have been, had the contract and the design been prepared with care and due diligence from the start. Generally, supplementary agreements increase construction costs tremendously and tarnish the reliability of the consultant and they always become a source of friction among the different parties involved in the project. Valuation of unit prices is also a source of conflicts among project participants.

The causes of cost overrun from the questionnaire survey are identified based on respondents' response on each variables of cost overrun in causing cost overrun. For example, causes of cost overrun identified by the different researchers, as indicated in the literature review part of this thesis, might not be causes of cost overrun for the Ethiopian construction industry cases, hence it is important to ask the respondents for their agreement on each particular variables of cost overrun, then this is accompanied by

identification of causes of cost overrun based on their occurrence, for example, force majeure related causes of cost overrun occur less frequently but their impact, if they happen, is devastating one and they increase the of cost the project substantially, hence identifying the rate of occurrence alone can not help in identifying the critical causes of cost overrun that are more prevalent for Ethiopian construction industry. To clearly identify the most common causes of cost overrun it is important first to identify the causes of cost overrun for Ethiopian public building construction projects, and then identify their rate of occurrence and finally their impact on the final cost of the project.

The factors which are chosen by the respondents to be causes of cost overrun in the Ethiopian public building construction projects are identified from the returned questionnaires based on the mean scores (MS) of the three groups of respondents, clients, consultants and contractors for each variables cost overrun. In this research variables of cost overrun which have a mean score of greater than 2 are taken as causes of cost overrun; since a mean score of less than 2 means the respondents do not agree that the variable will be a cause of cost overrun.

Table 4.3, below shows the causes of cost overrun for Ethiopian public building construction projects, based on the responses of clients, consultants and contractors;

Table 4.3: Causes of cost overrun

No	Hypothesized Causes of Cost overrun	MS of Client	MS of Contrac	MS of Consult	Weighted Avg.	Responsible Party
1	Inflation or increase in the cost of construction materials	3.00	3.67	3.14	3.26	Government & others
2	Lack of planning and coordination or less emphasis to planning	3.17	3.33	3.21	3.24	Client & Consultant
3	Fluctuations in the cost of labor and/or material or any other matter affecting the cost of the execution of the works and subsequent legislation that affect the project (Clause 70)	3.42	3.33	2.64	3.11	Government & others
4	Insufficient geotechnical investigation	2.92	3.00	3.29	3.08	Consultant
5	Additional costs due to variations works (Clause 51.1)	3.00	3.00	3.21	3.08	Consultant
6	Change in foreign exchange rate (for imported materials)	2.75	3.50	2.93	3.05	Government & others
7	Change orders and/or lack of control on excessive change orders	2.75	3.08	3.14	3.00	Client & Consultant
8	Costs due to special risks which very often include out break of war, projectile missile, hostilities, contamination and other such risks (Clause 65)	2.92	3.00	3.07	3.00	Government & others
9	Delay of drawings and/or order requested by the contractor in accordance with Sub Clause 6.3 (Clause 6.4)	2.75	3.08	3.07	2.97	Consultant
10	Changes in Plans and drawings	2.75	2.83	3.14	2.92	Clients, end user, & Consultants
11	Inappropriate/inexperienced contractor	2.75	2.83	3.07	2.89	Clients, Consultant & Contractor
12	Encountering of not foreseeable physical obstructions and conditions (Clause 12)	2.75	2.92	2.86	2.84	Consultant & others
13	Failure to identify problems and institute necessary and timely design and programming changes	3.08	2.67	2.71	2.82	Consultant & Contractor
14	Failure on the part of the employer to give possession of the site in accordance with the terms of the contract (Clause 42.1)	2.92	2.75	2.79	2.82	Client
15	Inaccurate quantity estimate or excess quantity during construction	3.25	3.33	2.00	2.82	Consultant
16	Unclear specifications or changes to specification	2.75	3.00	2.64	2.79	Consultant
17	Contractors bankruptcy	2.67	3.17	2.57	2.79	Contractor

