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**COST OVERRUN AND IMPACT ASSESSMENT OF ADDIS
ABABA'S LIGHT RAIL TRANSIT CONSTRUCTION PROJECT.**

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A thesis submitted to the School of Graduate Studies of
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**ADDIS ABABA INSTITUTE OF TECHNOLOGY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF CIVIL ENGINEERING**

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CHAPTER 1

1. Introduction

1.1 Background of the topic

Transportation is the back bone of success in economic activities, it is necessary that a mass transit system like rail systems be constructed for efficient transportation of commuters. As a result of the growing emphasis on environmentally “clean” alternatives to private vehicles, transport ministries and public transport companies have been concentrating more on the expansion or development of transport systems that combine urban, suburban and regional transport, in which light rail systems linked to subway systems and major railways form a cohesive network (ILO, 1994).

To facilitate rapid change and development the Ethiopian national urban transport policy (ENUTP) requires ensuring adequate efficient and high quality transport infrastructure to guarantee efficient mobility of goods and people .Although the proposed ENUTP of goods and people seeks to achieve these goals there are challenges which slow it down the most adequate being inadequate infrastructure in the current network arising from certain constraints. (Yetenayet, 2012)

To alleviate this problem Ethiopia in its GTP (Growth and Transformation Plan) plans to construct more than 2395 Km standard gauge railway by Phase-one. As part of this phase – one plan, Ethiopia is constructing a Metropolitan electric railway in Addis Ababa which has a total length of 34.25 km (North-South line 16.9 km and East-West line 17.35 km) the two lines (North-South and East-West) use common track of about 2.7 km. and is designed to fit for elevated, at grade and below grade transportation and access. It has a high carrying capacity of 15,000 PPH (passengers per hour). (ERC,2014)

The construction cost management of such a large project is very demanding and the construction cost of light rail transit project is relatively high in comparison road projects. Therefore the main purpose of this research is to assess the construction cost management practices being conducted in Addis Ababa’s light rail transit project with the aim of identifying

Cost overrun and impact assessment of Addis Ababa’s light rail transit construction project.

the presence and cause of cost overrun in the project and discuss mitigation measures which can be implemented in future railway projects.

1.2 Definition of the Problem

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 these countries are executed with scarce financial resources. (Fetena nega , 2008)

Research into construction projects in most developing countries indicates that by the time a project is complete the actual cost exceeds the original contract price by 30% while change order results in 83% cost overrun. (Al momani, 1996)

Based on a study conducted by (Flyvbjer, 2003) on 258 transport infrastructures, rail projects appear to be particularly prone to cost escalation, followed by fixed links. Road projects appear to be relatively less predisposed for cost escalation, although actual costs are higher than forecast costs.

Light rail trains and other rapid transit systems can play a significant part in improving the attractiveness and quality of public transport. This in turn can promote local economic growth and reduce carbon through modal shift however Building light rail systems has been expensive. The high capital costs have meant that in practice, even where passenger forecasts may justify its consideration, light rail has not often been seen as an affordable option for local transport authorities to pursue. (Keith 2002)

The construction cost of rail way projects is one of the main reasons why it makes engaging in such a large project as a country difficult. Even though the high initial cost is mostly attributed to tracks, sleeper and body component of the rail way, the construction of elevated, at grade and tunnel section account for a substantial amount of the cost. Therefore to avoid cost overruns and assess the causes of cost overrun this paper will research the construction cost management practices of Addis Ababa's LRT project with the aim of identifying cost overrun in the project and providing mitigation measures which can be used to eradicate or decrease the presence of cost overrun in current or future project.

1.3 Research Question and Objectives

General objective

The general objective of this paper is the assessment of construction cost management practice of the LRT projects being conducted in Addis Ababa with the aim of identifying cost overruns so that Addis Ababa's light rail transit project can be constructed as much as possible with maximum affordable quality. Therefore it is very important to identify the presence of project cost overrun during the project implementation. The cost management of light rail transit projects should mainly include scientific plan, control and verification of labor, materials and cost consumed during the project implementation. Cost must be controlled throughout the whole construction course, it needs active involvement of and close cooperation of everyone involved in the project. Only if cost control is put on leading position in construction course projects can achieve anticipated cost objective and obtain economy benefit from the project. Therefore by assessing the construction cost management practices being conducted in LRT project a better understanding in to cost management of large LRT projects can be obtained.

Specific objective

1. Assessing the presence and extent of cost overrun in Addis Ababa's light rail transit project.
2. Assessing the cost management practice in Addis Ababa's LRT projects.
3. Identifying the cause of cost increase / overrun and provide recommendation for mitigation measures that are being taken or need to be taken to avoid cost increase.
 - ❖ Within the view of accomplishing these objectives, the research has posed the following three questions, which are to be addressed by the selected research instruments.

Research questions

1. What are the existing project cost management practices in Addis Ababa's LRT projects?
2. Has the light rail transit projects in Addis Ababa been affected by cost overruns?
3. What are the causes of cost increase and mitigation measures being used to avoid this cost increase?

1.4 Scope and Limitations of the Study

The scope of this study is mainly focused on assessment of cost management practice of the project with the aim of identifying the presence and cause of cost overrun in the project. Furthermore the research goes on to identify mitigation measures being implemented to reduce the presence of cost overrun. Two of the main limitations observed in this study include lack of most of the contractor's staff to provide and communicate documentation and information in the two major languages under use in Ethiopian construction (Amharic and English) and hardship in the use of standard cost overrun calculation methods such as EVA due to faulty interpretation of the contract and omission of representative bill of quantities.

1.5 Research type

This research can be categorized as explanatory and largely descriptive. Based on the fact that that the research tries to describe the current cost management practice of Addis Ababa's LRT project with the aim of identifying and explaining the presence and causes of cost overrun in the project.

1.6 Data source

The data in this study is largely quantitative and in part qualitative. The qualitative data was obtained from archival reports such as various literature, journals and books while the quantitative data is obtained from questioners and structured interviews carefully crafted to study the construction cost management practices of Addis Ababa's light rail transit project being conducted.

The data is there for a composite of

- ❖ Archival reports

- ❖ Questioners survey
- ❖ Interviews

1.7 Study participants

The main study participants in this research are (ERC) Ethiopian rail Way Corporation, CREC (Chinese railway Engineering Corporation) and the consultant (SWE road).

As for any sample, a key question is whether the sample is representative of the population. Therefore participants were selected from three of the institutions who were directly involved in management of Addis Ababa's light rail transit project and which were directly linked to the cost management of the project. These participants include project managers, resident engineers, claim experts and representatives amongst others which are not specified here.

1.8 Thesis Structure

Chapter 1 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 2 Covers the literature review part of the thesis which includes information about cost management practices, instances and causes of cost overrun specific to transportation projects and rail way projects around the world, construction contracts and general information about Addis Ababa's LRT project and contract.

Chapter 3 Covers the research methodology, the methodological approach consists of the overall research strategy, research design the analysis of data and writing of the thesis paper.

Chapter 4 Contains the discussion and analysis part it contains the findings and analysis of the data which is obtained through various means.

Chapter 5 Conclusions and further research recommendation, in this part the research conclusions and recommendations are presented. This will serve as action guidelines to stakeholders in the rail way construction industry.

Structure of the research

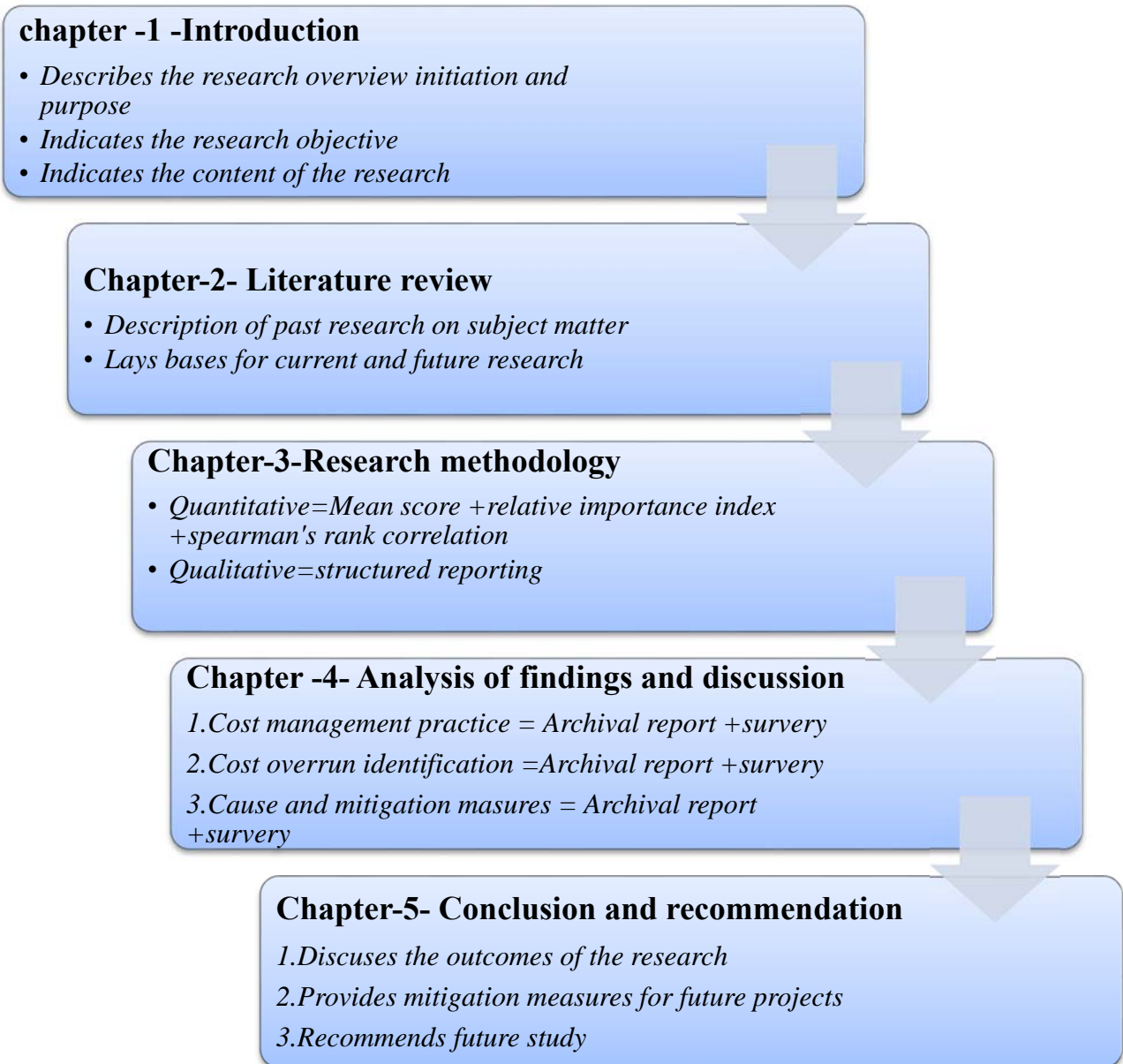


Figure 1.1 Structure and approach to the research

CHAPTER 2

2. Literature review

In order to gain a basic understanding of cost management practice in construction industries specially those such as light rail transit projects and to identify various strategies and techniques used in the control of cost overrun, it was necessary to conduct a comprehensive literature search. This literature search was threefold. The first objective was to document the state of the industry with respect to the challenges of cost in construction projects specific to cost overrun. The work of many researchers in this area has helped to establish a framework for data collection and interpretation; they were used for developing an understanding of the cost factors involved in the increasing costs of projects in rail transit construction.

The second objective was to assess cost and variation management practice of an EPC contract with the aim of identifying the factors which affect contract cost of the light rail transit project which was signed between Ethiopian Railway Corporation and China railway engineering.

The third objective of this literature review was to clarify the scope of work being conducted in the construction of Addis Ababa's light rail transit project with the aim of identifying the various changes estimating practices and claims with respect to the contract agreement which would help identify the presence of cost overrun in the project.

2.1 Introduction

Project management is the application and integration of modern management and project management knowledge, skills, tools and techniques to the overall planning, directing, monitoring and control of all dimensions of a project from its inception to completion. (PMBOK 2013)

It is the motivation of all those involved to produce the product, service or result of the project on time, within authorized cost, quality and to the satisfaction of participants. (Fewings, 2005)

As can be seen from the above definitions project management is a wide process which encompasses several sub processes and deals with fulfilling predetermined project objectives. Among these processes, one is the project cost management process, which is the general subject area of this research.

2.2 Project cost management

Cost management is the process, which is necessary to ensure that the planned development of a design and procurement of a project is such that the price for its construction provides value for money (VFM) and is within the limits anticipated by the client. (Keith Potts, 2008).

Cost management is the total process, which ensures that the contract sum is within the client's approved budget or cost limit. It is the process of helping the design team design to a cost rather than the costing a design. (Keith Potts, 2008).

Project cost management includes the process involved in planning, estimating, budgeting and controlling cost so that the projects can be completed within the approved budget. The above three process interact with each other and with other processes in other knowledge areas to achieve the project objective but despite the wide use of these processes and various management practices, many Construction projects still suffer from cost overruns.(PMBOK 2013).

2.2.1 Cost Estimation

Is the process of developing an approximation of the cost of resource needed to complete the project activity the project cost estimate is primarily concerned with the cost of resources needed to complete the project activities and includes all the processes which are employed to maintain financial control over a project (Friedman, 2005).

As a project progresses from concept to final design more of the unknown factors can be eliminated from the estimate and numbers that reflect the design can be produced. Estimates at final design, prior to bid, are often referred to as the engineer's estimate, and are used to finalize project funding prior to bid solicitation and construction. Proper estimating and control of the project, especially at early design phase is crucial to the construction industry. (Jonathon, 2002)

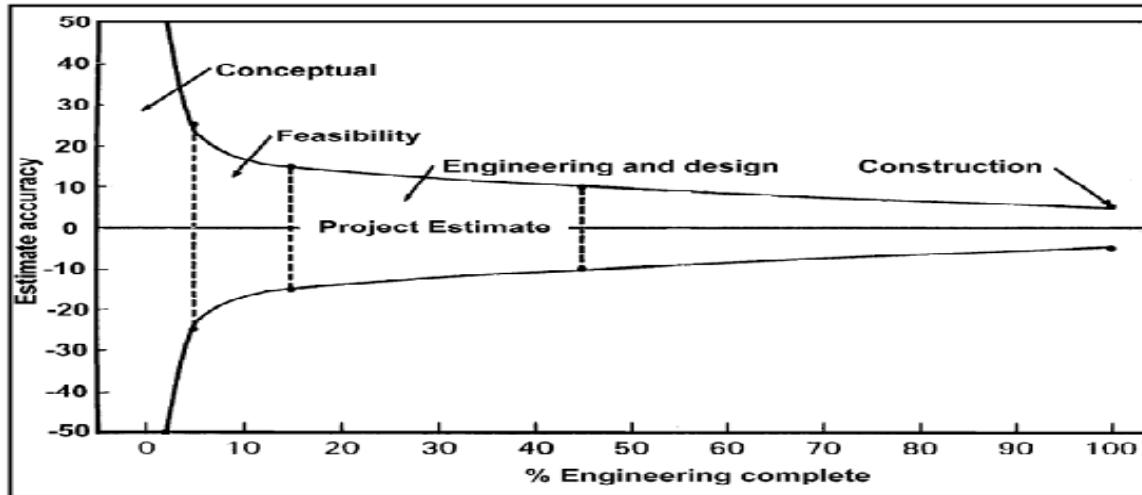


Figure 2.1 Estimation Accuracy vs. Project Development phase (Source: Jonathon, 2002)

The figure above represents Jonathon's view of development of a project stage and Estimation accuracy. It states that as the project develops from the conception stage to the construction stage level of accuracy of estimation increases.

However Cost estimating is not an exact science, even with a consistent and comprehensive methodology, careful attention is needed to ensure a quality estimate. The cost estimator needs to research, compare and, above all, use their professional judgment to prepare a quality cost estimate. Coordination between the project planning cost estimates, the project design cost estimates and the Standard Specifications that will be used to construct the project is required. (CDT 2005)

On seven large Danish bridge and tunnel projects since 1960, construction costs had been underestimated (average cost overrun was 14%) and traffic had been overestimated in the initial phases of planning. Cost overrun and benefit shortfall pattern is also found in studies from other countries of large transport projects. The result of this over optimism in the initial phases of planning was that decisions were based on misleading forecasts that might lead to a misallocation of funds and underperforming projects (Flyvbjerg, Bent. 1997)

A study conducted in United States of America on cost estimating problems associated with pioneer energy projects and process plants revealed that 74% of cost growth was caused by under estimation, that is, improper estimation (Morrow, 1988).

According to (Keith Potts 2008) to avoid such problems when developing a cost estimate the following factors need to be considered:

- ❖ Land acquisition including legal fees;
- ❖ Client's own organization costs allocated to the project (this obviously varies but can be as much as 10% of the overall project budget).
- ❖ Site investigation (frequently underrated and under-budgeted resulting in unnecessary extra costs and time –could be as much as 1% of budget).
- ❖ Insurances (many major clients prefer to insure against the risks and take out a project insurance policy covering both themselves and the contractor –may be up to 1% of the budget).
- ❖ Consultants' fees including design (on large transportation and infrastructure projects this can be as much as 15–20% of the budget);
- ❖ Construction costs (typically account for between 70% and 80% of the project sum)(excluding land);
- ❖ Value added tax (VAT)
- ❖ Contingency and risks (covers for the unknown and may be between 20% and 25%) or if project of long duration the contingency factor could be double or triple these items.
- ❖ Financing and legal costs (financing costs can be substantial depending on financing method chosen).

Furthermore with regards to Ethiopian case and with regards to LRT projects the following factors should be taken into consideration

- ❖ Availability of foreign currency and exchange rates throughout the stage of the project
- ❖ Track age, motive power , speed ,service and terrain
- ❖ Tunnel work that has a high degree of inaccuracy
- ❖ Consideration of feasibility estimate contract price and ridership forecast in final estimate
- ❖ Market conditions and rate of Inflation
- ❖ Estimation of integration of LRT system with current traffic conditions both pedestrian, and motor.

- ❖ Development of a complete clear and concise engineering estimate before solicitation or bid.

2.2.2 Cost budgeting

Cost budgeting is the process of aggregating the estimated cost of individual activities or work package to establish a cost base line Cost budgeting involves aggregating the estimated costs of individual schedule activities or work packages to establish a total cost baseline for measuring project performance. The cost baseline is a time – phased budget that is used as a basis against which to measure, monitor and control overall cost performance of the project. (PMBOK 2013)

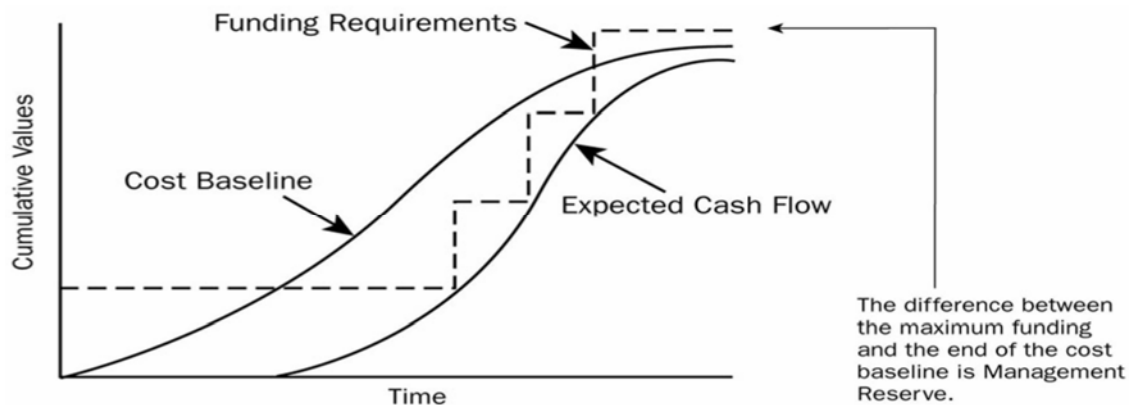


Figure 2.2. Cash Flow, Cost Baseline and Funding Display (PMI, 2004)

The figure above is a representation of expected cash flow and cost base requirements of a project with time which is crucial tool in planning and budgeting as it helps to determine the funding requirements of a project.