18	Cost under estimation	2.92	3.08	2.43	2.79	Client, Consultant & Contractor
19	Additions and/or enhancement required by clients or end users	2.17	2.92	3.14	2.76	Client & end user
20	Difficulties in obtaining construction materials in the local market	3.00	2.75	2.57	2.76	Government & Contractor
21	Errors in setting out which are based on incorrect written data supplied by the Engineer (Clause 17)	3.00	2.75	2.57	2.76	Consultant
22	Ambiguities or discrepancies of documents (Clause 5.2)	2.83	2.83	2.57	2.74	Consultant
23	Loss or damage due to excepted risks or employers risk (Clause 20)	2.50	2.83	2.43	2.58	Government, Client & others
24	Suspension of work ordered by the Engineer (Clause 40.1)	2.58	2.58	2.57	2.58	Consultant
25	Complexity of construction projects	2.75	2.42	2.36	2.50	Consultant & Contractor
26	Poor communication among contractor, consultant, and the client	2.42	2.50	2.50	2.47	Client, Consultant & Contractor
27	Mistakes during construction or defective work	2.42	2.67	2.36	2.47	Consultant & Contractor
28	Supplementary/additional agreement	2.75	2.58	2.14	2.47	Client & consultant
29	Cost associated with test of samples not provided in the contract (Clause 36.4)	2.42	2.25	2.57	2.42	Client & Consultant
30	Funding problems or client's shortage of finance or delayed payments to contractors	2.00	3.00	2.21	2.39	Client
31	Lack of end user involvement	2.50	2.25	2.36	2.37	Client, Consultant & end user
32	Executive bureaucracy in the client's organization	2.42	2.50	2.14	2.34	Client
33	Uncovering of works that has already been completed, but they are found to be executed in accordance with the contract (Clause 38.2)	2.50	2.17	2.21	2.29	Client & Consultant
34	Acceleration required by the owner (shortening of contract time)	2.33	2.75	1.79	2.26	Client & end user
35	Indemnities that the employer has contractually undertaken to assume (Clause 22.2)	2.42	2.42	2.00	2.26	Client & others
36	Different consultant for Design, Supervision & Contract Administration	1.58	2.33	2.71	2.24	Consultant
37	Increase in tax/change in government fiscal/monetary policies	2.25	2.75	1.71	2.21	Government
38	Searching for defects which are not the fault of the contractor (Clause 50)	2.17	2.50	1.93	2.18	Client & Consultant

39	Fossils or discovery of things of geological or archeological interest (Clause 27)	2.25	2.00	2.21	2.16	Others

As we can see from Table 4.3 above, the major causes of cost overrun are inflation or increase in the cost of construction materials, poor planning and coordination or less emphasis to planning, fluctuation in the cost of materials according to clause 70 of MoWUD, 1994, etc which are in agreement with the literature review. However there are some differences between the results of the literature review and the questionnaire survey. In the Ethiopian construction industry delayed payments are tolerated by domestic contractors but delayed payments are not tolerated by foreign contractors operating in Ethiopia, foreign contractors claim for additional payment for the interest rate on delayed payments. Domestic contractors tolerate delayed hand over of construction sites but foreign contractors do not tolerate delayed hand over of construction sites by employers; foreign contractors claim to be compensated for idle hours of man power and equipments due to the delay. These are due to cultural differences between domestic contractors and foreign contractors; domestic contractors which suffered from delayed payments and late site hand over, say that such tolerance is to avoid adversarial relationship with the stakeholders on that project and hence to create conducive working environment. Actually, this is not the only reason for such tolerance; sometimes they tolerate such things to escape penalties due to their own mistakes, one of the commonest contractors' problems is delay due to their own problems.

Contrary to the literature review, increase in work men's wage can not be a cause of cost overrun in the Ethiopian case. If there is an increase in work men's wage due to inflation or due to some other problems in the country, this increased wage rate will be shouldered by the contractor, it will not pass to the project owner as in the case of rise in the cost of cement, fuel, reinforcement bar and asphalt. In the Ethiopian construction industry the contractor can be compensated for the increase in the cost of cement, fuel, reinforcement bar and asphalt. For other items, unless and otherwise specified in the particular conditions of contract, price increase is not compensable for contractors.

Without prioritization of the causes, and identification of the responsibilities, the solutions to cost overruns will be incomplete. Identifying the stakeholders in the construction industry who are responsible for causing cost overrun in public building construction in Ethiopia are some of the most important information needed to take corrective measures for minimizing or avoiding cost overrun. Identification of responsible party is useful to understand who causes cost overrun so that concerned parties will give more attention to minimize or avoid the problem of cost overrun.