The project budget is a planning document which reflects the financial plan of the project activities, with specific goals clearly outlined along with the costs expected to be incurred. (Chikatra 2001).

The primary purpose of having a budget is to assign financial targets and resources to each activity to form the basis for controlling performance and to make participants of the project cost conscious. (Abeselom Abraham 2008)

In construction projects, both owners and contractors prepare budget. But contractors' budget is resource-cost and earned value or revenue oriented budget, it includes monthly or quarterly

financial statement of income and expenditure, forecast of financial statements of projected balance sheet, cash flow, profit, loss and performance measuring baselines (Chikatra, 2001).

According to (Yang ZhongBo2012) There are many factors which can affect budget during construction. For instance,

- ❖ Requisition,
- ❖ Environmental protection,
- ❖ Construction period,
- ❖ Material fee,
- ❖ Transportation cost and manpower consumption

Therefore a comprehensive understanding of cost budgeting is an essential factor in the control of construction cost.

2.2.3 Cost control and planning

Cost control is the process of influencing the factors that create cost variances and controlling changes to the project budget. (PMI 2004)

The objective of the cost control process is to ensure that budgetary requirements are adhered to during the design and implementation of the project and that the out-turn cost is in line with the contractor and the client expectations. (Ian M Thoms 2003).

Keeping a project within budget depends on the application of an efficient and effective system of cost control. From the information generated it should be possible not only to identify past trends but also forecast the likely consequence of future decisions including final out-turn cost, that is, the final account. (Keith Potts 2008)

According to a paper written for Norfolk Light Rail Project Final Project Completion Plan cost control which was used for the Project consists of setting a series of Project criteria or baseline, as of the point of completion of preliminary design; as design and construction progress, periodic and special comparisons between current design schedule and cost projections were made. When such comparisons of baseline objectives and current projections of schedule and/or cost events differed significantly or showed a trend of widening variation, a "red flag" or exception report was produced which alerted management to a variable requiring corrective action.

Such an early warning gave management time to assess the cause of the problem, evaluate alternative courses of action to restore the Project to plan, and ordered the concluded action taken. When restoration to original plan or the current baseline was impractical, the baseline was formally revised and updated and the impact of such change on the other baselines reviewed.

Therefore from the report written for Norfolk Light Rail Project Final Project Completion Plan cost control processes which were used in the process follow the cost control processes which are out lined at PMBOK 2013 which articulately stipulate the following crucial points as the bases for effective cost control.

- ❖ Controlling influencing the factors that create changes to the authorized cost baseline.
- ❖ Ensuring that all change requests are acted on in a timely manner.
- ❖ Managing the actual changes when and as they occur.
- ❖ Ensuring that cost expenditures do not exceed the authorized funding by period, by WBS component, by activity, and in total for the project.
- ❖ Monitoring cost performance to isolate and understand variances from the approved cost baseline;
- ❖ Monitoring work performance against funds expended.
- ❖ Preventing unapproved changes from being included in the reported cost or resource usage.
- ❖ Informing appropriate stakeholders of all approved changes and associated cost; and bringing expected cost overruns within acceptable limits.

Therefore as stated in the previous pages by various authors project cost management is an aggregate of cost estimation, cost budgeting, control and planning the figure below is a summary of the factors which need to be taken in to consideration while conducting project cost management.

Summary of factors which need to be taken in to consideration in cost management

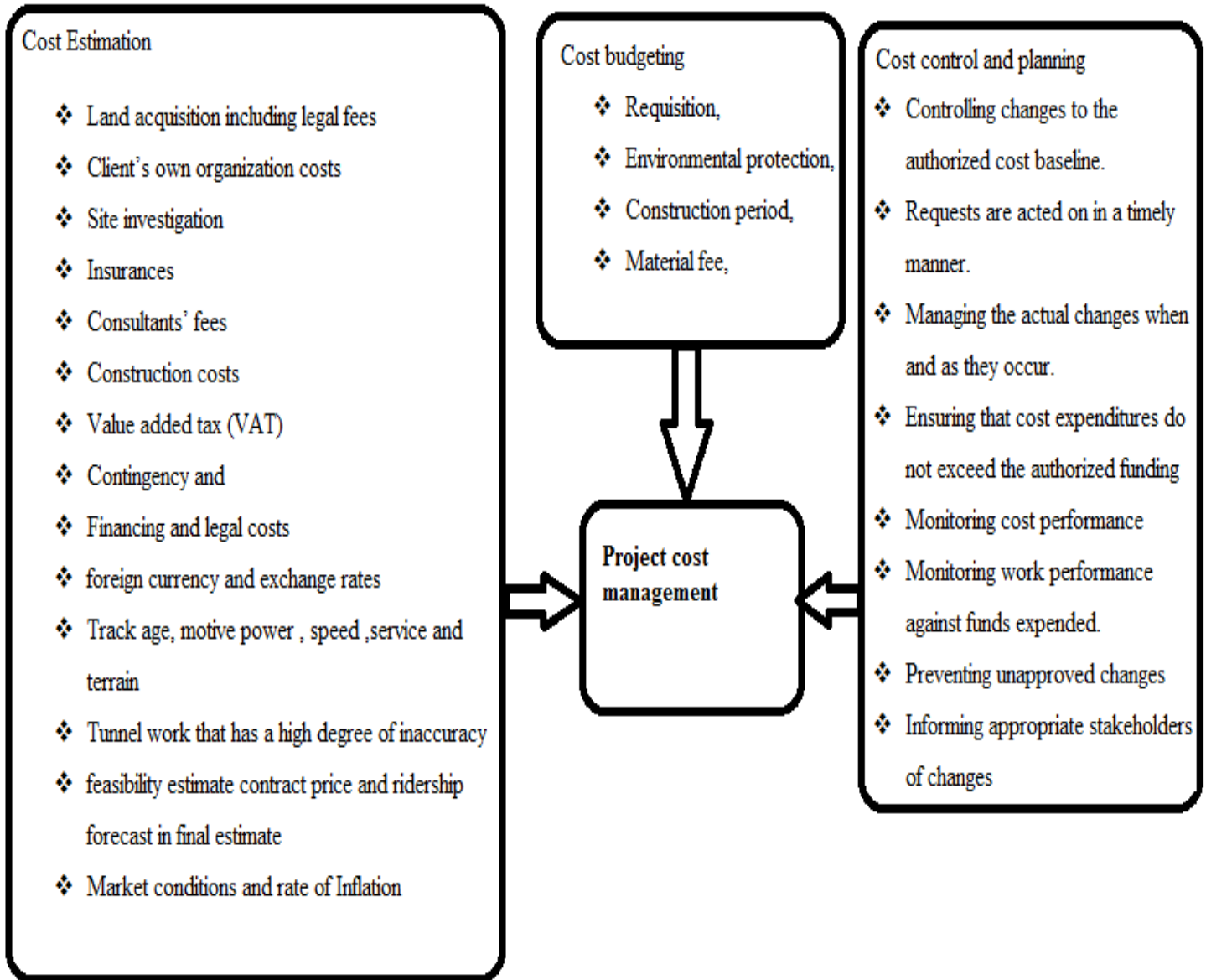


Fig 2.3 Factors which need to taken into consideration in cost management of projects.

2.3 Cost Overrun

2.3.1 Definition of Cost Overrun

Cost overrun is also called “cost escalation,” “cost increase,” or “budget overrun” (Zhu & Lin, 2004 in Enshassi, Al-Najjar, & Kumaraswamy, 2009). Cost overrun is the excess of actual cost over budgeted cost which occurs when the final cost of the project exceeds the original estimates (Avots, 1983; Azhar et al. 2008). Cost overrun has become a universal phenomenon (Endut et al., 2009) which adds pressure to investment decision (Ali & Kamaruzzaman, 2010).

Cost overrun is measured as a percentage of actual costs over the estimated costs of the project (Cantarelli, 2009; Choudhury & Phatak, 2004) as shown.

$$\text{cost overrun} = \frac{(\text{Actual Cost} - \text{Estimated Cost})}{\text{Estimated Cost}} \%$$

Actual costs are defined as real and accounted construction costs determined at the time of project completion. Estimated costs are defined as budgeted or forecasted construction costs determined at the start of projects (Cantarelli, 2009). There are various definitions suggested by various scholars in the construction industries. Cost overrun can also be measured using earned value analysis

Earned Value analysis is a method of performance measurement. Earned Value is a program management technique that uses “work in progress” to indicate what will happen to work in the future. Earned Value is an enhancement over traditional accounting progress measures. Traditional methods focus on planned accomplishment (expenditure) and actual costs. Earned Value goes one step further and examines actual accomplishment.

This gives managers greater insight into potential risk areas. With clearer picture, managers can create risk mitigation plans based on actual cost, schedule and technical progress of the work. It is an “early warning” program/project management tool that enables managers to identify and control problems before they become insurmountable. (Sagar K April 2012)

Costs overrun is 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].

- ❖ Cost overrun is the amount by which actual costs exceed the baseline or approved costs [Wideman, 2002].
- ❖ Cost overrun is 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.
- ❖ Cost overrun is simply defined as ‘when the final cost of a project exceeds original estimates (Avots 1983). It is an excess of actual cost over budgeted.

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. (Flyvbjerg, Bent 1997)

An examination of the records of more than four thousand construction projects by Morris (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

The U.S. General Accounting Office (1999) conducted reviews of progress and cost estimates of 14 transit projects in the New Starts Program. The report provided the status of each project including any cost increases (or decreases) and their causes. Among the 14 projects reviewed, 6 had experienced cost increases of between 2 to 25 percent (at the time of the report). The report highlighted “higher than anticipated contract cost, schedule delays, project scope changes, and system enhancements” as the main causes of cost increases. The report provided this research with valuable data on some projects.

Various studies addressed cost overruns for transportation projects specifically. For example, Pickrell (1992) investigated the cost overruns and benefit shortfalls of 8 rail transit projects in the

US. In his study, Pickrell (1992) starts from the premise that forecasters overestimate rail transit ridership and underestimate rail construction costs and operating expenses. To understand these inaccurate forecasts, he points, on the one hand, to optimism among local officials and to inadequate planning processes on the other. He argues that the causes of underestimated costs lie in the structure of programs and the existence of dedicated funding sources that provide few incentives for local officials to seek accurate information for evaluating alternatives.

Fouracre et al. (1990) investigated cost overruns for 21 metro projects worldwide. Nearly all the metro systems incurred costs higher than expected. These overruns were attributed to ‘a range of factors, including the additional costs of unforeseen service and utility diversions and other civil works problems, which could not be offset by contingency allowances; changes in specifications; currency devaluation and rises in interest charges’.

Pickrell (1990) compared the estimated *versus* actual costs of 10 urban rail transit projects in the U.S. with a total value of \$15.5 billion (in year 1988 dollars). Estimated costs were those that were prepared at the alternatives analysis phase to help the decision-makers choose the most preferred alternative. Pickrell also attempted to determine the reasons for the differences between actual and estimated costs. The report notes that 9 out of 10 projects studied suffered from cost overruns ranging from 13 percent to 106 percent, and ridership forecasts were overestimated by 28 percent to 85 percent. The author discussed cost underestimates coupled with ridership overestimates in the projects studied. Also, the author noted that a major contributor to the cost escalation appeared to be delay in project start time or construction schedule.

Further, in most cases, the project contingencies were insufficient and unrealistically optimistic. This report considers the alternatives analysis phase and actual costs without looking at cost increases between the preliminary engineering, final design, and construction phases.

Schumann (1988) describes the planning and design approaches for the Sacramento RT Metro, a light rail transit (LRT) project that at the time achieved the lowest capital cost per route mile of a new federally funded rail system. The paper shows how the design was based on the principle of using available right-of-way and using “off-the-shelf” vehicle components and other systems that have been proven to work elsewhere. It presents the comparison between the estimated (estimate

after preliminary engineering) and actual capital costs and ridership. The cost comparison is presented by asset category (right-of-way, stations and parking, etc.). Overall, the project experienced a cost overrun of 34 percent, most of which came from right-of-way construction (Guide way and track work) and management and engineering.

Cost overrun is a global phenomenon in the construction industry and very rarely projects are finished within the budgeted cost. The issue of cost overrun in construction projects is very dominant in both developed and developing countries but this trend is very severe in developing countries where these overruns sometimes exceed 100% of the anticipated cost (Azhar, Farooqui, & Ahmed, 2008).

Many studies have been conducted in developing countries with regards of Cost overrun. For example the a study conducted by Kaliba, (2009) states that the main cause of cost overrun conducted in zamiba's construction industries include inflation , Change in the scope of the project , delay in schedule and lack of managerial and technical knowledge .

Another study conducted in Tanzania by Stanslaus Karoli (2011) states that Contractual incompleteness and consequent post contract adjustments and opportunistic behavior of some project participants are root causes of conflicts in building projects and there are in-sufficient mechanisms and strategies to deal with conflicts in building projects.

Over the years many studies have been conducted on cost overrun around the world one research which tried to study the recurrence of cost overrun in transportation projects specific to rail and road projects is the one conducted Anchalee Jenpanitsub “Cost Overruns in Transport Projects” this study presents the. Presence and percentage of cost overrun in developing and developed countries.

Number and type of project examined	years covered by study sample	countries covered in sample	Average difference of cost (%)	Authors/year of publish
Ten major transit projects	1971-1987	USA	52%	UTMA/1990
15 projects 7 rail 8 road	befor 1994	sweden	7 rail, 17% 8 road 86%	Riksrevisionsverket 1994
3969 construction contracts by FDOT	1980-1995	Florida, USA	7%	Office of program policy analysis and Government Accountability 1996
Rail and road projects	1997-2000	Sweden	rail 14% , Road 5%	SIKA/2002
258 projects 58 rail 33 fixed-link 167 road	1927-1998	20 countries on 5 continents	over all 28% 58 rail 45% 33 fixed link 34% 167 road 20%	Flyvbjerg, Holm and Buhi/2002 2003 and priemus Flyvbjerg and wee/2008
21 rail and bus way projects	1990-2002	USA	21%	Federal Transit Administration 2003
620 road projects	1992-1995	Norway	5%	Odeck/2004
2,668 road construction and maintenance projects	1996-2002	indiana, USA	4.50%	INDOT/2004
16 urban rail	1995-2004	USA	30%	dentata et al/ 2006
127 road projects	1993-2003	Canada	127 road , 5.9%	Qing Wu/2006

Table 2.1 Anchalee Jenpanitsub Cost Overruns in Transport Projects Experiences from Sweden

Number and type of project examined	years covered by study sample	countries covered in sample	Average difference of cost (%)	Authors/year of publish
44 urban rail projects	1966-1997	18 in north America 13 in Europe 13 in developing nations	44.90%	Flyvbjerg 2007
129 road and bridge peojcets	before 2008	85 in philippines 44 in thailand	philippines :5.4% Thailand : -10.8%	Roxas Jr., Chalempon/2008
161 projects 138 road 16 rail 2 air ports 5 ports	1985-2005	south Korea	Road 11% Rail 48%	Lee J.K/2008
21 major transit projects	2003-2007	USA	40%	Federal T.Administration/2008
849 projects from seventeen infrastructure sectors 157 road and high way 122 railway	1992-2009	India	157% road and highway 16% 122 railway 95%	singh/2009
Transit projects 19 rail 21 road 7 urban transport	200-2009	Europe	Rail 26.9% Road 9.4% Urban transport 45.40%	RGL Forensics faber Maunsell/Aecom and Frontier Economics/2010
6 European high speed rail projects	before 2010	Europe	51%	chevrouel Reynaud/2010
35 road and 28 rail projects	2005-2009	sweden	Road N/A, Rail 55%	Riksrevisionen/ 2010,2011

Table 2.1 As sited from Anchalee Jenpanitsub Cost Overruns in Transport Projects Experiences from Swedn

The previous table set forth by Anchalee Jenpanitsub is an indication of the extent of cost overrun around the world specifically with respect rail and road projects to and it can be used to summarize and compare the extent of cost overrun in road and rail projects.

year	Total % of overrun in rail projects	Total % of overrun in road projects	Difference
1994-2009	530.8%	184.2%	346%

Table 2.2 summary and comparison of Anchalee Jenpanitsub's table

Even though the table provided by Anchalee Jenpanitsub was not meant for evaluation of the extent cost overrun between road and rail projects it can be a simple indication of the percentage of variation observed between road and rail projects therefore accordingly rail projects are much more prone to cost overrun than rail projects.

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].

Public construction projects in Ethiopia are parts of the country's development initiative. It shares a 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%, MoWUD, (2006).

The light rail transit construction project which is being conducted by Ethiopian Railway Corporation is one of the major public projects being under taken by the Ethiopian government since most of the construction cost control and cost management of such a mega project is relatively new to our country.

There is no skilled man power present, if the need arises to construct a light rail transit project at other urban cities in Ethiopia by a local contactor and local man power force the occurrence of cost over run will be inevitable. Therefore a study of cost overrun identification in the construction of light rail transit projects being conducted in Addis Ababa will help prevent from repeating some of the mistakes being made in various public construction projects which have been completed and which are being conducted by the Ethiopian government.

2.3.2 Causes of cost overrun

In construction projects there are various reasons as to why projects fail to meet the desired outcome specific to construction cost even though this reasons differ from project to project some factors are sited here which are relevant to this paper.

Changes in design and scope, inadequate site investigation, inadequate quality of contract documents, relocation of services and utilities, shortening of contract period due to government pressures and priorities, land acquisition and resettlement, environmental issues were the most dominant factors identified, resulting in cost escalations in highway project (Creedy et al. 2010).

Morris (1990) studied the factors influencing cost overruns in public sector projects and found that escalation in costs is attributable partly to the fact that the original estimates were prepared at the then current prices, and partly to delays which enhance the effect of inflation and to direct escalation in costs arising out of change in scope and errors.

Based on certain assumptions with regard to the pace of expenditure on projects, Morris (1990) has roughly computed that for the 133 projects, which were studied, only 25 to 30% of the cost increase is attributed to inflation. The remaining 70 to 75% has to be explained in terms of delays, inefficiencies, scope changes, changes in statutory levies, variations in exchange rates and to the combined effect of these factors with inflation.

Study of Datta (2002) depicts that delays between the planning stage and actual implementation of especially large infrastructure projects is a ubiquitous problem resulting in cost and time overruns. Other studies (Mansfield et al. 1994; Schexnayder et al. 2003) identified that cost overruns occur due to a result of problems such as delay in land acquisition, unexpected

problems in supply of raw materials, illegal encroachment on land even during project implementation, or due to internal problems in government organizations.

To identify the presence of construction cost overrun in the light rail transit projects being conducted in Addis Ababa some of the causes of cost overrun which were discussed and observed in the previous pages of this literature review with respect to various light rail transit projects, metro projects and main rail way construction projects are listed below with the aim of giving the reader a better understanding of the major factors which affect railway construction cost ; I would like to stress the fact that the factors which are listed here below are neither the only causes of cost overrun in light rail transit projects nor are they the main causes of such light rail transit projects but as can be seen from the previous literature there is a notable recurrence of cost overrun related and not limited to the factors listed below.

2.3.3 Classification of cause of cost overrun

In previous studies causes of cost overrun were classified based on various means and categories which are used to rate and rank the significance of the cause of this cost overrun in relation with the responsible party for the cause of cost overrun.

In this paper the cause of cost overrun will be divided so that the pertinent issues in the study of the cause of cost overrun in Addis Ababa’s LRT project can be classified with a specific aim resolving ambiguity as to the cause, responsible party and stage of construction.

Therefore after careful consideration to classify the cause of cost overruns with the aim of categorizing the main issues effectively in Addis Ababa’s LRT project the following method of classification were selected.

Stage of construction	Responsible party
I. Pre-construction stage (stage of construction)	Owner /client
	Consultant
	Contractor
II. Construction stage	Owner /client
	Consultant
	Contractor

Table 2.3 Calcification of stage and responsible party to cause of cost overrun

I. Pre construction stage

There are many reasons which could be cited as causes of cost overrun in rail way projects and in the construction industry as a whole this literature will discuss some of the reasons for cost overrun with the aim of obtaining the relevant topics which are specific to LRT projects in Addis Ababa . First we consider the causes and sighting of causes of cost overrun in the construction sector during pre construction stage.

A. Inadequate or incomplete design

A study conducted by Caltrans (2007) states that design risks can be attributed to Design consultants, project/site, cost estimate and schedule, and right of way acquisition. The list of design risks that come under these categories include: limitations in Designer’s qualifications, lack of professionals, lack of teamwork spirit, lack of understanding of cost/schedule management, design errors and omissions, unreliable geotechnical data and test results, inaccurate or inadequate surveys, incomplete or inaccurate engineer’s estimate, omitted quantities, un-sound schedule estimation, delays in right-of-way appraisal and acquisition.

In a claim against Multiplex for non-payment, filed at the Technology & Construction Court, Cleveland Bridge alleged that ‘by the Spring of 2003 there were serious problems arising from late and incomplete design by the civil and structural engineers and delays in providing design information. The design changes and late information caused substantial cost increases, and delays and disruption to the subcontract works.. (Keith Potts, 2008).

According to McLennan and Jorss (2004) poor design documentation include the following root causes:

- ❖ Inadequate project briefs based on unrealistic expectations of time and cost
- ❖ Lack of integration along the supply chain linking parties between project phases
- ❖ Poor understanding and low skills in risk assessment and management
- ❖ Inadequate use of CAD/computer technology in design process and in completion of specification.

In engineering procurement construction (EPC) contract like the one which was signed between Ethiopian railway corporation (ERC) and china railway engineering corporation (CREC) the risk of design is entirely covered by the contractor that is CREC but this does not mean that the contractor is not faced with the risk of cost overrun which might occur due to various defects pertaining to the design. But Due to the clauses in the EPC turnkey contract the contractor cannot ask compensation for this design defects unless design changes occur from the owner, which institute compensation to the contractor as per the contract. Therefore as a contractor the design team should be aware of this risks pertaining to EPC turnkey contracts and design accordingly.

B. Lack of appropriate Site investigation

According to (Getachew Tsegaye 2009) unforeseen geological conditions and the associated geotechnical problems is a major contributor to cost and schedule overruns on large civil engineering projects. However, the geological conditions cannot be blamed for all of the cost and schedule overruns. Many of these disasters are the result of inadequate geological data, inadequate site investigations, inappropriate interpretation of available data, and incompetence in dealing with the problems once they have arisen. In spite of numerous attempts to deal with these situations by the incorporation of various clauses in contract documents, the problems persist.

It is suggested by (Hoek and Palmieri, 1998) that the best solution is to define the geological conditions as early and as accurately as possible so that surprises are minimized. Where no local source of geological information is available, there is no option but to mount a geological and geotechnical site investigation program that will identify the overall conditions of the site and give some indication of potential problem areas.

An important requirement of any good railway track is that track geometry must be maintained during train operations. Many superstructure defects, such as rail breaks, are directly or indirectly caused by

- ❖ Poor track geometry.
- ❖ Poor vertical alignment of conventional ballasted rail track which can lead to poor passenger comfort, higher track maintenance and renewal cost, speed restrictions as well

as potential derailment. Uneven track deterioration or settlement is the main cause of poor track geometry.

This irregular track deterioration is often caused by settlement of the substructure, which is often highly dependent on site conditions.

The main party responsible with regards to cost overrun due to lack of site investigation is the contractor but this is subject to change in accordance with the type of the contract.

C. Insufficient and inadequate Estimating techniques

By examining the cost escalation of previous rail projects and reviewing the arguments of researchers who have asserted that cost estimates of rail projects have been routinely underestimated, (Dan, sean and pat 1993) have concluded that the problem of high overruns is mainly confined to cost estimates done in the conceptual stages of the projects. Design estimates are most likely to escalate when engineers lack experience with the specific type of project or technology.

According to (Flyvbjerg,2003) cost overruns in major transportation projects are widespread due to “a lack of realism in initial cost estimates” and The length and cost of delays are underestimated, contingencies are set too low, changes in project specifications and designs are not sufficiently taken into account, changes in exchange rates between currencies are underestimated or ignored, so is geological risk, and quantity and price changes are undervalued as are expropriation costs and safety and environmental demands.

Even though mistakes with regards to estimation is based in the pre construction stage according to international science of engineering most mistakes can be attributed to considering project cost estimation as a single process Project estimation is not a single process the stages of project estimating can be seen in the context of the project life cycle structure. Therefore estimation can be attributed to both pre and construction stage of a project.

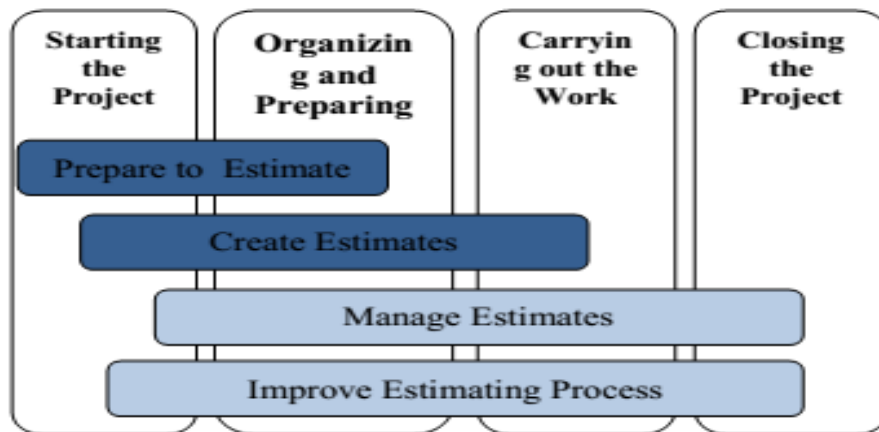


Figure 2.4 Estimation process (International Journal of Science and Engineering Investigations, 2013)

D. Size of contract

There is controversial view when it comes to the size of the project for example research has suggested that the likelihood of cost overrun increases with contract size and complexity as well as the number of change orders as the change-order rate increased, contract size increased (Garry D.creedy ,2005)

Flyvbjerg and Buhel 's 2003 examination of more than 1300 construction projects found that a cost overrun rate of 1 to 11% is more likely to occur on larger projects than smaller projects as managers typically have longer periods of time to rectify cost-related issues and therefore keep cost overrun rates low.

On the other hand, (Mansfield 2006) research showed that larger overruns were experienced in smaller projects. This suggests that larger projects may be better managed and that longer completion times provide an opportunity to make adjustments to facilitate cost control.

E. Inadequate specification

Specification, describes in words the works to be built, the quality of material and workmanship to be used, and methods of testing etc. a written or printed description of work to be done, forming part of the contract and describes the additional information which are not shown in the drawings, specification is considered as the remedy instruction to the drawings. (LUI YI 2009).

A specification is prepared by an architect or consulting engineer to provide written technical information mainly on the quality of materials and workmanship. The specification would be a contract document in its own right if the contractor tenders on the basis of drawings and specification only. Where bills of quantities are used for building work the specification is included with the bill of quantities as preambles. In this way the specification again becomes part of the contract documents. (Martin brook, 2004)

According to (Fetena nega 2008) specification should

- ❖ 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;
- ❖ Adequate and realistic specifications of materials and methods are stated in the contract documents.

II. construction stage

A. Scope changes.

A scope change is defined as any discretionary change in the size or configuration of a project. Scope changes include both additions to and subtractions from a project, as well as discretionary changes in the elements that make up the project.(Hilton and stoney 2007) the authors comment that decreases and increases in scope are both sometimes used by ingenious or desperate project managers to mask what would otherwise be cost overruns.

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 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. [O'Brien, 1998].

Scope changes are due largely to inadequate planning and feasibility studies. If importance is paid at the right time scope changes and additional works can be considerably reduced. Another cause is poor scheduling i.e. not having the right materials, the right tools, the right information, the right training, and the right people all at the right place at the right time. Such improper planning is the major cause of time delays as well as cost overruns.(Civil and Environmental Engineering, 2004).

According to (Garry D.Creedy 2006) to manage scope changes the following qualitative measures need to be considered.

- ❖ Define the purpose of projects and detailed scope to eliminate unnecessary changes
- ❖ Limit any scope change after preliminary design
- ❖ Review and sign-off design scope by client
- ❖ Minimize scope change after the decision to build is made
- ❖ Ensure client involvement in scope development and preliminary design
- ❖ Ensure better communication of project objective before execution
- ❖ Use feedback from previous projects.

B. Delays or time overrun

Delay is a pervasive phenomenon in construction project delivery. It is branded as the most common, costly and risky problem encountered in construction project with a debilitating effect on the parties to a contract. It creates adversarial relationships, distrust, litigation, cash-flow problems, project abandonment and general feeling of apprehension towards each other (S.M. Ahmed, S. Azhar 2007).

In construction, delay could be defined as the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for the delivery of a project. It is a project slipping over its planned schedule and this is a common problem in construction projects.

To the owner, delay means loss of revenue through non availability of production facilities and rentable space or a dependence on present facilities. In some cases, delay causes higher overhead costs to the contractor because of longer work period, higher material costs through inflation, and due to labor cost increases. (Kaliba et al., 2009).

Completing projects on time is an indicator of efficiency, but the construction process is subject to many variables and unpredictable factors, which result from many sources. The sources are the performance of parties, resources availability, environmental conditions, involvement of other parties, and contractual relations, and the completion of a project within the specified time is rare (Ahmed, S. Azhar 2002).

If project costs or schedules exceed their planned targets, client satisfaction would be compromised. The funding profile no longer matches the budget requirement and further slippage in the schedule could result (Kaliba et al., 2009).

According to Ahmed et al. (2002), delays on construction projects are a universal phenomenon and transportation construction projects are no exception. Delays are usually accompanied by cost overruns. These have a debilitating effect on contractors and consultants in terms of growth in adversarial relationships, mistrust, litigation, arbitration, cash-flow problems, and a general feeling of trepidation towards other stakeholders (Ahmed et al., 2002). This problem is not unique to developed countries and is being experienced in most of the developing economies.

Types of delay

Delay in projects is almost inevitable. Some delay will take place at a particular period in the completion of an activity and some other ones may be capable of leeway in when they have their effects. (According to Scott 2008) The three major types of delay are:

❖ Employer's responsible delay

He described employer's responsible delay as those that results into variation and failure to provide site information. He further elaborated that the delays emanated from the Employer are found in the areas of extension to time and escalation of costs due to inflation, delay in the

payment of interim certificates; inability of the client or his representatives in taking quick decision, late handing over of site, delay in the supply of materials and inadequate planning.

❖ **Contractor's responsible delay**

Contractor's responsible delays are caused by inability of the contractor to proceed with the project diligently and efficiently as a result of inadequate labor/ plant provisions and insolvency of the contractor.

❖ **"Neither" party responsible delay.**

"Neither" party responsible delay (Extraneous conditions) exist in situations that are beyond the capacity of either the contractor or the client. Such extraneous circumstances are resultants from strikes, riot, exceptional adverse weather, force majeure and acts of God, loss and damage due to fire and storm, Inability of the contractor to reason beyond his control and which he could not reasonably have foreseen at the date of the contract to secure such resources and delays caused by nominated subcontractors or suppliers which the contractor has taken all possible steps to avoid or reduce.

According to (Ahmed 2008) delay could be non-excusable or excusable (with or without compensation) and concurrent delays.

He further explained that non-excusable delays are either caused by the contractor, subcontractor or other party but are within the control of the contractor. These non-excusable delays are as a result of equipment breakdown; inadequate scheduling or mismanagement; underestimation of productivity.

It is however within the terms of contract that when excusable delays occur, both parties will have to share the risks involved. The contractor will not receive compensation for the cost of delays, but will be entitled to an additional time to complete his work and is relieved from any contractually imposed liquidated damages for the period of delays. This type of delay can also have an impact on noncritical activities which need a more detailed analysis to determine whether an extension of time is warranted, or if the reduction of float time can be

justified. Excusable delays can therefore be further classified into excusable with compensation and excusable without compensation.

C. Inflation or market conditions

The term “inflation” applies to the “disproportionate and relatively sharp and sudden increase in the quantity of money, or credit, or both, relative to goods available for purchase”. Inflation produces a general rise in price levels but, more importantly, causes a decrease in the monetary unit with time, and these consequences are proportional to the rate of inflation. If the effects of inflation are not included in financial and economic studies, possible outcomes include selecting incorrect alternatives, understanding budgets, and overstating profits. (Asteway Yigezu 2008)

Inflation has become a chronic problem whose effects permeate the entire construction industry. Contractors are faced with server uncertainty in bidding and financing work on projects. Owners are not only paying for the increased costs of facilities and capital but also for premiums on construction prices because of the uncertainties of inflation and its side effects.

Productivity is affected because contractors can not accurately forecast long-term returns on their investments and are required to divert necessary capital to meet resource costs. In particular, the proper assignment of economic risks in contracting should reduce costs in the long term, although this would entail considerable change in construction industry operations [Stukhart 1982].

Inflation remains a main factor of cost increases (Arditi, Akan, and Gurdamar 1985; Merewitz 1972). Thus, it is necessary to consider the estimation of the inflation rate and the inflationary effects of schedule delays when developing the project cost estimates and analyzing cost overruns. The agency preparing the estimate (especially at the planning phase) should adjust the cost estimate to account for the likely project development schedule and the likely midpoint of construction.

Engineering procurement construction (Epc)/turnkey Contracts that make the Contractor entirely responsible for such risks as weather, unforeseen conditions, delay, unrest, material shortages, and inflation are like to be more dispute prone than those that spread such risks among the

parties. for a typical EPC and PPP project, the time period between bidding and operating is usually very long, and the cumulative impact of inflation over time will be significant. Because bidders have no way of managing inflation risk, if asked to bear such risk, they will either refuse to bid (the risk is too high) or make very conservative inflation assumptions (risk pricing), which will push project costs up significantly.(Akpan and Igwe, 2001).

Many factors can be attributed to cost overrun in the construction of railway projects the factors listed above are some of the causes of cost overrun which have observed in the construction industry to summarize this causes of cost overrun a table is provided below stating the causes of cost over run in various projects.

To summarize the causes of cost overrun presented in this paper the following table is provided

Author	Major Causes of cost over run	Project type
(Creedy et al. 2010)	❖ Changes in design and scope	Highway project
	❖ Inadequate site investigation	
	❖ Inadequate quality of contract documents	
	❖ Relocation of services and utilities	
	❖ Shortening of contract period	
(Ahsan and Gunawan 2010).	❖ Government pressures	International development projects
	❖ Scope changes and additional work	
	❖ Changes in design	
Morris (1990)	❖ Inappropriate government policies	Public sector projects
	❖ Faulty estimation	
	❖ Delays	
	❖ Inflation	
Datta (2002)	❖ Variation in exchange rate	
	❖ Delays b/n plan and implementation	
Caltrans (2007)	❖ Design risks , right of way acquisition ,	High way and rail
Harthy and Amur Salim (2006)	❖ Inadequate Design	Unspecified

Keith Potts, 2008	❖ Late and incomplete design	ClevelandBridge projects.
McLennan and Jorss (2006)	❖ Inadequate Design	Unspecified
Hoek and Palmieri (1998)	❖ Site conditions	Unspecified
J.O. Okumbe, J.J. Verste 2008	❖ Delays or time overruns	“
Baldwin et al, 2004	❖ Mismanagement of Materials	“
The Office of Inspector	❖ cost estimates	Hiawatha LRT
Pickrell (1990)	❖ cost estimates	urban rail transit projects
Schumann (1988)	❖ cost estimates	Sacramento RT Metro, a light rail transit (LRT)
Stukhart 1982	❖ Inflation	Unspecified
Arditi, Akan, and Gurdamar 1985	❖ Inflation	Unspecified
Akpan and Igwe, 2001	❖ Inflation	Unspecified
Rowland 1981; Hinze et al. 1992	❖ Size of contract	Large construction projects
Jahren and Ashe’s(1990)	❖ Size of contract	Large construction projects
(Ahmed et al 2003) .	❖ specification	Unspecified
Martin brook ,2004	❖ specification	Unspecified

Table 2.4 - Summary of causes of cost overrun collected from various literatures.

2.4 Definition and types of contracts

A contract is defined as: "an agreement made between two or more parties which is enforceable by law to provide something in return for something else from a second party". Contracts can be very simple or they may be very long and complicated legal documents. When a contract is properly set-up it is legally binding upon. The two parties are expected to perform the various obligations they have undertaken, as expressed in a mutually agreed set of contract documents. A contract therefore, is necessary to protect both client and contractor. (Emad Elbeltagi 2004)

Construction contract types, though they are known by many titles and there are numerous variations, they fall into two fundamental categories, fixed price and cost reimbursable contracts. The element of risk, the willingness of the parties, the competition, complexity of construction, and urgency may influence the general type of contract selected.

In general, cost-reimbursable contracts transfer the economic risks to the owner, while fixed price contracts place the economic risks on the contractor. (Ostwald Phillip F 2001)

I. Fixed Price Contracts

Fixed price contracts have in common that, a contractor is to deliver construction work in accordance with the terms and conditions of the contract and the client is to pay a price equal to that specified by the contract. The price is fixed for the life of the contract time, precluding changes allowed by the contract. However, the terms and conditions may allow for adjustments. (Roy Plither,1992).

II. Cost Reimbursement Contracts

If a project cannot be accurately estimated, then the fixed price contract may not be suitable and the use of cost reimbursable contracts is preferable. Large complex constructions are candidates for this type of contract. These contracts involve recording the total actual costs of materials, plant and labor, known as the allowable or prime costs, incurred in order to carry out the works and then adding to them a previously agreed fee to cover profit and overhead costs, (Roy Plither, 1992).

Based on the above classifications and others criteria contracts can further be classified and listed as

- ❖ Design and build
- ❖ Design build finance and operate
- ❖ Emerging cost contracts
- ❖ Engineering procurement and construction contracts (EPC) turnkey contracts
- ❖ Engineering procurement and construction management contracts (EPCM)
- ❖ Fast-track construction
- ❖ Furniture fixtures and equipment (FF&E)
- ❖ Frame work agreement
- ❖ Guaranteed maximum price
- ❖ Lump sum contract
- ❖ Measurement contracts (re-measurement or measure and value contracts)
- ❖ Traditional contract (design –bid –build) (DBB)

Source (Wiki designing buildings Ltd 2014)

Basically there are various contracts which are suitable for various project types the one selected in Addis Ababa's LRT project by the owner /client ERC Ethiopian railway corporation was the **EPC turnkey** form of contract This form of contract, also called EPC-contract (*Engineer, Procure, Construct-Contracts*) is a form of contract where the contractor is responsible for the design and building of the project. Such forms of contract are particularly suitable for electro-mechanical contracts. In this form of contract, the contractor agrees to do the job for a fixed sum. In this case the contractor is responsible for the preparation of all details.

2.4.1 Engineering procurement construction (EPC) turnkey contract

A. Introduction

Contracts are essential tools for allocation of tasks, responsibilities and risks it is a principle of contracting that the party who controls risk should carry the risk, however more than this is needed. A contractor will often carry a risk whether he controls it or not but at a price. The contracting strategy shall take in to account the desired allocation of risk, division of responsibilities, market situation, splitting of works and services between the concerned parties, and time constraints. (Ostwald Phillip F 2001)

The selection of contracting criteria is the key factor which determines the entire project realization. Therefore an awareness and knowledge of the specific characteristics of possible approaches is essential. The selection of the contracting strategy is the key factor which determines the entire project realization among the various types of contracting methods some of the methods are EPC, EPC/ with long lead items, EPC and progressive lump sum (PLC). (Roy Plither 1992).