From the desk study it was found that each party blames the other for causes of cost overrun. From the clients' point of view most of the time consultants are responsible for causing the problem, project owners believe that had the designs, specifications and contract documents been done and prepared correctly from the start, there wouldn't have been late change orders and 'unexpected ground conditions', etc... From the consultant's point of view it is the project owners that initiate late changes and hence it is the client who is responsible for initiating cost overrun most of the time.

In the questionnaire survey the responsibility was rated among the parties that could be involved directly or indirectly in public building construction projects including project owners (clients), consultants, contractors, end users, government, and others. Identification is done based on the information gathered through the questionnaire and selecting the maximum percentage in each case. The identification of the responsible party for causes of cost overrun was shown in Table 4.3.

Lack of planning and coordination or less emphasis to planning, changes in plans, drawings and specifications, insufficient geotechnical investigations, inaccurate quantity estimate, unclear specification, etc… are found to be the fault of the consultant.

Additions or enhancement required by the client, funding problems or clients shortage of finance, late site handover to the contractor by clients, etc… are found to be causes of cost overrun for which project owners or clients are found to be responsible.

Contractors bankruptcy, inexperienced or inappropriate contractor, etc are found to be caused by the contractor problems, inflation or increase in the cost of construction materials, change in foreign exchange rate (for imported materials) are found to be caused by government related actions or others such as international or national market conditions, foreign government influences or general global conditions.

4.5.1 Identifying Causes of Cost Overrun based on Rate of Occurrence

The most frequent causes of cost overrun were assessed from respondents and results are given in Table 4.4 below. From the 53 causes of cost overrun which have a mean score of greater than or equal to 2 (MS $\geq$ 2) rate of occurrence are considered as important because there is at least a probability of 50% chance for the occurrence.

Table 4.4 shows causes of cost overrun based on rate of occurrence. The table shows the mean scores of clients' contractors' and consultants' with their weighted average mean score.

Table 4.4: Rate of occurrences of causes of cost overrun

No.	Hypothesized Causes of Cost Overrun	MS of Clients	MS of Contract	MS of Consult	Weighted Avg.
1	Inflation or increase in the cost of construction materials	2.50	3.58	3.07	**3.05**
2	Fluctuations in the cost of labor and/or material or any other matter affecting the cost of the execution of the works and subsequent legislation that affect the project (Clause 70)	2.83	3.25	2.43	**2.82**
3	Change in foreign exchange rate (for imported materials)	2.00	3.25	2.93	**2.74**
4	Change orders and/or Lack of control on excessive change orders	2.42	2.75	2.86	**2.68**
5	Lack of planning and coordination or less emphasis to planning	2.58	3.00	2.43	**2.66**
6	Additional costs due to variations works (Clause 51.1)	2.58	2.83	2.57	**2.66**
7	Failure to identify problems and institute necessary and timely design and programming changes	2.50	2.42	2.71	**2.55**
8	Changes in Plans and drawings	2.33	2.58	2.64	**2.53**
9	Insufficient geotechnical investigation	2.33	2.25	2.93	**2.53**
10	Contractors bankruptcy	2.25	2.83	2.50	**2.53**
11	Difficulties in obtaining construction materials in the local market	2.67	2.42	2.50	**2.53**
12	Cost under estimation	2.42	2.92	2.29	**2.53**
13	Inaccurate quantity estimate or excess quantity during construction	2.67	3.00	1.86	**2.47**
14	Delay of drawings and/or order requested by the contractor in accordance with Sub Clause 6.3 (Clause 6.4)	2.17	2.58	2.07	**2.26**
15	Inappropriate/Inexperienced contractor	2.17	2.08	2.43	**2.24**
16	Unclear specifications or changes in specification	2.00	2.33	2.29	**2.21**
17	Supplementary/additional agreement	2.25	2.42	1.86	**2.16**
18	Ambiguities or discrepancies of documents (Clause 5.2)	2.00	2.67	1.86	**2.16**
19	Poor communication among contractor, consultant, and the client	2.17	1.83	2.21	**2.08**
20	Encountering of not foreseeable physical obstructions and conditions (Clause 12)	1.92	1.92	2.21	**2.03**
21	Executive bureaucracy in the client's organization	2.00	2.25	1.79	**2.00**
22	Suspension of work ordered by the Engineer (Clause 40.1)	1.83	2.08	2.07	**2.00**
23	Failure on the part of the employer to give possession of the site in accordance with the terms of the contract (Clause 42.1)	1.67	2.00	2.29	**2.00**