B. Description of EPC Turnkey contract

In engineering and procurement construction (EPC) contract a single point contract is awarded which comprises as the name implies engineering, procurement and construction activities. This EPC contract contemplates that a single contractor will be responsible for the entire project from design through construction and testing.

Engineering, Procurement and Construction (EPC) Contracts are called Turn-key projects, they have a combined scope of work involving services and supplies .broadly, an EPC contract encompasses the following key activities. (SujitGhosh 2010)

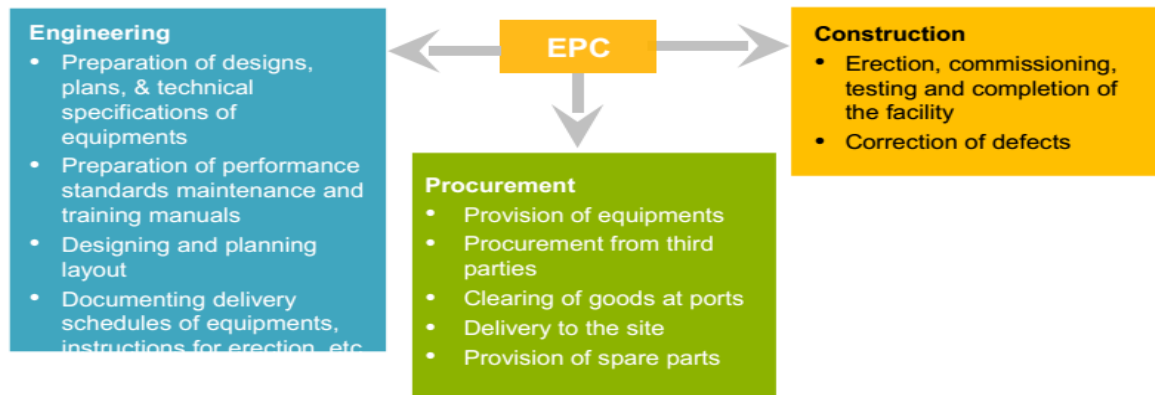


Figure 2.5 Indication of the activities of EPC contracts (SujitGhosh 2010)

Under EPC contract a contractor is obliged to deliver a complete facility to a developer who need only turn a key to start operating the facility; hence EPC contracts are sometimes called turnkey construction contracts. In addition to delivering a complete facility, the contractor must deliver that facility for a guaranteed price by a guaranteed date and it must perform to the specified level. Failure to comply with any requirements will usually result in the contractor incurring monetary liabilities.

The basic concept behind a design/build construction contract can best be understood by comparing it to a traditional construction contract. The typical contract involves a three-party arrangement between an owner, design professional and contractor. The owner hires a design professional to design the structure and then the contractor to construct the project according to the design plans and specifications. In so doing, the owner warrants the sufficiency of the plans and assumes any liability for defects for them to the contractor. The contractor is then responsible for defective construction and workmanship, but is free from any liability for design defects. The design professional, while responsible for design, does not assume any liability for defective construction, other than for his failure to detect such defective construction as should have been obvious to him through the course of his field services rendered during the construction operations. (Alexander meibner et al 2010)

By contrast, in a design/build contract, the owner enters into a single agreement by which the design/build contractor agrees to perform both the design and construction of the project. In some instances, the contractor may also agree to be responsible for acquiring land, financing the project and leasing the finished structure. This more comprehensive arrangement is often referred to as a “turnkey” contract.

In either a design/build or turnkey arrangement, the contractor’s objective is to satisfy the owner’s broad performance specifications rather than to adhere rigidly to the design professional’s plans and specifications. As well as being responsible for faulty workmanship in construction, the contractor is also liable for any deficiencies in design under this arrangement. (Alexander meibner et al 2010)

Key characteristics of an EPC contract

- ❖ Single point of responsibility for performance of the works , communication and coordination remains with the contractor
- ❖ Guaranteed completion date, performance and firm contract price
- ❖ Clear division of obligation and liabilities
- ❖ High contract price due to mark ups: contract price may be inflated as the EPC contractor and due to the initial engineering phase.
- ❖ Full dependence on the contractor

Advantages of an EPC contracts

- ❖ The contractor bears the risk of integrating the performance of all package contractors, including designers
- ❖ The contractor bears supply chain solvency risk
- ❖ The transfer of other construction risks is maximized relative to other procurement methods
- ❖ A high degree of certainty (on paper) can therefore be attained as to cost, time and quality
- ❖ Remedies (such as LDs), liability caps and bond amounts are all sized relative to the total cost of the works and thus likely to cover a significant proportion of the owner's losses
- ❖ Administrative burdens on the owner are minimized

- ❖ The documentation is relatively simple and standardized
- ❖ EPC procurement is widely used and understood and is the most "bankable" procurement method

Disadvantages of EPC

- ❖ Cost – contractors will add a substantial risk premium to the price
- ❖ Control – the contractor controls the detailed design and construction process
- ❖ Quality – the contractor will aim for the minimum compliant standard
- ❖ Bidder resistance – EPC has been unpopular among some contractors (though market conditions are rapidly changing)
- ❖ Employer has little control over the quality of construction more risk of latent defects and high maintenance costs
- ❖ The Contractor will price for the risk taken Contract Price higher than under other forms of contract

2.4.2 Conditions of contract for EPC /Turnkey project

These Conditions of Contract are intended for use where one entity (the Contractor) provides a fully equipped facility ready for operation at the ‘turn of the key’.

The Employer is required to provide a fully descriptive document specifying precisely what is to be built and to what standards. In defining the Employer’s Requirements, the employer may provide preliminary drawings, site data, and technical requirements including specifications. The Employer’s Requirements may also contain requirements for specified outputs from the completed facility. (Michael D. Robinson. 2011).Which may be suitable for the provision on a turnkey basis of a process or power plant, of a factory or similar facility, or of an infrastructure project or other type of development where. (Conditions of Contract for EPC/Turnkey Projects First Edition 1999)

A. The conditions of contract circumstances suitable in EPC/Turnkey projects

- ❖ A high degree of certainty of final price and time is required
- ❖ The contractor takes total responsibility for the design and execution of the project with little involvement of the employer. Under the usual agreement for turn key projects, the contractor carries out all the engineering, procurement and construction (EPC): providing a fully – equipped facility, ready for operation. (at “Turnkey).

B. Conditions of contract for EPC/Turnkey projects which are not suitable for use in the following circumstances.

- ❖ If there is insufficient time or information for tenders to scrutinize and check the employer’s requirements or for them to carry out their design, risk assessment studies estimating (taking particular account of sub-clauses 4.12 and 5.1)
- ❖ If the employer intends to supervise closely or control the contractors ‘s work, or to review most of the construction drawings
- ❖ If the amount of each interim payment is to be determined by an official or other inter

2.4.3 Contractual conditions that impact contract cost in engineering procurement construction contracts (EPC).

- ❖ Risk: - According to EPC contract first edition 1999 the contractor shall take full responsibility for the care of the works and materials and plant from the commencement date until the date of completion and turn over.
- ❖ Variations:- EPC contracts generally attempt to limit any opportunity by the contract to claim for additional cost. However, the acceptance of variation may achieve a lower contract price and impart flexibility to the contract in dealing with risks and contingencies.
- ❖ Force Majure/ Unforeseeable Difficulties
The contractor accepts total responsibility for having foreseen all difficulties and cost of successfully completing the works, the contract price shall not be adjusted to take account of any un foreseen difficulties or costs.

2.5 Description of Addis Ababa's Light rail transit project

To effectively solve the problem of urban transportation, especially that of the downtown area, the government of Ethiopia decided to build a light rail in the city of Addis Ababa.

Currently this project has planned two lines the east –west line and the south-north line. About 3 km is the sharing section for both E-W route and N-S route, which has the greatest passenger current. (CREC2009)

The project is located in Addis Ababa, the capital of Ethiopia, which is the location of the head office of African Union. The altitude of the plateau is 2,400m. With an urban population of over 3,400, 000, it takes 24% of the total population of Ethiopia. The urban area is 530. 14 km² and the density reached 5,607.96/km. (CREC2009).

The Addis Ababa LRT covers the East-West and North-South transport corridors. The East-West corridor passes through the city center from the eastern peripheries of the city to the west. In its 2nd phase, the East-West corridor will connect suburban towns from the Oromia region such as Legetafo in the East and Sebeta in the West.

Major residential and real estate development locations at Ayat, CMC, Gurdshola and the area west of Torhailoch are accessed through this route. Meskel Square is the major public gathering location in Addis Ababa and Meganagna Square is an important transit hub and commercial centre. The East-West corridor crosses the ring road twice at Megenagna and Torhailoch.

The North-South corridor is a heavily-used route; it is utilized to access Africa's largest open market, Merkato. The initial phase of the project starts from Giorgis (Piazza) in the north and heads a little distance to the west to access Merkato and Autobus Tera (the Intercity Bus Terminal). Afterwards, the route heads south until it joins the East-West route at Lideta. From Lideta to Meskel Square both services have a common route until the North-South route bifurcates to the south heading to the new Gotera interchange, Saris and Kaliti.

Currently, City Buses and Minibuses serve the transport demand along the corridor. Both modes share the same space in the corridor along with other vehicles. At rush hours the corridor is too

congested and travel time is high. It is evident that the travel demand is not being satisfied with the existing system. If no action is taken, the problem is expected to worsen in the future with consequences of seriously affecting the economic activities of the city.

As a result, the Government of the Federal Democratic Republic of Ethiopia has decided that the corridor needs to be developed as Light Rail Transit (LRT) mass transport line.

Master Plan of Addis Ababa's EW and NS LRT line



Figure 2.6 Master Plan of Addis Ababa, showing East-West and North-South Corridors with red color

Clear representation of master plan is provided in appendix c

According to the 1st bankable feasibility study conducted by Addis Ababa's light rail transit project by the Ministry of Transport and Communications (MOTaC) and Ethiopian Railways Corporation. The first phase of AA-LRT system will cover a total route length of 31.048 km considering separate main line length for the two corridors. Under this phase, the East-West corridor lies from Ayat

village to Torhailoch covering some 17.35km and the North-South Corridor covers from Giorgis (Piazza) to Kaliti with a route length around 16.9km. The number of stations are assumed to be around 18 per corridor and these stations will be distributed at equal distance apart from each other in each corridor.

Furthermore the service requirements for Addis Ababa’s LRT system are supposed to satisfy the following requirement.

Description	Initial Operations Phase
Operating Fleet	41 vehicles (1st phase)
System Capacity	4.05M PKM pa (Initial phase)
Load Standard	Max 6 passengers /m²
Train Length	28.40 m
Max Train Load	286 passengers
Min. Headway	120 seconds
Intermediate station Dwell	13 s (approx.)
End Station Dwell	180 s (approx.)
Round Trip Time	77 min. (approx.)
Avg. Operational Speed	34.78 km/h
Maximum Line Speed	80 Km/hr
Power pickup	Pantograph
Gauge	1435mm

Table 2.5 – Summary of Addis Ababa’s LRT project operation and size

2.5.1 Cost of Addis Ababa’s light rail transit project

The project cost estimate conducted by the bankable study states that for the estimate of the project the following scope of works were taken in to consideration. Utilities ,At-Grade and Structures ,Special Structures ,Stations, Depot Facility, Track work, Power Supply , Power Distribution ,Train Control ,Supervisory Control.

Based on the above consideration and a prevailing aggregated unit prices and quantities for Phase 1 the Bankable feasibility study estimate of the LRT Project was **400,234,004.25 million USD**, the Capital Cost Estimate is given in the appendix B Table 1 and 2 in 2005 prices.

Then Ethiopian Railways Corporation (ERC) a corporation incorporated under the laws of federal Democratic republic of Ethiopia, and China Railway Group Limited (CREC) incorporated under the laws of the people republic of china signed the EPC Turnkey contract for Addis Ababa LRT project on September 3, 2009 in Beijing as the Employer and the contractor.

As per the contract it is agreed that 85% of the contract price for EPC Turnkey Contract is to be payable in US dollar and is to be financed under the Loan agreement made between the Employer and EXIM bank of china through the buyer's credit and remaining 15% of the contract price for EPC Turnkey contract is to be payable in Ethiopian birr and to be financed by the Employer.

The loan agreement for the project has been signed by the Employer and EXIM bank of china on June 22, 2011 and loan Agreement is still under examination and approval by the Chinese Government. In a meeting conducted under china Railway Group Limited office, Chengde , P. R, china the price final negotiations were conducted and the final price for Addis Ababa LRT project was agreed to be **475,000,000.00 mil USD** (Four hundred and seventy five million united states of American dollars only).

The conditions of the contract comprises the “General conditions” which forms part of the conditions of contract for EPC/Turnkey projects first Edition 1999 published by the federation des ingenieursconseils (FIDIC) and amendments to the general conditions.

Therefore based on these conditions of contract, and factors which institute cost reimbursement with respect to the contract and the presence of factors stated as the main causes of cost overrun in international transportation projects study will be conducted by using research methodology present in the next chapter.

CHAPTER 3

3. Research design and Methodology

3.1 Introduction

This chapter presents the general approach and specific techniques adopted to address the objectives of the research. The chapter also presents the research design and the methods used in data collection, data analysis and interpretation it begins with the definition of research and research methodology and concludes with a look at the limitations of the methodology employed to conduct the study.

According to (Kothari (2004) Research methodology is a way to systematically solve the research problem and research methodology shall identify the research basis, research hypothesis or questions, research design and research analysis, and Kumar (1999) defines research as a process, that is undertaken within a frame work of set of philosophies, uses procedures, methods and techniques that have been tested for their validity and reliability; and designed to be unbiased and objective.

Therefore to achieve the aim of this thesis that is cost overrun/increase identification and impact assessment of Addis Ababa's LRT project a systemically organized methods and techniques have been adopted for their validity, reliability; and designed to be unbiased and objective.

3.2 Research design and research type

The research strategy adapted for this research can be categorized as applied, exploratory, and descriptive. It is applied and exploratory because the research was initiated to identify practical problems and tries to find the presence or absence of cost overrun in the construction of LRT project in Addis Ababa, It is also descriptive because it tries to describe the cost management practices of LRT project in Addis Ababa.

Based on the method of data collection and analysis the research can also be classified as both qualitative and quantitative to obtain the appropriate data desk study, interview and questioners were used therefore the overall approach, as described in chapter 1 of this thesis, followed a four

stage process; having established the basis of the research, necessary data were collected, analyzed, and conclusions and recommendations were made based on the findings.

3.3 Data Source and Collection

To achieve the desired objective that is identifying the presence of cost increase/overrun and assess the Cause of this cost increase and cost management practices which were used to avoid Cost overrun or can be attributed as the cause for cost increase this study employed Primary and Secondary data collection as the source of data. Based on the information acquired from literature Reviews and inputs from various local experts the primary data were collected through questionnaires and interviews, from crucial participants in Addis Ababa's LRT project

The questionnaire is categorized into four major sections.

Section 1: Covers general profile of the respondent,

The use of this section is to determine the respondents experience in rail way project and cost management of such kind of large transportation project which would help in giving weight to the respondents answer.

Section 2: Assesses the current cost management practice of the company

Project management is a wide process which encompasses several sub processes and deal with fulfilling predetermined project objectives. Among these processes, one of the most crucial management processes is cost management process Project cost management includes the process involved in planning, estimating, budgeting and controlling cost so that the project can be complete within the approved budget.

Therefore to assess the current cost management practice of Addis Ababa's LRT project and to perform correlation with management practice and cost increase of the light rail transit project and efficiency of the cost management practice observed from the pre construction stage to the construction stage.

Section 3: Assesses the presence and cause of cost increase / overrun incurred or expected to Occur,

Cost overrun is 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 contractor.

And main focus of this research is to identify the presence of cost increase/overrun in the light Rail transit project and the cause of this overrun and the various cost management practices Which are being used to avoid the occurrence of cost overrun.

To achieve this objective various lists of causes of cost overrun which have been observed in transportation projects and specifically railway projects were collected for the respondent to rate as the cause of cost overrun.

Section 4: Assesses the strategies used to avoid cost increase/overrun and explores the opinion of the respondent for cost increase /overrun reduction strategies.

Various strategies exist to mitigate the occurrence of cost increase and to assess which of this methods are being used and should be used to avoid cost increase respondents were asked to rate the various mitigation measures which are being used in Addis Ababa's LRT project.

General Suggestions on the topic and extra mitigation measures were collected from the respondents so that we can achieve a better cost management practice for Phase-2 and 3 of the railway project.

Finally the data which was collected through questioners were substantiated through structured and unstructured interviews carefully crafted to obtain the viable result which can lead to conclusion and recommendations.

The secondary data was collected from data obtained from various LRT project documentation such as feasibility study, contract documents, Claim letters, cost and time schedules prepared by ERC, CREC and the consultant SWE Road.

3.4 Method of Analysis

The data collected for this study encompasses qualitative and quantitative sections the qualitative data was obtained mainly through interviews conducted with various parties responsible for the project and the quantitative data was obtained from the same study group through a structured questioner.

In the analysis, the ‘mean score’ method was adopted for section 2, 3 and 4 part of the questionnaire section 2 assesses the current cost management practice of the company by investigating the current cost estimating, budgeting and cost control practice of the company section 3 assesses the presence and cause of cost increase / overrun incurred or expected to Occur by direct percentage determination and mean score method, Finally section 4 assesses the strategies used to avoid cost overrun and explores the opinion of the respondent for cost overrun reduction strategies.

To establish the degree of use of cost management practice and determine the extent to which cost overrun factors have contributed to the presence of cost overrun the mean score method is used this method allows to determine the mean factor which is contributory to cost overrun in Addis Ababa’s LRT project.

Therefore the mean score method is used to determine the cost management practice such as cost control , cost budgeting and cost estimation of Addis Ababa’s LRT project The mean score (MS) for each potential risk factor of cost overrun is computed using the following expressions.

$$MS = \frac{\sum(f*S)}{N} \dots\dots\dots \text{Eq. (1)}$$

Where:

MS = Mean score

f = frequency of response for each score

S= score given to each factor (1to5)

N= Total number of responses for each factor

- 1. Very low (insignificant) =0-25%
- 2. Low= 25-50%
- 3. Medium=50
- 4. High =50-75%
- 5. Very High =100%

Based on this rating the respondents were asked to give reasons for their answer if their answer fell in the region above or below 50%

Relative Importance Index

$$RII = \sum \frac{W}{A*N} \dots\dots\dots \text{E.q. (2)}$$

Where:-

W = weighting given to each factor by the respondents and ranges from 1 to 5 where '1' is very low ' and '5' is very high ',

A = highest weight (i.e. 5 in this case), and

N = total number of respondents.

Spearman's Rank Correlation

Then to compare the answers given by the three parties that is the client/owner, consultant and contractor the Spearman's rank correlation coefficient r is used to measure and compare the association between the rankings of two parties for a single cause of delay, while ignoring the ranking of the third party. And it is calculated by the following formula:

$$R_s = 1 - [(6 \sum d^2) / - (n^3 - n)] \dots \dots \dots \text{E.q (3)}$$

Where

R_s = Spearman's rank correlation coefficient between two parties

d = the difference between the two parties

n = the number of pairs of ranks

The rank correlation coefficient is used for measuring the differences or agreement in ranking between two groups of respondents scoring the various factors (i.e. clients versus consultants, clients versus contractors, client versus construction professionals, consultants versus construction professional, construction professionals versus contractor, and consultants versus contractors).

CHAPTER 4

4. Analysis of findings and discussion

4.1 General overview

In this chapter three main research data sources were used for the collection of relevant information and analysis. These data sources include archival reports, questionnaires and

interviews they were used to identify the presence of cost overrun, rank the major risk factors leading to cost overrun and assess mitigation measures being used to avoid the occurrence of cost overrun in Addis Ababa's LRT construction project.