24	Funding problems or client's shortage of finance or delayed payments to contractor	1.67	2.28	2.17	**2.00**
25	Lack of end user involvement	1.67	2.83	2.14	**2.00**

As indicated on Table 4.4 above, inflation or increase in the cost of construction materials, change in foreign exchange rate, and lack of planning and coordination or less emphasis to planning, change orders or variation orders are the top most frequently encountered causes of cost overrun. Where as force majeure related causes of cost overrun such as out break of war, hostilities, uprisings, etc..., are rarely encountered in the Ethiopian construction industry. Since the occurrences of causes of cost overrun related to force majeure are rare, they have low rank.

4.5.2 Identifying of causes of cost overrun based on Impact

As discussed previously identifying the rate of occurrence only will not help in identifying factors that are critical in causing cost overrun; regardless of the chance of occurrence the significance of the factor independently has to be gauged with respect to its severity, when it happens during construction phase.

Table 4.5 shows causes of cost overrun based on impact. The table shows the mean scores of clients' contractors' and consultants' with their weighted average mean score.

Table 4.5: Impact of causes of cost overrun

No.	Hypothesized Causes of Cost Overrun	MS of Client	MS of Contract	MS of Consult	Weighted Avg.
1	Inflation or increase in the cost of construction materials	2.92	3.67	3.21	**3.26**
2	Fluctuations in the cost of labor and/or material or any other matter affecting the cost of the execution of the works and subsequent legislation that affect the project (Clause 70)	3.25	3.33	2.93	**3.16**
3	Costs due to special risks which very often include out break of war, projectile missile, hostilities, contamination and other such risks (Clause 65)	3.17	3.00	3.21	**3.13**
4	Change in foreign exchange rate (for imported materials)	2.42	3.58	3.21	**3.08**
5	Additional costs due to variations works (Clause 51.1)	2.67	3.33	3.21	**3.08**
7	Changes orders or lack of control on excessive change orders	2.67	2.92	3.07	**2.89**
8	Insufficient geotechnical investigation	2.75	2.75	3.07	**2.87**
9	Difficulties in obtaining construction materials in the local market	2.83	3.08	2.57	**2.82**
10	Ambiguities or discrepancies of documents (Clause 5.2)	2.67	2.92	2.86	**2.82**
11	Encountering of not foreseeable physical obstructions and conditions (Clause 12)	2.75	2.75	2.93	**2.82**
12	Contractors bankruptcy	2.67	3.08	2.64	**2.79**
13	Inappropriate/Inexperienced contractor	2.75	2.67	2.93	**2.79**
14	Lack of planning and coordination or less emphasis to planning	2.58	3.17	2.43	**2.71**
15	Failure to identify problems and institute necessary and timely design and programming changes	2.58	2.50	2.86	**2.66**
16	Changes in Plans and drawings	2.50	2.67	2.71	**2.63**
17	Failure on the part of the employer to give possession of the site in accordance with the terms of the contract (Clause 42.1)	2.25	2.75	2.86	**2.63**
18	Inaccurate quantity estimate or excess quantity during construction	2.92	3.08	2.00	**2.63**
19	Cost under estimation	2.58	2.92	2.43	**2.63**
20	Unclear specifications or changes in specification	2.42	2.83	2.43	**2.55**