The archival study was mainly carried out to obtain actual data from the source documents which included the contract documents, supplementary agreements, variation orders and progress reports to have contextual bases on cost overrun in the project.

Even though the respondents of the study were unwilling to facilitate the appropriate documentation for full analysis of cost overrun identification the data obtained from claim documentation, contract agreements, bankable feasibility study estimates and progress reports were used in the archival analysis.

Then the questionnaire survey respondents were presented with a range of questions designed to assess the cost management practice of Addis Ababa's LRT project. With the aim of determining the tools, techniques and inputs being practiced in cost management of the project. The questioner asks the respondents to choose the tools and techniques being practiced and challenges faced in the practice. Which allows them to rate the degree of practice and the challenge by indicating the degree of challenge or use from "very low (0-25%) to "very high (75-100%)". Then the respondents were asked about the presence and degree of cost overrun in the project after they completed this stage a list of possible factors which were collected from desk which was presented for them to rate from "very low (0-25%) "To "very high (75-100%) "As being the cause of the observed cost overrun in the project finally the respondents are asked to rate from a final list of mitigation measures which are being used to avoid and decrease the presence of cost overrun in the project. Furthermore interviews were conducted to supplement the answers obtained from questioner and archival reports.

4.2 Research surveys

4.2.1 Questionnaire design

The questionnaire design took into consideration the objectives of the study with the aim of answering the research questions after conducting a desk study for the determination of a valid method for obtaining the required output for the research objective a great effort and

brainstorming was done for designing the questionnaire. Meetings with members of the industry were conducted to identify the right questions required and to present them in a clear and an unambiguous format. Special care and consideration was taken for phrasing the questions in a language that is easily understood by respondents.

4.2.2 Contents of the questionnaire

The questioner is comprised of four sections the first section covers general profile of the respondents the second assesses the current cost management practice of the company while the third tries to determine the presence and cause of cost overrun incurred or expected to occur and finally the fourth section of the questioner assesses the strategies used to avoid cost overrun and explores the opinion of the respondent for cost overrun reduction strategies.

4.2.3 Questionnaires Response Rate

To perform a comprehensive study of the cost management practice and to determine the presence and cause of cost over run in Addis Ababa's light rail transit project a total of 25 respondents were selected, respondents comprised of Resident engineers, claim experts, contract administrators and project managers amongst others out of this 25 respondents 16 questioners were collected giving a response rate of 61% and from this 16 questioners which were collected 1 questioner was found to be invalid due to lack of full information given by the respondent therefore valid response rate of 57% is obtained. From these 15 questioners analysis was conducted to determine the cost management practice, the presence of cost overrun in the project and mitigation measures which are being conducted to prevent the presence of cost overrun.

Respondent category	Questioner Distributed	Questioner collected	Percentage collected	Valid response	Valid response rate (%)
consultant	9	6	67%	6	67%
Contractor	4	2	50%	2	50%
Client/owner	12	8	67%	7	58%
Total	25	16	61%	15	57%

Table 4.2.1 Questioner response rate

4.2.4 Questionnaire distribution and gathering

Questionnaires were hand delivered to the selected respondents which were believed to be directly responsible in the construction and management of Addis Ababa’s LRT project.

Group of respondent	Participants of the study	No	Weight (%)
Consultant	Resident engineer	1	6.25%
	Deputy resident engineer	1	6.25%
	Claim expert	1	6.25%
	Quantity surveyor	1	6.25%
	Contract Engineer	2	12.5%
	Total percentage response	6	37.5%
Contractor	Construction Finance deputy	1	6.25%
	Contractor representative	1	6.25%
	Total percentage response	2	12.5%
Owner	Construction manager	1	6.25%
	Resident engineer	2	12.5%
	Contract administrator	2	12.5%”
	Project manager	1	6.25%
	owner representative	2	12.5%
	Total percentage response	8	50%
	Total valid participants	16	100%

Table 4.2.2 List and percentage of participants

4.2.5 Interview design

The interview questions were prepared based on the questioner provided to the participants it is used as a supportive tool for the questioner and archival reports collected from the study therefore based on this objective the interview was divided in to four sections. The first section is used to determine the presence or lack of factors which need to be taken in to consideration in

cost management practice of Addis Ababa’s LRT project the second section of the interview determines the presence and cause of cost overrun and challenges of the use of EPC turnkey contract and finally the interview question determines mitigation measures which are being used to avoid or decrease the occurrence of cost overrun in the project.

4.2.6 Contents of the interview

Unlike the questioner which was largely used to determine the tools and techniques in construction cost management of Addis Ababa’s LRT project the interview was conducted to determine first and foremost the presence or lack of factors which need to be taken in to consideration while conducting project cost management in the project it further goes on to determine the presence and cause of cost overrun and effects of the use of EPC turnkey contracts and finally the interview goes on to determine mitigation measures which are being used to avoid the presence or lack of cost overrun in the project.

4.2.7 Interview response rate

With regards to the interview out of the fifteen respondents who participated in the questioner survey ten of them were willing to provide the required information for the interview questions provided to them which gives a response rate of 63% therefore the analysis was conducted based on this interviews , questioners and archival reports

Respondents category	No of participants selected for Interview	No of willing respondents	Percentage willing respondents	Valid response rate	Valid response rate %
Consultant	6	4	67%	4	67%

Contractor	2	1	50%	1	50%
Owner	7	5	71%	5	71%
Total	15	10	63%	10	63%

Table 4.2.3 interview response rate

4.2.8 Data analysis

As stated in the literature review section of the study Project cost management is a process involved in planning, estimating, budgeting and controlling cost so that the projects can be completed within the approved budget and these three process interact with each other and with other processes in other knowledge areas to achieve the project objective (PMBOK 2013). Therefore to assess the cost management practice of Addis Ababa's LRT project and to determine the use of planning, estimating, budgeting and controlling practice in the reduction or prevention of cost overrun a questioner has been developed. In this section the respondents are asked to rate the degree of use of the tools of cost management practice from very low (0-25%) to very high (75-100%).

1. Very low (insignificant) =0%
2. Low= 25-50%
3. Medium=50
4. High =50-75%
5. Very High =75-100%

4.3 cost management practice

4.3.1. Questioner data analysis on cost management practice

A. General cost management practice

First the respondents were asked to rate the priority given to cost in relation to time, quality and rate of construction in Addis Ababa's LRT project by this we will be able to determine the

priority given by each of the participants in relation to the type of contract that is EPC turnkey contract.

No of respondents	Contractor	consultant	Owner	reasoning
	2	6	8	Rank 1 st =contra 2 nd =consul 3 rd =owner Difference is an indication of risk transfer in EPC turnkey contract
1	5	4	4	
2	4	3	4	
3		5	4	
4		4	3	
5		4	3	
6		4	3	
7			3	
8			3	
Ms=S(f*s)/N	4.5	4	3.5	
Score	V. High =75-100%	High =50-75%	High =50-75%	

Table 4.3.1 Analysis on the priority given to cost in Addis Ababa’s LRT project

The result presented above is a simple description of risk transfer from owner to contractor as stated in EPC turnkey Force Majure section of the contract the contractor accepts total responsibility for having foreseen all difficulties and cost of successfully completing the works; the contract price shall not be adjusted to take account of any unforeseen difficulties or costs therefore the contractor generally aims for the minimum compliant standard with respect to quality the main focus of the contractor is to assure the completion of the project in the allotted time and within the approved budget but as can be seen from the result mean score of the three parties is 4 setting the priority given to cost amongst them at High =50-75%

Then the respondents were asked which of the formal construction cost management methods they use to assess the cost of Addis Ababa’s LRT project and to indicate how they would rate

there importance to the project. From the lists provided to them the respondents were asked to choose one of the methods or tools of cost management practice these tools of cost management practice include Earned Value Analysis and Project Cost-Value Reconciliation amongst others and from these lists the participants result is present below.

Methodology under use	contractor	consultant	owner	rank
Monthly WBS Reports/progress report	4.5	4	4.5	1 st
	V.High =75-100%	High =50-75%	V.High =75-100%	
Project Cost-Value Reconciliation	2	1	1	4 th
	Low =25-50%	V. Low =0-25%	V. Low =0-25%	
Profit or loss on each contract at valuation dates	2	2	1.24	3 rd
	Low =25-50%	Low =25-50%	V. Low =0%	
Labor/Plant/Material (actual versus forecast reconciliation)	4.4	4	4.2	2 nd
	High =50-75%	High =50-75%	High =50-75%	
Earned Value Analysis	1	1	1	5 th
	V. Low =0-25%	V. Low =0-25%	V. Low =0-25%	
Unit Costing	2	1	1	6 th
	Low =25-50%	V. Low =0-25%	V. Low =0-25%	

Table 4.3.2 Assessment of tools of cost management under use in Addis Ababa’s LRT project

These results are presented graphically in a compressive manner there for from the result the main tool of cost management practice under use in Addis Ababa’s LRT project are monthly WBS reports/progress and labor/plant/material actual versus forecast reconciliation.

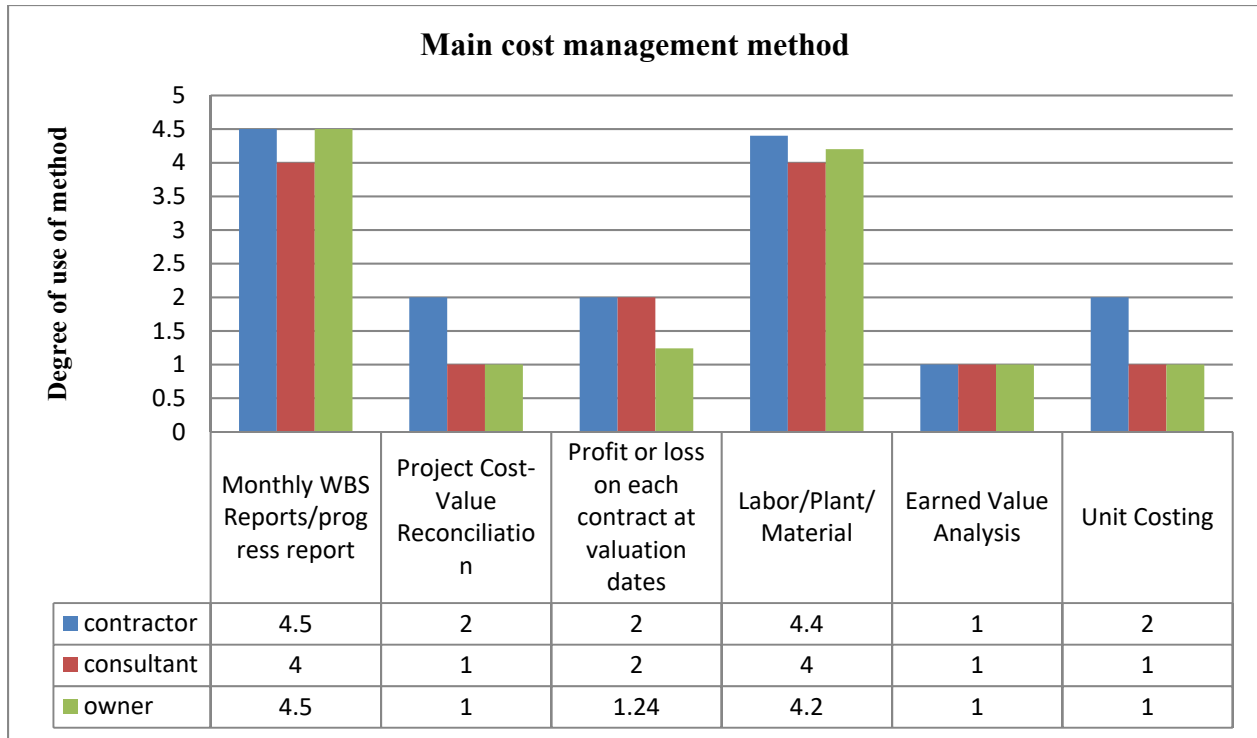


Fig 4.1 Assessment of tools of cost management practice under use in Addis Ababa’s LRT project

The reasoning given by the respondents for results given above was lack of a representative bill of quantity and the fact that most of the risk is in the hands of the contractor due to this the main means of communication between the three parties is Monthly WBS Reports/progress report, Labor/Plant/Material (actual versus forecast reconciliation) and the schedule provided during the beginning of the project amongst other means of management tools.

Earned value analysis, unit costing and Profit or loss on each contract at valuation dates are not being performed in this project even though specially earned value analysis is one of the major tools of cost management process lack of use of the methodology cannot be considered as the main reason for cost increase in the project but the methods under use focus on planned accomplishment (expenditure) and actual costs. While other methods such as Earned Value goes one step further and examines actual accomplishment. This gives managers greater insight into potential risk areas.

B. Questioner analysis on cost Estimation.

As stated in chapter two of this study by (Friedman, 2005 and Ahuja 1994) Estimating is the primary function of the construction industry; the accuracy of cost estimates starting from early phases of a project through the tender estimate can affect the success or failure of a construction project. Therefore First the participants were asked to rate the accuracy of Addis Ababa’s LRT project estimates.

No of respondents	Contractor	consultant	Owner	Reasoning
	2	6	8	Main reason given for this discrepancy is lack of representative engineering estimate and contract type.
1	3	2	2	
2	3	2	1	
3		1	2	
4		2	2	
5		2	2	
6		2	2	
7			2	
8			2	
Ms=S(f*s)/N	3	1.8	1.6	
Score	Medium =50%	Low=25-50%	Low =25-50%	

Table 4.3.3 Assessment of accuracy of Addis Ababa’s LRT project cost estimate

The mean score between the three respondents to the question given above is 2 which gives a rank of Low=25-50% value and the reason given by almost all of the respondents is lack of engineering estimate and accurate bill of Quantity (BOQ) during bidding process even though BOQ is not governing during EPC turnkey contract it can be a crucial tool for the development of construction estimate and bases for future project evaluation furthermore the major problem noted by the owner while conducting construction cost estimate was lack of experience in such kind of railway projects.

Then the participants were asked to rate the cause for the variation observed in the feasibility study estimate which was 400,234,004.25 USD and contract price 475,000,000.00 USD from the list of causes provided for them.

Cause for increase/variation	contractor	consultant	owner	rank
Cost underestimation and Manipulation of forecasts	1.2	1	1.4	5 th
	V. Low =0%	V. Low =0%	V. Low =0%	
Mitigation of Risk	4.5	4	5	2 nd
	High =50-75%	High =50-75%	V. High =100%	
Variation occasioned by change in brief by owner	2	1.5	1.3	4 th
	Low =25-50%	Low =25-50%	V. Low =0%	
Design changes at contract signing stage	3.5	4	3.5	3 rd
	High =50-75%	High =50-75%	High =50-75%	
Un-predictable estimate changes	1	1.4	1.2	6 th
	V. Low =0%	V. Low =0%	V. Low =0%	
Rough estimate due to size and complexity of project and omission of bid process	5	4.5	5	1 st
	V. High =50-75%	V. High =50-75%	V. High =50-75%	

Table 4.3.4 Assessment of cause for variation in feasibility and contract estimate

Therefore from the answer provided by the respondents the main reasons provided for the variation of the bankable feasibility study estimate and the contract price agreement is due to the fact that the bankable feasibility study estimate was considered as being a rough estimate and the size and complexity of the project.

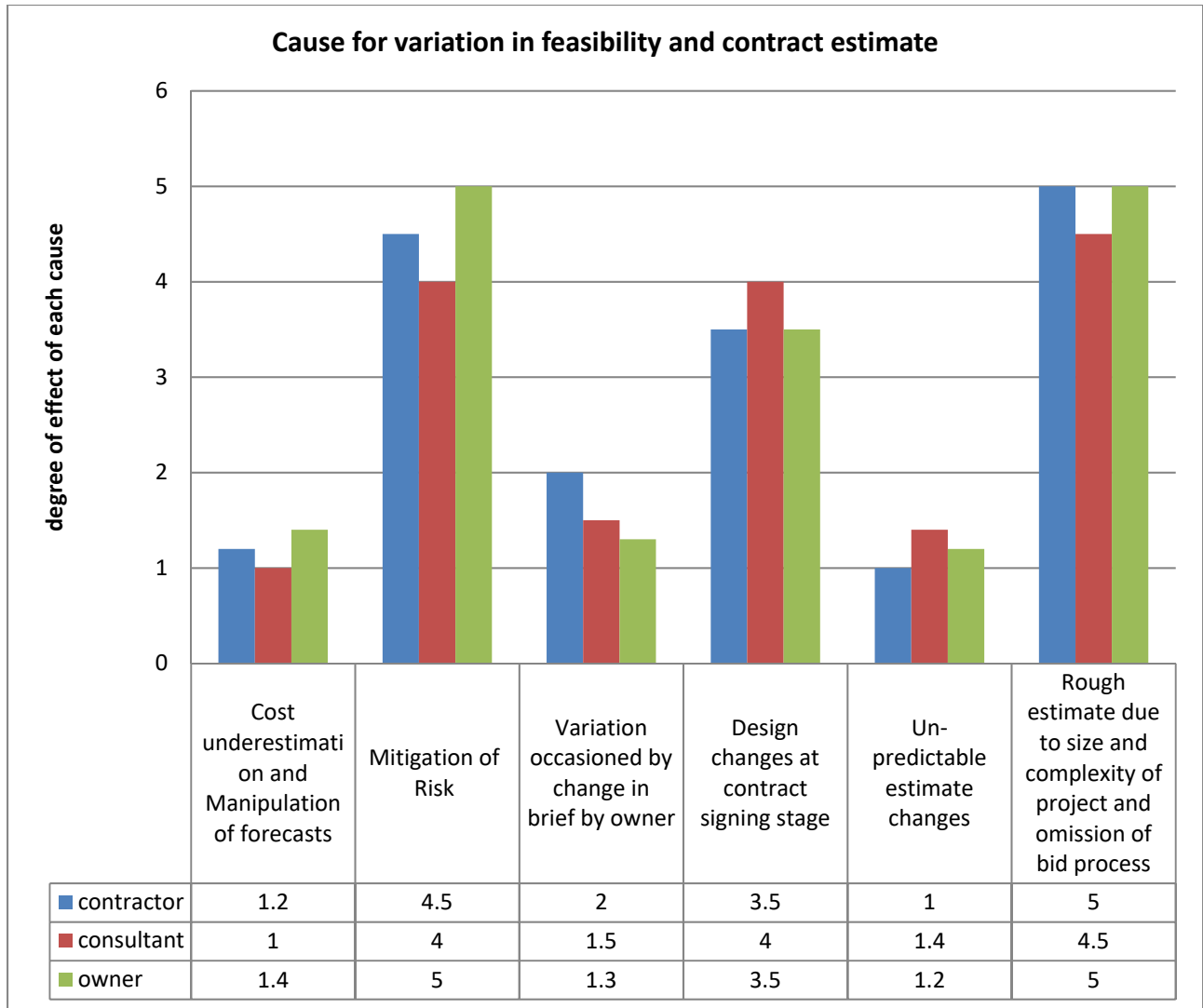


Fig 4.2 Assessment of cause for variation in feasibility and contract estimate

The graph clearly presents the cause for variation in the design estimate and the feasibility study estimate the main cause noted by the respondents for variation in Addis Ababa’s LRT project was mitigation of risk associated especially with the size of the project and type of contract even though design changes were observed during the contract signing stage the main attributing factor for cost overrun were mitigation of risk and size of the project.

Then the respondents were asked for what purposes do the participants of the project use construction cost estimation in Addis Ababa’s LRT project from the list provided for them and then rate the use.

Purpose of use of estimation	contractor	consultant	owner	rank
To control or monitor project execution	5	4.5	4	1 st
	V. High =100%	V. High =100%	V. High =100%	
To estimate the amount of work to be conducted in the period	4	4	3.5	2 nd
	High =50-75%	High =50-75%	V. High =100%	
To prepare tender price estimate	1	1	3.5	4 th
	V. Low =0%	V. Low =0%	High =50-75%	
To schedule the project	4	3.5	4.5	3 rd
	High =50-75%	High =50-75%	High =50-75%	
To compare with the cost base line	1	1.4	1.2	5 th
	V. Low =0%	V. Low =0%	V. Low =0%	

Table 4.3.5 Assessment in to the use of estimation in Addis Ababa’s LRT project

The main reason for use of estimation in Addis Ababa’s LRT project is to control or monitor project execution and to estimate the amount of work to be conducted in the period even though a bankable feasibility study estimate was conducted instead of being a true representative estimate of the project it was used to obtain general tender price estimate by the owner and as seen in the previous question the bankable feasibility study estimate was gravely under estimated with respect to the contract price or tender estimate.

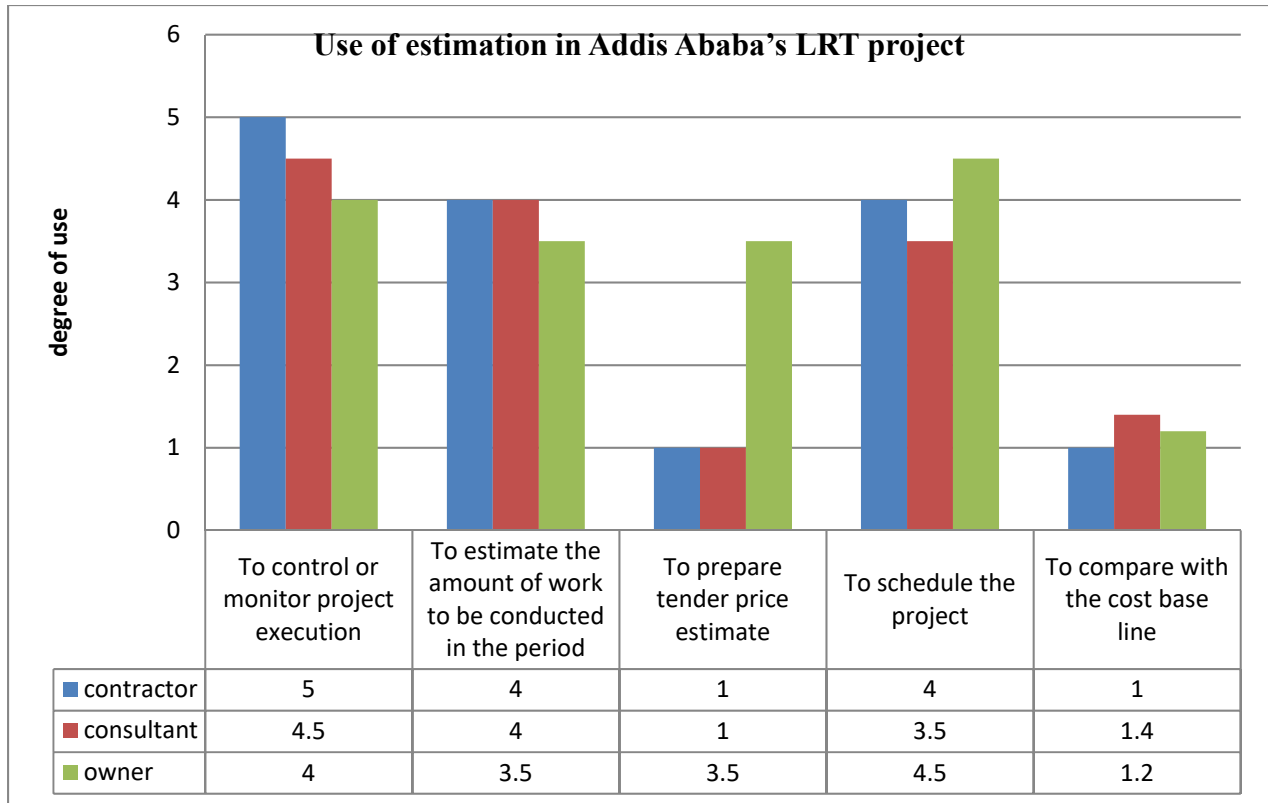


Fig 4.3. Assessment of use of estimation in Addis Ababa’s LRT project

Addis Ababa’s LRT is the first project of its kind in Ethiopia developing a standardized estimation technique should be one of the major objectives of the owner ERC (Ethiopian railway corporation) and the use of estimation should include and prioritize methods for controlling and monitoring project execution.

The respondents further explained the use of such construction cost estimate can only be developed by increasing the number and experience of personnel involved in construction cost estimate by providing training to participants involved in construction cost estimate and preparation of a standardized light rail transit (LRT) estimation documentation

Then the participants were asked to rate mistakes or omissions observed during the design and construction estimate in Addis Ababa's LRT project.

Estimation mistakes/omissions	contractor	consultant	owner	rank
Front loading of items of work	1	1	1	5 th
	V. Low =0%	V. Low =0%	V. Low =0%	
Delay between design estimates and bid estimate	4.5	4	5	1 st
	High =50-75%	High =50-75%	V. High =100%	
Lack of documentation	3	4	4.5	2 nd
	Medium =50%	High =50-75%	V. High =100%	
Lack of experience in the field or estimation	2	2	3.5	3 rd
	Low =25-50%	Low =25-50%	Medium =50%	
Lack or Under estimation of rate of inflation	3	2	2.6	4 th
	Medium =50%	Low =25-50%	Medium =50%	
Under estimation of items of work	1	1	1.2	6 th
	V. Low =0%	V. Low =0%	V. Low =0%	

Table 4.3.6 Assessment of mistakes or omissions observed in Addis Ababa's LRT project cost estimate

According to the participants of the study the main problem observed during the estimation of Addis Ababa's LRT project is delay between the contract bidding estimate and feasibility study estimate and lack of appropriate documentation to base the estimate on. Even though the delay cannot be considered as a mistake or omission it is directly responsible for cost increase construction and standardization of documentation for estimation can be an effective tool for evaluation of the feasibility of the projects to be constructed in the future.

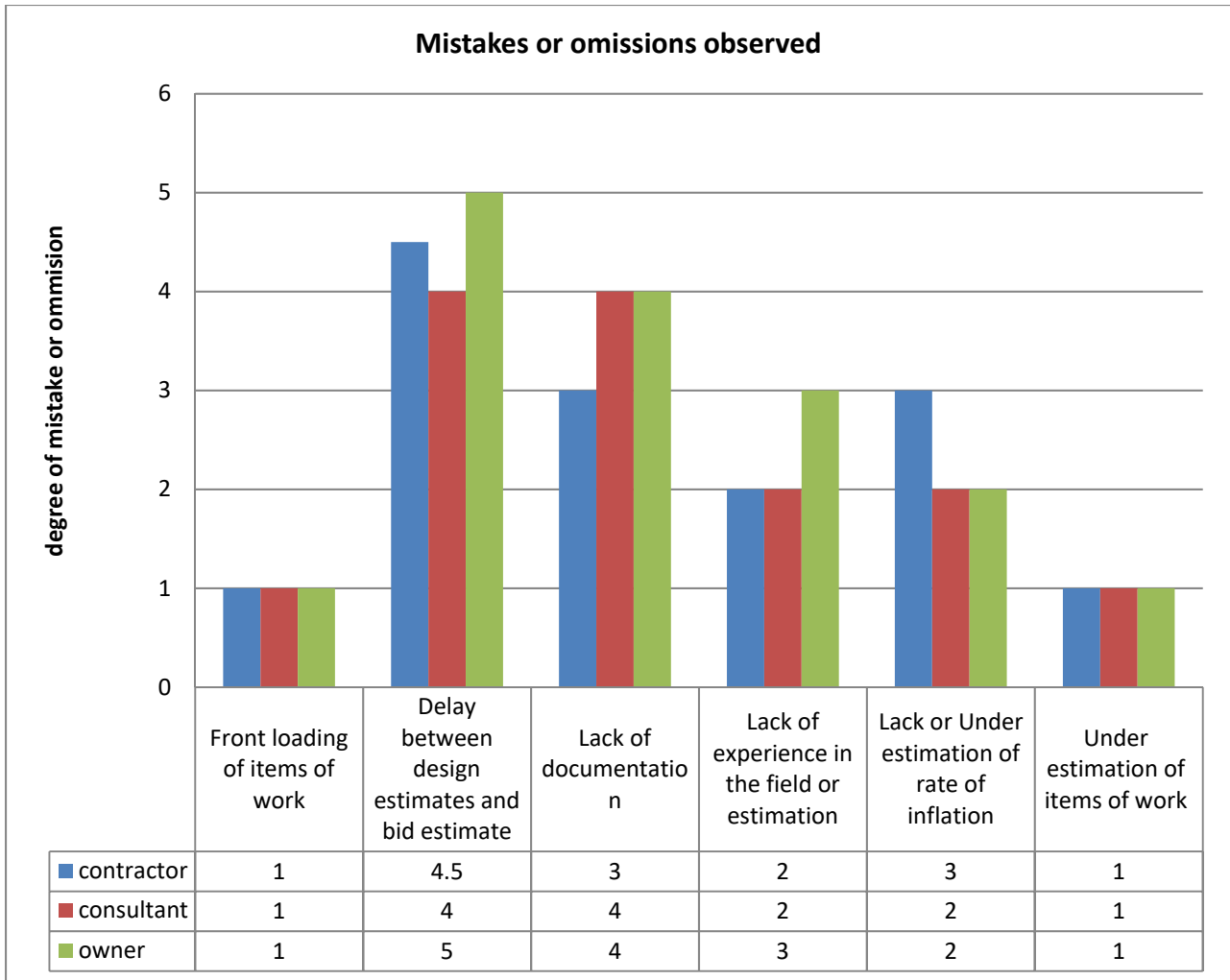


Fig 4.4 Assessment of mistakes or omissions observed in Addis Ababa’s LRT project cost estimate

From the plotted graph main mistakes observed in Addis Ababa’s LRT project include

- ❖ Delay between design estimate and bid estimate,
- ❖ Lack of documentation,
- ❖ Lack of experience in the field and estimation

Then the respondents were asked the estimating technique they widely use in Addis Ababa’s LRT project this will help to determine the methodology being used and the problem associated with the methodology and the reason for lack of use of other methods.

Estimation mistakes/omissions	Contractor	consultant	owner	rank
Standard estimating procedure detailed estimating	1.2	1	1	4 th
	V. Low =0%	V. Low =0%	V. Low =0%	
Analogous estimating / Estimates based on past projects	4.5	1	5	1 st
	High =50-75%	V. Low =0%	V. High =100%	
Parametric estimating	1	1.2	1	2 nd
	V. Low =0%	V. Low =0%	V. Low =0%	
Probabilistic / statistical estimating methods	1	1.2	2	3 rd
	V. Low =0%	V. Low =0%	Low =25-50%	

Table 4.3.7 Assessment of estimation method under use in Addis Ababa’s LRT project

The main reasoning given by the respondents for the choice of estimation methodology that is analogous estimates based on previous project was because most rail way projects around the world and Addis Ababa’s LRT project is based on estimation per mile or Km and other estimation methodologies is not being practice as the project is relatively new to the country and the development of standardized estimation methodology is not yet being considered and most of the estimation being conducted in Addis Ababa’s LRT project is being done by the contractor.

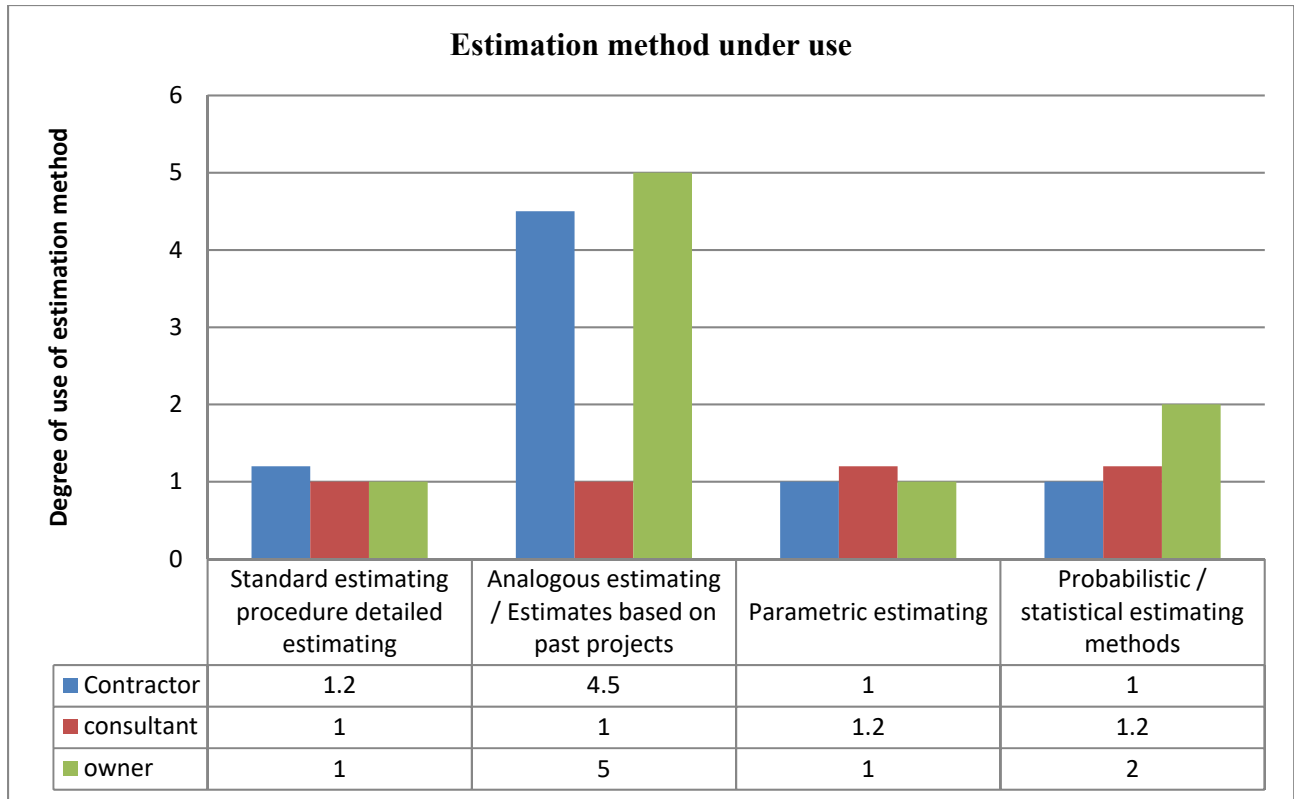


Fig 4.5 Assessment of estimation method under use in Addis Ababa’s LRT project

Then the respondents were asked their source of information in Addis Ababa’s LRT project cost estimate.

Purpose of use of estimation	contractor	consultant	owner	rank
Market assessment	2	1	1	3 rd
	Low =25-50%	Medium =50%	V. Low =0%	
Published standards	1	2	1	4 th
	V. Low =0%	Low =25-50%	V. Low =0%	
Data collected from previous projects	3	1	2	2 nd
	Medium =50%	V. Low =0%	High =50-75%	
Cost per mile/ K.m from previous project	3	2.5	3	1 st
	Medium =50%	Medium =50%	Medium =50%	

Table 4.3.8 Assessment of source of information for estimation in Addis Ababa’s LRT project

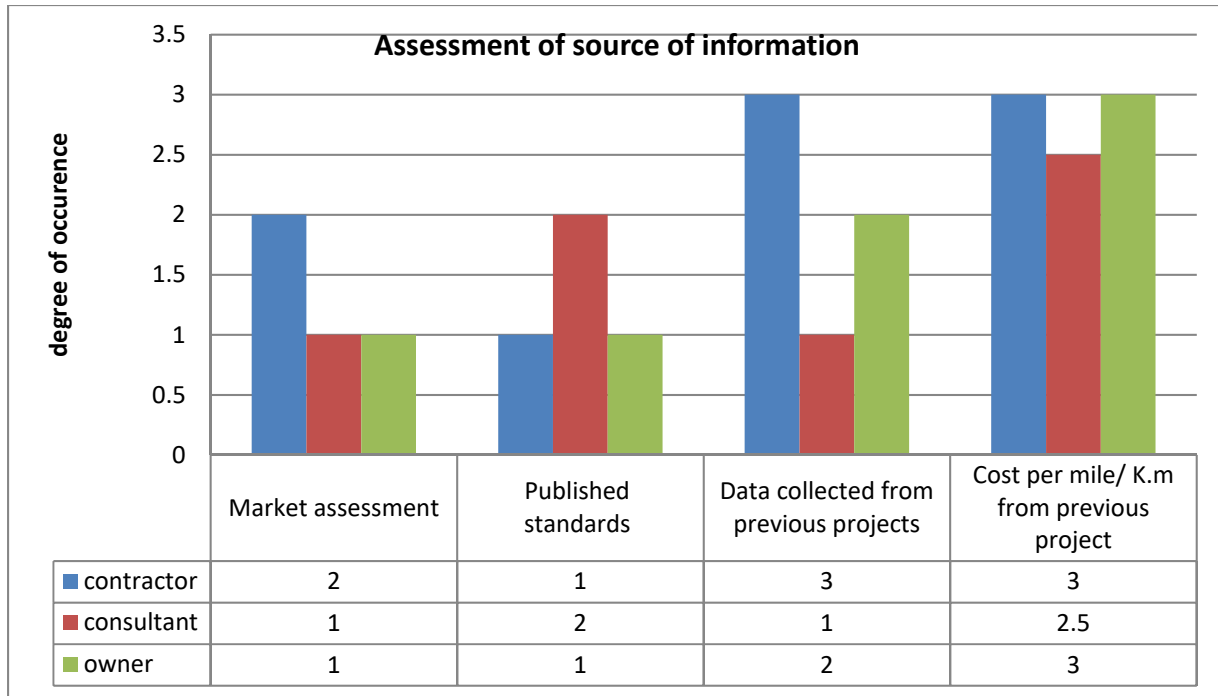


Fig 4.3.8 Assessment of source of information for estimation in Addis Ababa’s LRT project

The main source noted by the respondents of the study for estimation of Addis Ababa’s LRT project was cost per mile or kilometers and data collected from previous projects around the world.

Then the respondents were asked if they have seen trends of over estimation in Addis Ababa’s LRT project.

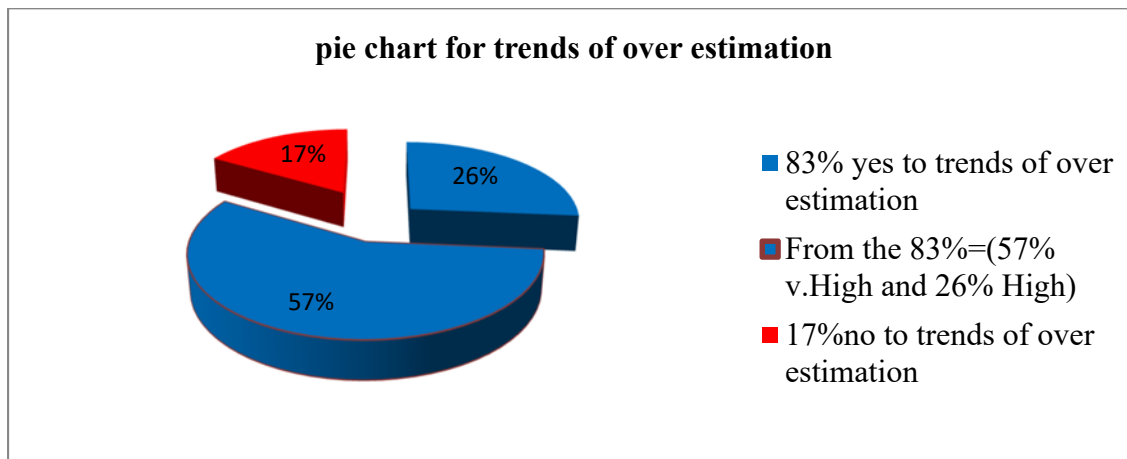


Fig 4.6 Pie chart indicating trends of over estimation according to respondents

The pie chart represents the participants answer to trends of over estimation observed in Addis Ababa’s LRT project as presented 83% of the respondents said yes and out of this 83 percent 57% of them rated trends of overestimation V. High and 26% gave a High result the rest of the respondents said no to the presence of trends of over estimation the main reason provided for this answer is the WBS provided by the contractor is neither representative nor governing with respect to the contract. Then the respondents were asked if they think the type of construction contract specifically “EPC turnkey contract” in Addis Ababa’s LRT construction project has led to over estimation.