21	Delay of drawings and/or order requested by the contractor in accordance with Sub Clause 6.3 (Clause 6.4)	2.42	2.83	2.36	**2.53**
22	Suspension of work ordered by the Engineer (Clause 40.1)	2.42	2.58	2.50	**2.50**
23	Errors in setting out which are based on incorrect written data supplied by the Engineer (Clause 17)	2.42	2.83	2.21	**2.47**
24	Additions and/or enhancement required by clients or end users	1.92	2.58	2.71	**2.42**
25	Funding problems or client's shortage of finance or delayed payments to contractors	1.83	3.00	2.43	**2.42**
26	Mistakes during construction or defective work	2.33	2.50	2.07	**2.29**
27	Supplementary/additional agreement	2.33	2.58	2.00	**2.29**
28	Loss or damage due to excepted risks or employers risk (Clause 20)	2.50	2.50	1.93	**2.29**
29	Complexity of construction projects	2.33	2.00	2.43	**2.26**
30	Executive bureaucracy in the client's organization	2.25	2.33	2.00	**2.18**
31	Indemnities that the employer has contractually undertaken to assume (Clause 22.2)	2.25	2.50	1.86	**2.18**
32	Poor communication among contractor, consultant, and the client	1.92	2.25	2.29	**2.16**
33	Acceleration required by the owner (shortening of contract time)	1.92	2.67	1.79	**2.11**
34	Lack of end user involvement	1.83	2.08	2.21	**2.05**
35	Different consultant for design and Supervision & Contract Administration	1.50	2.33	2.29	**2.05**

From Table 4.5 above finance related causes of cost overrun such as inflation or increase in the cost of construction materials, fluctuation in the cost of materials according to Clause 70 of MoWUD conditions of contract, etc and force majeure related such as out break of war, up risings, etc have higher impact on the final cost of the project at completion. Even if force majeure related causes of cost overrun have severe impact on the final cost of the project at completion their rate of occurrence is low.

4.6 Tests for Agreements on Causes of Cost Overrun Among Stakeholders in the Construction Industry

One of the purposes of this thesis is to investigate whether there is agreement or not on the attitudes of stakeholders towards the causes of cost overrun on public building construction projects in Ethiopia. Hence in this section respondents' response will be tested for correlation using Spearman rank correlation coefficients, to see if there is difference in ranking between two groups of respondents; these are Clients versus Contractors; Contractors versus Consultants; and Clients versus Consultants, on the variables of cost overrun and their rate of occurrence.

The purpose of a hypothesis test is to avoid being deceived by chance occurrences. The tests also helped to evaluate whether consensus of opinions exist among respondents.

The Null Hypothesis (H_O) is:

There is no agreement in the ranking of causes of cost overrun between two groups of respondents

The Alternative Hypothesis (H_A) is:

There is agreement in the ranking of causes of cost overrun between two groups of respondents

The spearman correlation coefficient (ρ) is calculated using Equation 3.2 and tabulated as shown below in Table 4.6,

In order to decide whether to accept or reject the null hypothesis, the level of significance 95% (P = 0.05) is used. This allows to state whether or not there is "agreement" between respondents response.

If the calculated value of ρ is greater than the critical value, H_0 is rejected, i.e. there is evidence of a statistically significant agreement between the groups. If the calculated value of ρ is less than the critical value, H_0 is accepted**,** i.e. there is no evidence of a statistically significant agreement between the two groups.

Table 4.6: Summary of correlation test on the ranking of causes of cost overrun

Respondents	Rho ($\rho_{\chi\alpha\lambda}$) = 1 - $\frac{(6x\sum \mathbf{d_i}^2)}{(Nx(N^2-1))}$	Critical value of ρ (Appendix B)	Significance for P < 0.05	Reject/don't reject the Null Hypothesis
Client Vs Contractor	0.690	0.364	significant	reject
Contractor Vs Consultant	0.627	0.364	significant	reject
Client Vs Consultant	0.573	0.364	significant	reject

In this case, with a significance level of 95% (P = 0.05), the calculated value of ρ for all the three group cases are greater than the critical values of ρ, so the hypothesis that there is no significant agreement between the respondents is rejected i.e. the null hypothesis is rejected.

From Table 4.6 above, it can be concluded that there is strong correlation between the attitudes of the respondents in all the three groups and hence the null hypothesis should

be rejected and the alternative hypothesis shall be accepted. This means that most of the respondents have the same perception about causes of cost overrun.
In a similar way correlation test is done for rate of occurrences as shown below in the following section.