C. Cost control, budgeting and planning.

Cost budgeting is the process of aggregating the estimated cost of individual activities or work package to establish a cost base line while Cost control is the process of influencing the factors that create cost variances and controlling changes to the project budget therefore conducting assessment in to cost management practice of Addis Ababa’s LRT project supplements the study to be conducted on cost increase identification and impact assessment of the project.

As a supplement to cost estimation questions provided for the participants of the study the first question was for what purpose the participants used the tools of cost control system in Addis Ababa’s LRT project and the rate of use of this purposes.

Purpose of cost control tools	contractor	consultant	owner	
To draw attention to operations which are uneconomical	1.2	1	1	4 th
	V. Low =0%	V. Low =0%	V. Low =0%	
To provide feedback to the estimation process	4.5	4	4.5	2 nd
	High =50-75%	High =50-75%	V. High =100%	
To check profitability of project	1	1.2	1	3 rd
	V. Low =0%	V. Low =0%	V. Low =0%	
For monitoring efficiency of performance of resources	4	5	4	1 st
	High =50-75%	V. High =100%	High =50-75%	

Table 4.3.9 Purpose of cost control in Addis Ababa’s LRT project

From the data main tools of cost control system internationally developed include performing earned value analysis and comparison the current cost of the project with the cost base line and according to the answer provided by the respondents the main purpose for cost control system is for monitoring efficiency or performance of resource and the reason provided for the low score in other section of the use of tools and techniques was the fact that it was and EPC turnkey contract and the owner and the consultants are not directly involved in cost control process of the project.

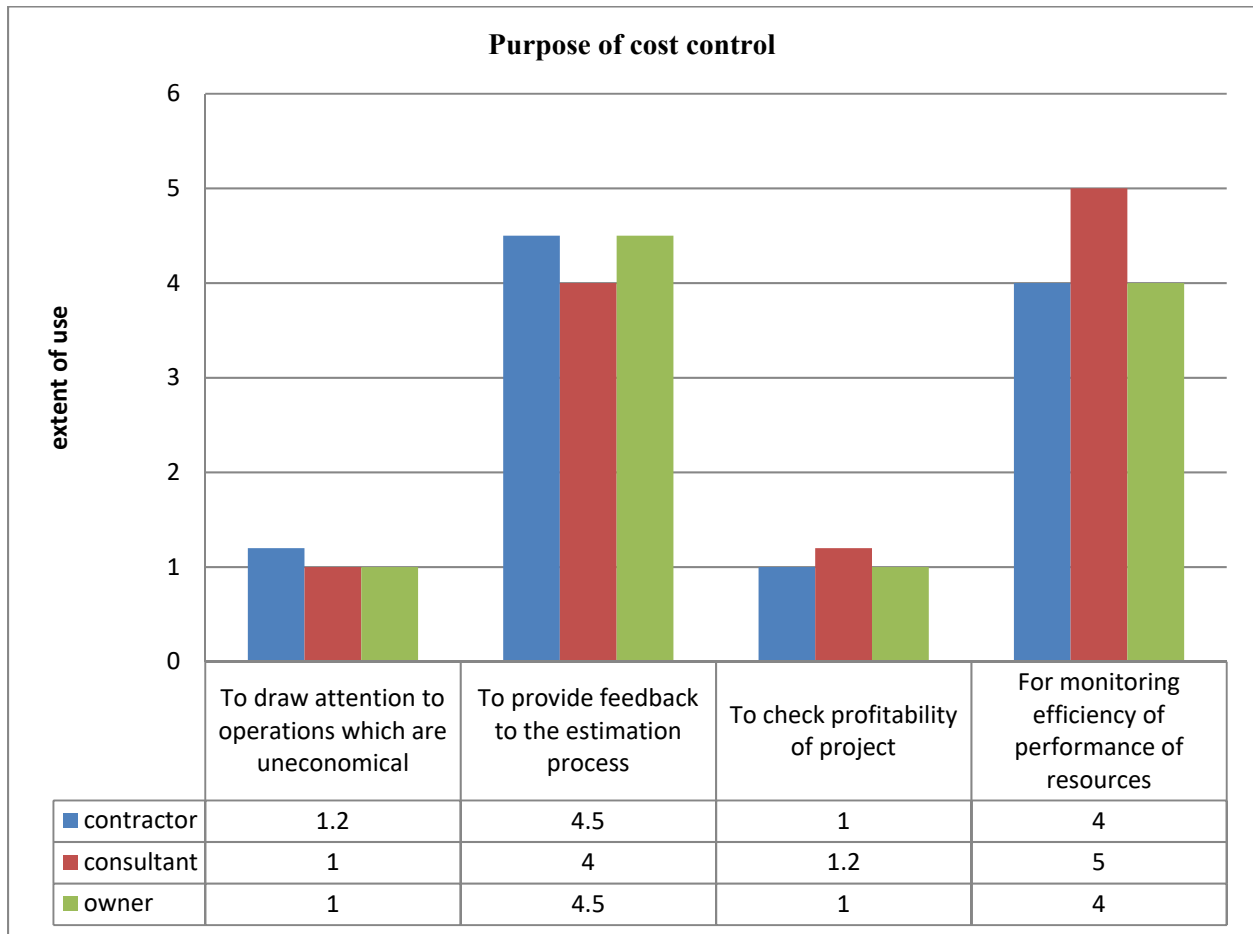


Fig 4.7 Purpose of cost control in Addis Ababa’s LRT project

Then the respondents were asked in their opinion, which component of the project cost receives more attention, by Controlling and/or reporting system which allows directly in determining the section of the project which is controversial when it comes to cost and indirectly the degree of involvement of the three parties when it comes to cost control.

Components of project	contractor	consultant	owner	rank
Material	4	1	1	6 th
	High =50-75%	V. Low =0%	V. Low =0%	
Labor	4	1.2	1	3 rd
	High =50-75%	Low =25-50%	V. Low =0%	
Equipment	4	2	1	2 nd
	High =50-75%	V. Low =0%	V. Low =0%	
overhead cost	4	1.2	1	5 th
	High =50-75%	Low =25-50%	V. Low =0%	
Underground utility relocation ,excavation and Elev.st construction	4	5	3	1 st
	High =50-75%	V. High =100%	Medium =50%	
Risk allowance	3	1.6	1.2	4 th
	Medium =50%	V. Low =0%	V. Low =0%	

Table 4.3.10 Components of the project which receive attention by cost control

According to the respondents the component which receives more attention by controlling cost of the project was underground utility relocation, excavation and construction followed by equipment the answer given by the contractor is a clear indication of the type of contract being implemented and the degree of attention given by the participant with regards to cost when it

comes to underground utility relocation, excavation and elevated structure construction the cause for controlling and reporting arose due variations observed due to change.

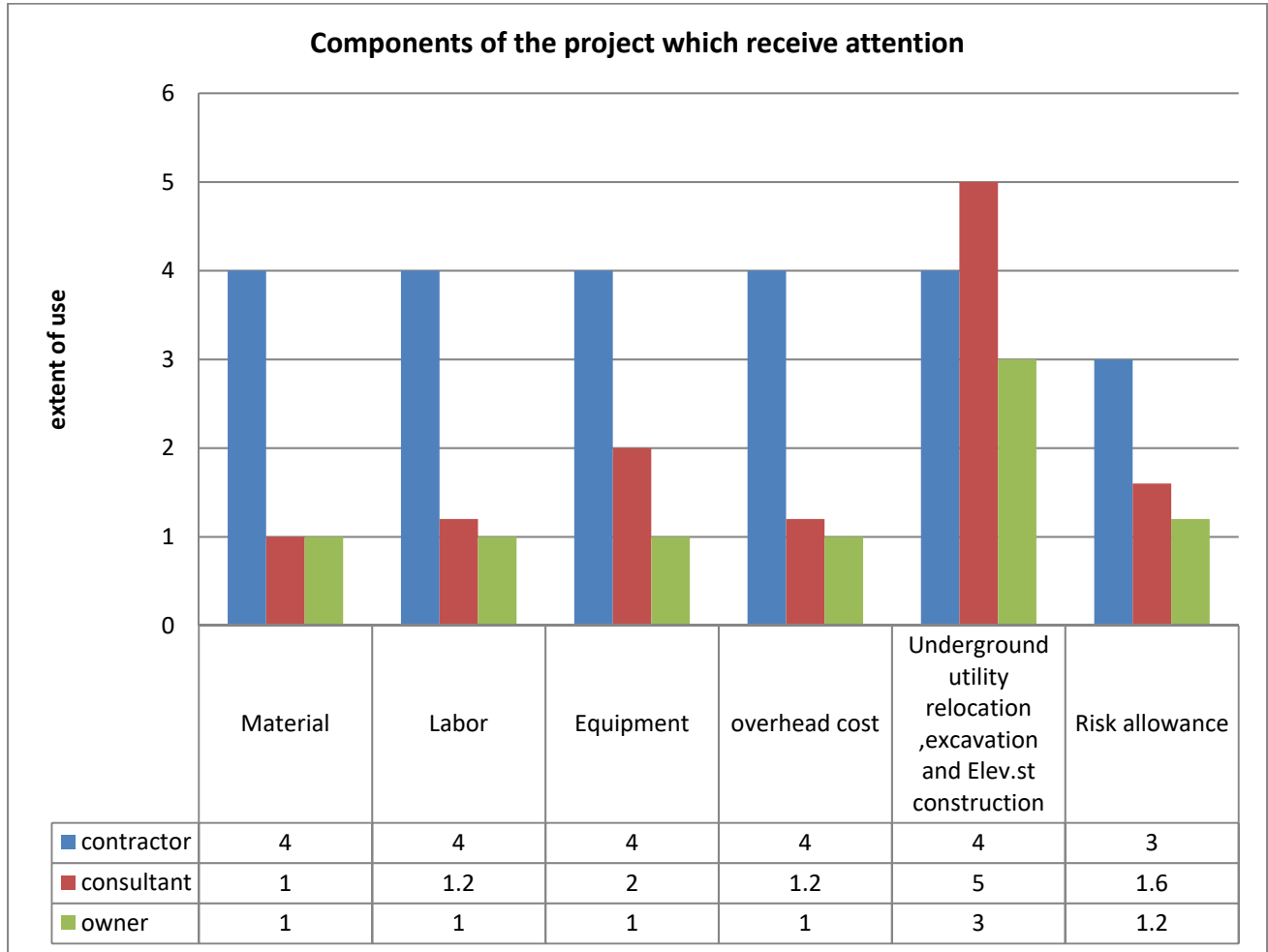


Fig 4.8 Components of the project which receive attention by cost control

Therefore from the graph the main area that receives more attention by cost control in Addis Ababa’s LRT project is underground utility relocation, excavation and construction of elevated and underground stations. Furthermore from the graph the use of cost control is being applied in all of the listed factors

Finally with regards to construction cost management, control and budgeting the participants were asked if the methods of cost control listed for them have been used in cost management of Addis Ababa’s LRT project and to rate the use of the methodology.

Purpose of cost control tools	contractor	consultant	owner	rank
The budget is base lined	3	2.5	3	4 th
	Medium =50%	Medium =50%	Medium =50%	
Budget is updated regularly	1	2	1	6 th
	V. Low =0%	Low =25-50%	V. Low =0%	
The project cost is tracked on regular update cycles	4	4.5	4	1 st
	High =50-75%	V. High =100%	High =50-75%	
The costs of labor, equipment, and material are tracked separately	4	1	1	5 th
	High =50-75%	V. Low =0%	V. Low =0%	
Variance analysis (difference of budgeted and actual cost) is preformed	3	3	3	3 rd
	Medium =50%	Medium =50%	Medium =50%	
The Budget forecasts (cost to completion,) are prepared and tracked separately	3	4	4	2 nd
	Medium =50%	High =50-75%	High =50-75%	

Table 4.3.11 Purpose or use of cost control method

From the answer provided above by the respondents with regards to methods of cost control used in Addis Ababa’s LRT project the main construction cost control method under use was tracking of the cost of the project against the base line on regular update cycles and the reasoning

provided for use of this method by the participants was the payment which is being extended to the contractor as per the EPC turnkey contract agreement.

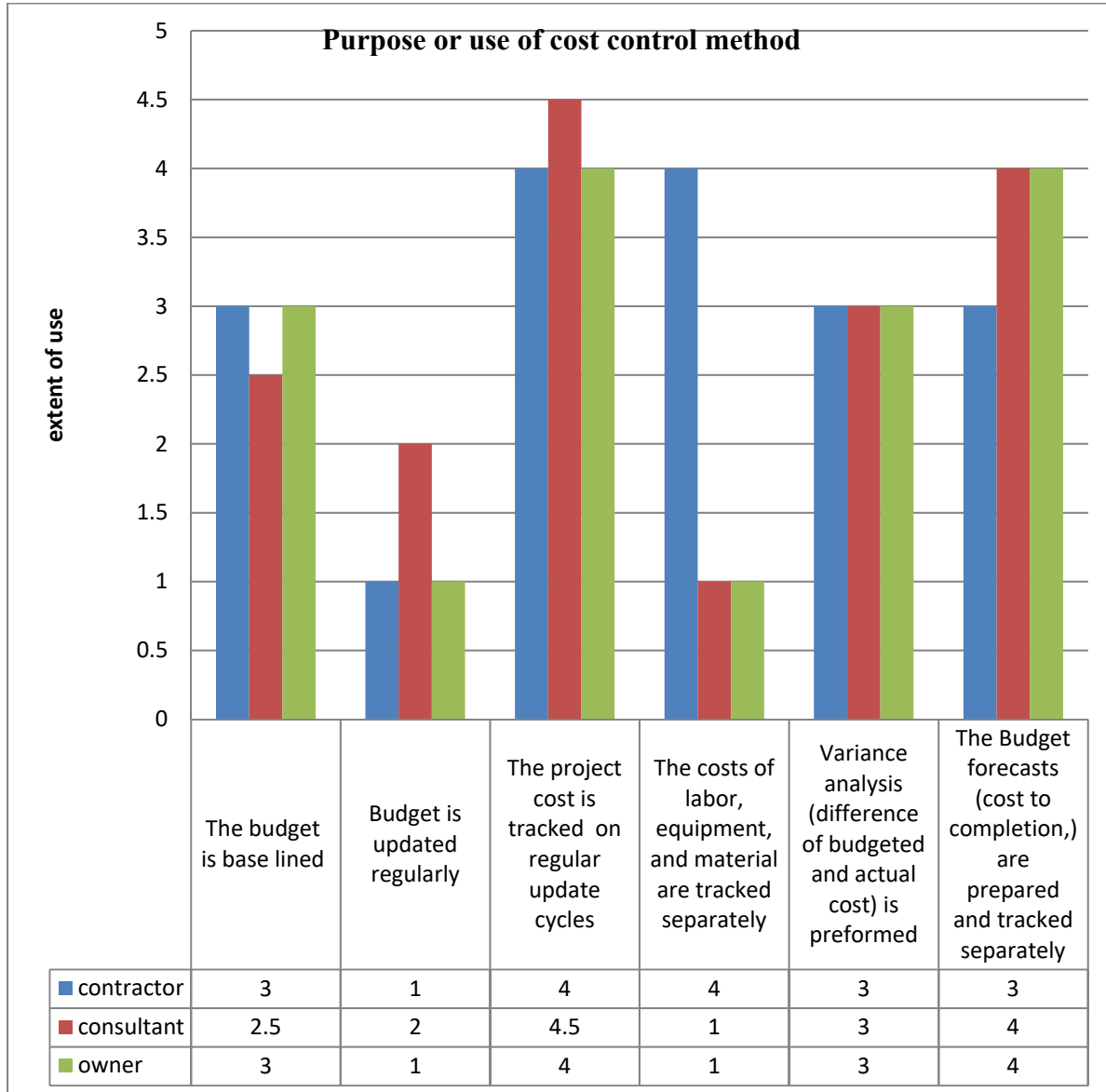


Figure 4.9 Purpose or use of cost control method

The next section of the questioner focuses on identification of presence and cause of cost over run as per the objective of the study.

4.3.2. Interview data analysis on cost management practice

A. General cost management practice

First the respondents were asked to state the problems observed with respect to cost management of Addis Ababa's LRT project?

According to the contractor consultant and owners the main problems observed with regards to cost include, handling cost increase observed and not claimed due to delay on land hand over, lack of experience of labor force which subsequently increases the cost of the project, Lack of the coordination of Ethiopian public sector development organizations in elimination of problems associated with right of way hand over and lack of proper geotechnical investigation prior to bid, lack of engineering estimate and omission of a representative bill of quantities were the main problems observed in construction cost management.

B. Interview analysis on cost estimation , budgeting , planning and control

According to the participants most of the construction cost management practices are being directly or indirectly implemented and considered while conducting construction cost management of Addis Ababa's LRT project.

With regards to estimation factors from cost of land acquisition, legal fees to contingency were included amongst others and with regards to cost control budgeting and planning, ensuring that cost expenditures do not exceed the authorized funding by period, by WBS component, by activity, and in total of the project were considered.

But lack a collaborated and efficient documentation and standardization of applicable methods of cost management practices were also noted as one of the main problems when it comes to cost and with regards to the owner comparison of initial feasibility estimate ridership forecast estimate and final contract price to assess the feasibility of the project in alleviation of transportation problems observed in the city were recommended by most of the participants.

According to the respondents the main problems observed in the use of EPC turnkey contract include increased price due to risk transfer which decreases the feasibility of the project, lack of involvement of the owner / client in the design process which decreases replication of project by local contractors and man power, reduced control of the project execution and quality.

Addis Ababa's LRT project is the first of its kind in Ethiopian and by the use of the contract the contractor bears the risk of integrating the performance of all packages of works including design which the alleviates the problem of the owner / client when it comes to lack of man power.

4.3.3. Archival data analysis on cost management practice

A. Description of the project

The planed lines are 75Km in the overall length and the lines in the E-W and N-S (phase 1) project to be executed currently is approximately 31.048 Km in length, including a common-track section of 2.662Km. The main line of the East-West is nearly 17.017Km long, while the main line of the North-south line is 16.693 Km long. AYAT depot is set at the east end of E-W line and KALITY depot is set at the south end of N-S line.

This two lines of LRT project (Phase I) project has a total length of 31.048Km and there are totally 23.159Km for sub grade sections, 7.229Km (ten bridges including the bridges of the common track section) and 0.659Km for tunnel section route of the project is set with following technical parameters, double tracks, track running speed of train 70Km/h, traveling speed of 20Km/h.

The date of contract signing was on September, 2009 current date of assessment is august 20114 the bankable feasibility study estimate was 400,234,004.00 and the original contract price was 475,000,000 and the revised contract quantity is still pending. The project was financed by a loan obtained from EXIM bank of china 85% of the contract price is in USD and the remaining 15% would be in Ethiopian birr to be paid as a down payment and ERC accepted CREC proposal as the preferential loan of buyer's credit would benefit the project and the contract type is EPC turnkey contract.

B. Issues or problems observed with regards to cost

I. Delay on land hand over

During this stage of the project the original master schedule with relevant land use schedule which was signed between the three parties that is contractor (CREC), consultant (SWE Road) and owner (ERC) on 27-nov.2012 was updated on 16 – April 2013. But even with the updated schedule the owner failed to hand over the land use with their mileage the main cause observed for delay of land hand over was overlap of work such as underpass and overpass with ACCRA, delay on relocation water main

lines, delay on relocation telephone lines and electric lines, delay on land hand over of Kaliti depot due to vehicles not being removed, pipes and culverts not being relocated based on this issues of claims initiated by the contractor a total 184 days and **3,502,619.9USD** dollars was requested by the contractor by noting sub-clauses of 1.13, 2.1 and 20 based on wastage of material and equipment which was discredited by noting that the contractor was given right of way to more land than they can handle and the contractor was instructed to work on other locations until the lands which had problems mentioned above were sorted out. Furthermore the contractor requested for 106 days based on the delay Kaliti depot land hand over on the updated schedule which at this stage is still pending.