The spearman correlation coefficient (ρ) is calculated using Equation 3.2 and tabulated as shown below in Table 4.7,

Table 4.7: Summary of correlation test on the ranking of variables of cost overrun based on chance of occurrence

Respondents	Rho ($\rho_{\chi\alpha\lambda}$) $= 1 - \frac{(6x\sum \mathbf{d_i}^2)}{(Nx(N^2-1))}$	Critical value of ρ (Appendix B	Significance for P < 0.05	Reject/don't reject the Null Hypothesis
Client Vs Contractor	0.923	0.400	significant	reject
Contractor Vs Consultant	0.829	0.400	significant	reject
Client Vs Consultant	0.840	0.400	significant	reject

In this case, with a significance level of 95% (P = 0.05), the calculated value of ρ for all the three group cases are greater than the critical values of ρ, so the hypothesis that there is no significant agreement between the respondents is rejected i.e. the null hypothesis is rejected.

From the above Table 4.7, it can be concluded that there is strong correlation between the attitudes of the respondents in all the three groups and hence the null hypothesis should be rejected and the alternative hypothesis shall be accepted. This means that most of the respondents have the same perception on frequency of the occurrences of variables of cost overrun.

4.7 Effects of Cost Overrun

From the survey results almost all respondents agreed on the severity of the effects of cost overrun on the project owner (client) or end user. Although the degree of effects of cost overrun varies on the stakeholders in the construction industry, all the parties involved are affected by cost overrun. The first victim of cost overrun would be the project owner since he has envisaged his construction project to be realized within an allocated cost and time frame. Anything outside these stated frames are cost overrun and time overrun to the client.

Cost overrun does not affect only those parties that are involved directly in the construction of a project, but its effects pass to the construction industry as a whole and consequently to the national economy of the country.

Cost overrun for public clients, whose financial resources are scarce, has many effects and it will be a source of friction between the public client and the consultant. When the cost overrun is due to financial constraints of clients, the construction projects suffer lots of problems which further aggravate the problems of cost overrun. For public projects cost overrun will lead to delay as the public clients do not have enough financial resources which are ready to be pumped to the construction project, they require new approval for these additional costs from higher public officials or Ministry of Finance and Economic Development (MoFED), in doing so time will go on and consequent delay on the project will crop up. Which lead to further cost overrun as a construction project is delayed for a long period of time it will be subjected to inflationary pressure and interests will be accumulated.

Even if it is not common in the Ethiopian construction industry to abandon a public building construction project due to cost overrun, projects suffer excessive delay from

cost overrun, which subsequently lead to additional cost overrun as the duration of a project is extended the price of materials will rise which subsequently lead to additional costs not only to the project owner but also to the contractor and to the consultant which participate on that project until completion. And the contractor will incur an additional cost due to idle man power and idle equipments.

Generally, the following are the main effects of cost overrun which are collected from the respondents of the questionnaire survey and desk study.

1. Delay,
2. Supplementary agreement,
3. Additional cost, budget short fall,
4. Adversarial relationship between participants of the project,
5. Loss of reputation to the consultant, the consultant will be viewed as incompetent by project owners,
6. High cost of supervision and contract administration for consultants,
7. Delayed payments to contractors,
8. The contractor will suffer from budget short fall of the client,
9. Poor quality workmanship,
10. Dissatisfaction by project owners and consequently by end users,
11. Negative attitude towards the construction industry by the higher public authority and by the society as a whole,
12. The contribution of the construction industry to the growth of national economy of the country will be less,
13. Cost overruns in construction projects prevent the planned increase in property and service production from taking place, and this phenomenon in turn affects, in a negative way, the rate of national growth
14. Weakens the growth of the construction industry by eroding mutual trust and respect,

15. Pours money unnecessarily to the project at hand at the expense of other new projects,
16. Distorts fair and equitable resource distribution,
17. Discourage investment, the investment on building construction by public clients will be less, hence the number of projects will decrease in the future,
18. Creates skeptical outlook on appraisal of other new construction projects,
19. Some project owners (clients) become reluctant to effect additional payments to contractors and they view the cost overrun as a fabricated thing. This will propel to delay the project and become a source of dispute among participants of the project,
20. Creates frustration on stakeholders.

One of the common effects of cost overrun is delay; this in turn affects clients, consultants and contractors. Furthermore, lengthy delays increase cost overruns tremendously.

Excessive cost overrun requires additional budget, this in turn eat up the scarce financial resources of the country, which lead to further budget short fall for construction projects. This prevents the planned increase in property and service production from taking place, and this phenomenon in turn affects, in a negative way, the rate of national growth. Cost overrun will also be a source of dispute among stakeholders and it will lead to adversarial relationship among project participants. Project owners will loose confidence on consultant and on professionals in general. To the industry as a whole, cost overruns could bring about a drop in building activities, bad reputation, and inability to secure project finance easily form public authorities in the future.

All these effects undermine the viability and sustainability of the construction industry.

CHAPTER 5 Conclusions and Recommendations

5.1 Conclusions

Financial resources are so scarce in developing countries like Ethiopia, hence, cost related issues in the Ethiopian construction industry are sensitive issues. Therefore, carrying out a research in this area will have a paramount importance.

Identification of causes of cost overrun is a prerequisite to minimize or to avoid cost overrun in the construction industry. The main objective of this research is, therefore, to identify and investigate the critical causes and effects of cost overrun on public building construction projects in Ethiopia. Desk study was used to identify the existence and extent of cost overrun on public building construction projects in Ethiopia. Questionnaire survey was also used to identify the causes and effects of cost overrun. Clients, consultants and contractors were asked to identify the variables of cost overrun in the Ethiopian construction industry. Frequency of occurrence of the variables of cost overrun, and their impacts on the final cost of the project were also asked. Agreements of the respondents on the causes of cost overrun, i.e. between client and consultant, between client and contractor, and between consultant and contractor were also tested. The data gathered from the survey are analyzed using the mean score (MS) and correlated using Spearman correlation coefficient (rho, ρ). The analysis of the results from the open-ended part of the questionnaire was carried out using descriptive analysis.

From the results of the analysis of desk study and respondents' responses the following conclusions are drawn.

1. Justification of the existence and extent of cost overrun on public building construction projects is important before identifying the causes of cost overrun. 67 out of 70, (95.7%), public building projects investigated in the research suffered cost overrun in their execution. For these public building construction projects, the actual cost overrun ranges from 0% to 126% of the contract amount.

2. Rate of cost overrun is found to be influenced by the contract amount. The regression analysis of the data gathered from desk study for 70 public building construction projects shows that the rate of cost overrun is found to decrease with increase in the contract amount.

3. There are significant variations in the total amount of cost overrun for the different types of public building construction projects investigated in this research. From the survey educational buildings have the lowest rate of cost overrun, where as health buildings have the highest rate of cost overrun.

4. From the results of this thesis 39 causes of cost overrun were identified by the respondents. The causes of cost overrun were identified based on the responses of the respondents. The most frequent causes of cost overrun are also identified by the research based on the ranking of the rate of occurrences of the variables of cost overrun. The most common causes of cost overrun are inflation or increase in the cost of construction materials, change in foreign exchange rate (for imported materials), change orders and/or lack of control on excessive change orders, failure to identify problems and institute the necessary and timely actions.

5. There is strong correlation on the responses of respondents, i.e. between client and contractor; between contractor and consultant; and between client and consultant in ranking causes of cost overrun and the rate of occurrences of the variables of cost overrun.

6. From the research it was found that consultants are most of the time found to be responsible followed by clients for the problems of cost overrun in the construction industry.

7. From this research clients are those who are severely affected by cost overrun, since they are forced to look for additional money to complete the construction

project. However, it should be noted that clients, consultants, contractors, and even the national economy of the country are all affected by cost overrun.

8. There are many effects of cost overrun to stakeholders in the construction industry. The most common effects of cost overrun in the construction industry are; delay, supplementary agreement, budget short fall of project owners, adversarial relationship among stakeholders, and loss of reputation for professionals on the construction industry especially to consultants.

5.2 Recommendations

Based on the findings of the research, the following recommendations are expected from key role players in construction projects.

5.2.1 Expected from Consultants

The consultant is one of the key role players in construction projects that translates the clients' needs and ideas in to plans and drawings and supervises the translation of these plans and drawings into visible physical structures. The following recommendations are expected from consultants.

1. Continuous coordination and direct communication, which will eliminate design discrepancies and errors as well as omissions in design and also provide an opportunity for professionals to review the contract documents thoroughly. This would help in eliminating change orders or variations due to discrepancy in contract documents.

2. Provide comprehensive information required for easier interpretation of the drawings and setting out of the works. Specifications should also be standardized as much as possible for ease of understanding by project participants; ensure adequate and realistic specifications of materials and methods are stated in the contract documents.

3. Detailed and comprehensive site investigation should be done at the design phase to avoid variations and late changes during the construction phase.

4. As much as possible avoid complex designs, while trying to achieve aesthetic appeal, consider seriously the issue of build ability in the design.

5. Build-in adequate flexibility in design to respond more proactively to imminent changes in client needs and requirements; after completion of designs and plans, cross-check designs and details to eliminate errors.

6. Adopt efficient information retrieval and distribution systems to guard against communication gaps; respond as quickly as possible to contractor and client questions and requests for clarification to avoid associated delays and confusions which consequentially will lead to cost overrun.

7. Ensure that the scope includes all the work required, and only the work required to complete the project successfully. Guard against incomplete identification of scope to avoid frequent changes; do not incorporate unnecessary works to avoid distractions and a drain on scarce resources.

8. Implement the necessary measures to reduce construction cost, since construction cost reduction is one way of reducing potential cost overrun.

5.2.2 Expected From Clients/Project Owners

Clients are one of the most important parties who invest their money for realization of construction project, and they are the key role players starting from conception through construction up to operation of the project. The following recommendations are expected from clients.

1. Clients should allow sufficient time to prepare project briefs and other feasibility studies. Allow sufficient time for proper feasibility studies, planning, design, information documentation and tender submission. This helps to avoid errors and omissions that consequentially help in avoiding or minimizing cost overrun.

2. Ensure comprehensive articulation and communication of owner and end-user needs and requirements during briefing sessions; client goals should be sufficiently accurate and realistic.

3. Fulfill contractual obligations, especially as regards to payment of contractor's works duly executed, or settlement of fees accounts of consultants and possession of construction site. Clients should ensure that adequate funds are available before projects are started, so that contractors can be paid in accordance with the contract agreement.

4. Employ professionals to work as counter part with consultants and contractors.

5. Select suitable contractors not only on the basis of price and time offerings, but also on experience, financial standing, capacity and expertise.

6. Minimize red-tape; that is, minimize unnecessary and excessive bureaucratic procedures in the clients' organization.

7. Implement cost reduction incentive proposals

5.2.3 Expected From Contractors

Contractors are one of the stakeholders who participate directly on the construction projects; accordingly the following recommendations are expected from contractors.

1. Procure construction materials and other items in collaboration with the client ahead of time.

2. Solve problems and propose solutions on construction projects proactively.

3. Minimize adversarial relations with stakeholders on construction projects.

4. Ensure efficient time management through proper resource planning, duration estimation, and schedule development and control; to avoid delay and hence to avoid cost overrun due to delay.

5.2.4 Expected From Government

Most public projects are financed by the government; hence, the government is one of the key role players in public construction projects. The following recommendations are expected from government authorities.

1. Phasing of large construction projects by the government, this helps the economy from becoming 'overheated' this in turn avoids the consequential effects of inflation and hence avoids cost overrun on construction projects.

2. The government must create a climate of economic stability that is sufficient to inspire investors, especially in the production of construction materials to be produced from local materials and production of enough quantity and quality of construction materials in the local market, this will curtail excessive price fluctuations associated with imported construction materials.

3. Make the required budget available on time.
4. Carry on capacity building programs for professionals and for firms on the construction industry. There must be programs for institutional strengthening and man power development in the areas of construction project management.

5. Assist individuals, organizations and institutions in the construction industry on research and development of appropriate construction management techniques and technology which will help to reduce problems related with cost overrun.

6. Create opportunity for domestic consultants in the construction industry to work as joint venture with foreign consultancy firms.

7. Work with private investors and financiers to co-finance public projects to overcome problems related with finance.

All stakeholders in the construction industry have to work for improving the out puts of the construction industry and to sustain a healthy growth of the industry. Especially consultants, contractors and clients have to use a holistic approach for solving problems in the construction industry; they have to familiarize themselves to the latest technology and methods to solve problems and look for solution proactively. Institutions and academicians in the construction industry have to work hand-in-hand with practitioners in the industry. A combined effort of stakeholders is necessary to apply the results of researches conduct in the construction industry.