Therefore currently at this stage of the study almost all of the items of claims of cost with respect to delay are either not substantiated or still pending and awaiting for approval from the responsible party.

II. Variation on elevated structure at Autobus-Tera and Anuar-Mosque

Based on the employers request to comply with the new master plan the contractor was asked to prepare and submit a detailed cost breakdown of the extension of overpass bridge No.1 of the LRT(H18:Autobis Tera junction (YCK4+300) to avoid the traffic conflict at the mentioned congestion as well as another and new elevated station N24 to be included based on this the contractor submitted a change in contract for an addition claim of **27,243,188.50 USD** on the EPC turnkey contract which was not substantiated based on the requirement of the number LRT elevated station in conceptual design and the review of the actual works which certified that the contractor was expected to construct 9 elevated stations along NS line of which 5 were in the shared common sections and the rest four to be in some other section of the LRT.

III. ERC's credit request on omitted Tunnel at Gottera.

Based on the conceptual design the contractor proposed a tunnel at Gottera Junction with a total length of 900m and one underground station however this has been replaced by two crossing bridges and a ground section having a total length of 1621m (699m bridge and 922 m ground section) according to this omitted tunnel section the owner ERC requested for credit of the amount **10,946,735.30 USD** to which the contractor

mentioned that they adopted bridge No5 and No6 which has been confirmed by ERC and this elevated proposal cost will result in an increment of **7,220,681.00 USD** therefore neither credit request nor cost claim were substantiated.

IV. Drainage line relocation at bridge No 4 and No 5, civil service and Kality

CREC encountered drainage pipe line at bridge No4 and No 5 located at civil service and kality of the N-S line and demanded ERC to relocate this drainage pipe line and noted the reason for lack of geotechnical investigation at the time the congestion of traffic at the location based on this CREC informed ERC that it will take the responsibility for relocation and the right to claim for delay and cost incurred due to relocation of the amount of **153,255.00 USD** which is still pending.

V. River line relocation at Meskel square

Underground sewage culvert which was located at about 393m of bridge No 2 on E-W line, Meskel square and requested ERC to remove or relocate the sewage structure to which claim was requested for relocation of the structure based on this the consultant responded this problem occurred due to lack of proper geotechnical investigation and cannot the bases for the request.

VI. Parking lot provision

A request for compensation for parking lot located at kality depot was forwarded for CREC on the basis that it was not included in the contractually control document to which the contractor was instructed to include it on the document as it was part of the original plan.

VII. Standard future utility crossing provision under LRT

Variation for Utility crossing from AAWSA and EEPCO which crossed the LRT line was requested by the contractor CREC to which the contractor himself planned the design as per local standards and requested for a supplementary agreement before implementation of the amount **70,309,678.00 ETB** to which a variation amount of **15,326,160.96 ETB** was forwarded by SWEROAD and instructed CREC to proceed with the contract agreement.

VIII. Elevated structure at East of Meskel square

CREC requested ERC for an alignment scheme and conformation of fly over structure beyond station EW16, at east line of Meskel square to which the SWE road found for this claim be Groundless and instructed the contractor to proceed as per the conceptual design scheme.

IX. changes observed in this period

To avoid traffic congestion on east to west corridor ERC proposed for 6 junctions and round about to produce integrated and serviceable systems of an inner city mass transit system and traffic flow in Addis Ababa.

No	Junction name (millage)	Instruction for change
1.	St Ureal church (YCK11+375)	conceptual design integrated with the road (Cut-open)
2.	St silase Mihret Ch.square (YCK17+200)	A specific traffic count and flow calculation
3.	last round about on LRT line (YCK20+150)	A specific traffic count and flow calculation
4.	Anwer Mosque junction (ZCK3+260)	Over pass bridge of LRT extended to avoid congestion
5.	Autobes tera junction(YCK 4+300)	Over pass bridge of LRT extended to avoid congestion
6.	Gotera interchange (YCK 13+590) (both end of the interchange)	Cut and cover section adopted based on conceptual design
Other:-Incorporation of Automated LRT line train control system		

Table 4.3.12 Changes observed in Addis Ababa’s LRT project

4.4 Occurrence and cause of cost overrun

4.4.1. Questioner data analysis on presence and extent of cost increase/overrun

As stated in chapter 2 section of this study by Azhar, Farooqui, & Ahmed cost overrun is a global phenomenon in the construction industry and very rarely projects are finished within the budgeted cost. The issue of cost overrun in construction projects is very dominant in both developed and developing countries but this trend is very severe in developing countries where these overruns sometimes exceed 100% of the anticipated cost.

Various studies addressed cost overruns for transportation projects specifically. For example, Pickrell (1992) investigated the cost overruns and benefit shortfalls of 8 rail transit projects in the US. In his study, Pickrell (1992) starts from the premise that forecasters overestimate rail transit ridership and underestimate rail construction costs and operating expenses.

To understand these inaccurate forecasts, he points, on the one hand, to optimism among local officials and to inadequate planning processes on the other. He argues that the causes of underestimated costs lie in the structure of programs and the existence of dedicated funding sources that provide few incentives for local officials to seek accurate information for evaluating alternatives.

To determine the presence of cost overrun in Addis Ababa’s LRT project the respondents were asked if the light rail transit project being conducted in Addis Ababa has been affected by cost overrun if so what is the percentage of cost overrun in observed during this period of the project the result is presented in the table shown below.

All of the participants answer to the presence of cost overrun/cost increase is “yes” therefore by taking the average percentage of the respondent’s answer the following Mean analysis is conducted in the table below.

No of respondents	Contractor (%)	Consultant (%)	Owner (%)	reasoning
	2	6	8	The mean score of the three respondents is 4.2 %. A cost overrun of 19,950,000.00 USD is observed.
1	2.5	2.5	2.5	
2	2.5	2.5	7.5	
3		7.5	7.5	
4		2.5	2.5	
5		7.5	7.5	
6		7.5	2.5	
7			7.5	
8			7.5	
Ms=S(f*s)/N	2.5	5.0	5.0	

Table 4.3.13 Percentage of overrun observed during this period

Then the participants of the study were asked the percentage of cost increase/overrun they expect when all claims and variations were substantiated by conducting the same analysis as shown in the table above the results were as follows.

No of respondents	Contractor (%)	Consultant (%)	Owner (%)	Total mean
$M_s = S(f \cdot s) / N$	5	7	6.5	6.2%

Table 4.3.14 Percentage of overrun expected to occur at end of project

Therefore this will give a cost increase of 6.2% or \$ 29,450,000.00USD of cost increase or cost overrun.

After conformation of the presence of cost increase/overrun the participants of the study were asked to choose and rate the cause of cost overrun from the list of possible factors that causes cost increase/cost overrun in Addis Ababa’s LRT project to determine what the main cause of cost overrun was in Addis Ababa’s LRT project. The pie chart shown below illustrates the percentage of cost overrun present at this stage of the construction according to the consultant, contractor and owner.

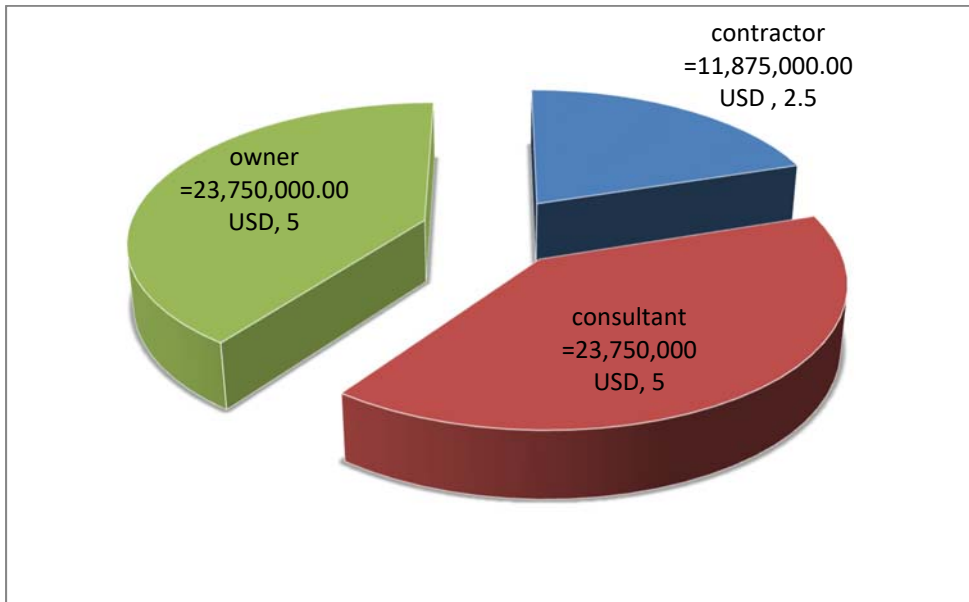


Fig 4.9 Pie chart showing the percentage of cost overrun observed in Addis Ababa’s LRT project according to the respondent.

- 1. Consultant =5%-----23,750,000.00 USD
- 2. Contractor=2.5%-----11,875,000.00 USD
- 3. Owner= 5%-----23,750,000.00 USD

4.4.2. Interview data analysis on the presence and extent of cost increase/overrun

Based on the interview question provided for the participants of the study in Addis Ababa’s LRT project on the presence and extent of cost overrun out of the ten valid respondents nine of the respondents answered “yes” giving an affirmative percentage response of 90%. Next participants were asked the percentage of cost overrun that they believe were present at the current status of the project to which four of the respondents answered 5-10% of cost increase and the remaining five respondents said an increase of up to 5% percent was present at the current status of the project.

4.4.3. Assessment of Extent of Cost overrun from archival data

Based on the archival study preformed on the claims requested accepted and still pending at this stage of the study assessment was conducted to determine a representative cost increase/over which came out to be 5 % of the total construction cost and the main cause observed for this cost increase is due Standard future utility crossing provision under LRT crossing, incorporation of automated LRT line controlling system and variations observed in the six junctions stated above. Based on the assessment conducted on the feasibility study of the project and desk study conducted on the identification of the presence of cost overrun the following bar chart is prepared to indicate the impact and extent of cost overrun present in the project.

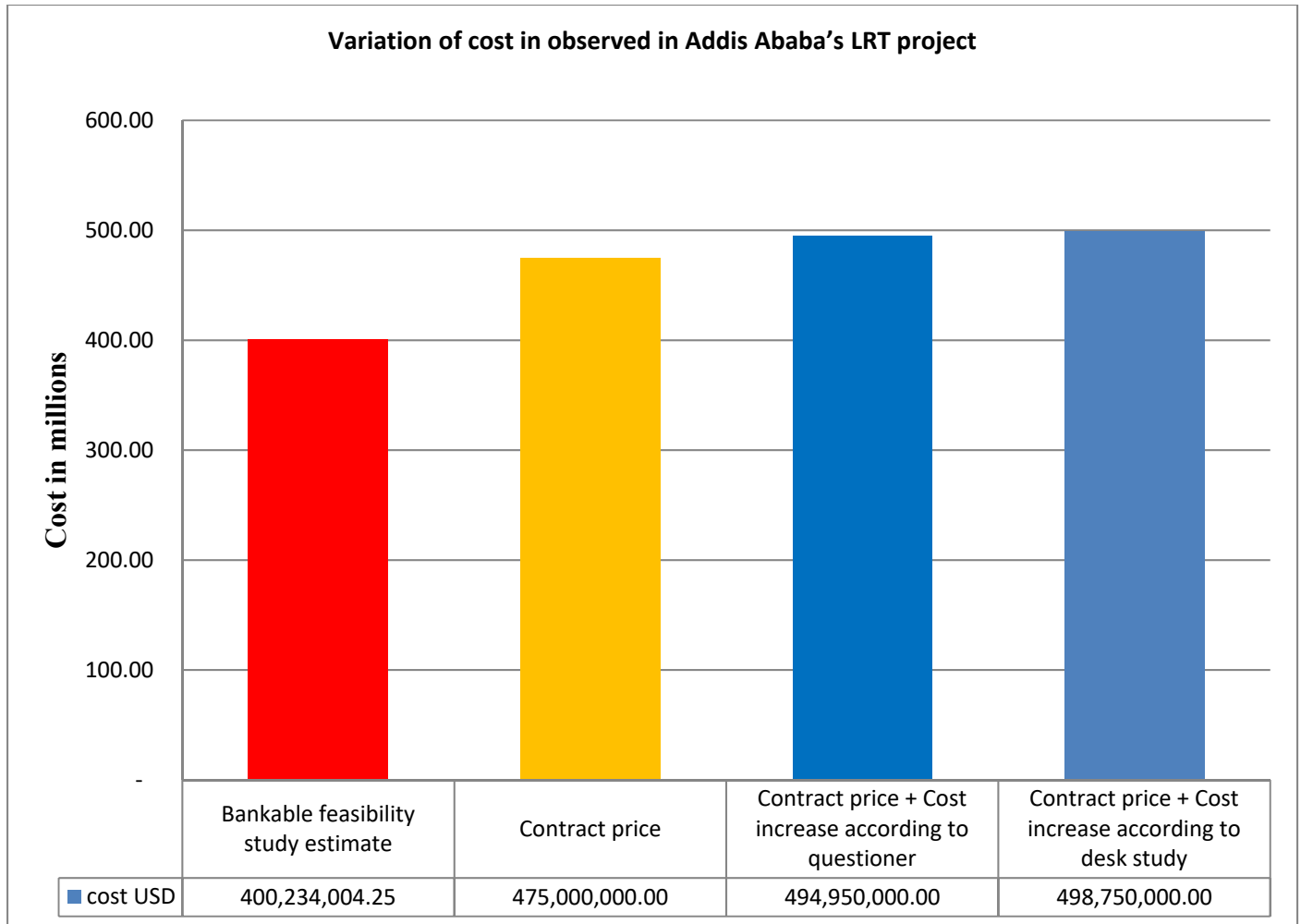


Fig 4.10 Bar chart indicating Variation of cost from feasibility to current status of the project

4.4.4 Assessment of Classification and rate of occurrence of cause of cost overrun

4.4.5 Questioner data analysis on cause of cost overrun

This section of data analysis deals with the information gathered from the questionnaire survey on identification of rate of risk factors leading to cost overrun and categorization of causes of cost overrun in Addis Ababa’s LRT project, during the questioner preparation stage of this study the participants of the study were asked to mention factors which can be considered as the causes of cost overrun, it was found that the consequently identified factors were already in the list and did not providing any additional input to the comprehensive list except some factors which are listed in different way.

During the desk study part of this research considerable effort was exerted to determine causes which are directly responsible for cost overrun in railway, metro and light rail transit project then further study was conducted on project documentation to determine factors which are particular to Addis Ababa's LRT project from this document 26 factors were determined to be directly linked to cost overrun in Addis Ababa's LRT project.

Before the development of questioners list of possible factors were arranged so as to determine the responsible party and stage of construction to avoid ambiguity. The stage of construction is divided in to two pre construction and construction; the responsible parties are classified as consultants, contractors and owner or client of the project.

classification of the responsible parties and stage of construction of factors which were considered to be the main reasons for cost overrun are stated below even though other methods of classifications are present due to the size of the study and preliminary data available for classification the classification method selected was based on stage of construction and responsible parties involved in the study.

From the Classification of causes of cost overrun presented below twenty six of the factors were selected and presented to the participants of the study then each of this factors were classified in to the responsible parties involved in the study and stage of construction. The participants of the study were asked to rate this causes of cost overrun from 1. Very low (insignificant) =0-25% , 2. Low= 25-50% , 3. Medium=50% , 4. High =50-75% 5. Very High =75-100%.

During the drafting stage of questioners on causes of cost overrun the selected respondents in Addis Ababa's LRT project were presented with a summary of classification of causes of cost overrun as the one shown in the table below after feedback was obtained from the participants and archival reports 26 factors were presented and analyzed.

Summary of classification of causes of cost overrun

Pre-construction stage

Client or Owner/government	Consultant	Contractor
Deliberate cost underestimation and Manipulation of forecasts	Delay caused by consulting party	Inappropriate site investigation
Insufficient financial budget.	Lack of experience in the type of project and contract	Insufficient time for estimate.
Lack of foreign exchange to conduct the project	Size of contract and difficulty In handling.	Incomplete drawings.
Government requirements in the selection of contractor.	Lack of appropriate and specific documentation	Type of contract document
Lack of finance management and plans.	Limitations in the form of contract	Delays b/n plan and implementation.
Inadequate estimating techniques and/or standards, resulting in unrealistic budgets.	Lack of application of risk management process	Lack of detailed design in tendering period.

Table 4.3.15 Causes of cost overrun expected to occur during pre construction stage

Construction stage

Client or Owner/government	Consultant	Contractor
Scope changes initiated by owner	Scope change initiated by consultant	Scope change initiated by contractor
Request for acceleration of works.	Work suspensions owing to conflicts	lack of skilled labor
Difficulties on importing equipment	Delays on land Hand over	Relocation of services and utilities
variation occasioned by change in brief by owner	Unsubstantiated Contractual claims, such as, extension of time with cost claims.	Inadequate specification
Additional work or Direct change orders by client	Slow inspection of completed works	Construction acceleration costs
delay payment of completed works	Logistics due to site location.	Lack of application of cost management process.

Table 4.3.16 Causes of cost overrun expected to occur during construction

Addis Ababa Institute of Technology Department of Civil Engineering

Table 4.3.17 Assessment of factors responsible for cost overrun in Addis Ababa's LRT project

List of possible factors	Ms of Contractor	Ms of Consultant	Ms of Owner	Stage of construction	Average mean	rank
1.Delay on land hand over	4	3	3.5	Pre-construction	4	7
2.variation caused due to underground and elevated structures	3.5	4	4	construction	4	2
3. Increase caused due to drainage and river line relocation.	3	3	3.5	Construction	3	12
4. parking lot provision	2	2.5	2	Construction	2	17
5.variation due to Standard future utility crossing provision	3.5	4	3	Construction	4	9
6. Lack of experienced labor force	4	3	3	Construction	3	11
7. Scope changes occasioned by inadequate pre-contract study	3	4	4	Pre construction	4	6
8. Inadequate site investigation unexpected ground conditions	3	4	4	Construction	4	5
9. Inadequate preconstruction study	4	4	3.5	Pre construction	4	3
10. Work suspensions owing to conflicts	3	3	2.5	Construction	3	16
11. Contractual claims, such as, extension of time with cost claims.	2	2	1.5	Construction	2	23
12. Lack of application of risk management process	3	4	3.5	Pre con and Construction	4	8
13. Difficulties on importing equipments and materials	2	1.5	2	Construction	2	22
14. Logistics due to site location.	3	3	3	Construction	3	14
15. variation occasioned by change in brief by owner	2	2	2	Pre con and construction	2	18
16. Acceleration of construction Costs	2	1.6	1.5	Construction	2	24
17. Long period between design and time of bidding/tendering	3	3.5	3	Pre Construction	3	13
18. Additional work/Direct change orders by client	4	3.5	3	Construction	4	10
19. Deliberate cost underestimation and Manipulation of forecasts	2	1.5	2	Pre construction	2	19
20. Insufficient financial budget	1	2.5	2	Pre construction	2	20
21. Lack of application of cost management process.	1	2	1	Pre con construction	1	26
22. Rework due to inappropriate construction quality/specification	1	2	2	construction	2	25
23. Type of construction contract (Turnkey, construction only,....)	3	3	3	Pre construction	3	15
24. Type of project bidding and award (negotiation, lowest bidder,.....)	3	4	4	Pre construction	4	4
25. Necessary variations of works	2	2	1.5	construction	2	21
26. Delay and scope change of the contract date and items of work	4	4	3.5	construction	4	1

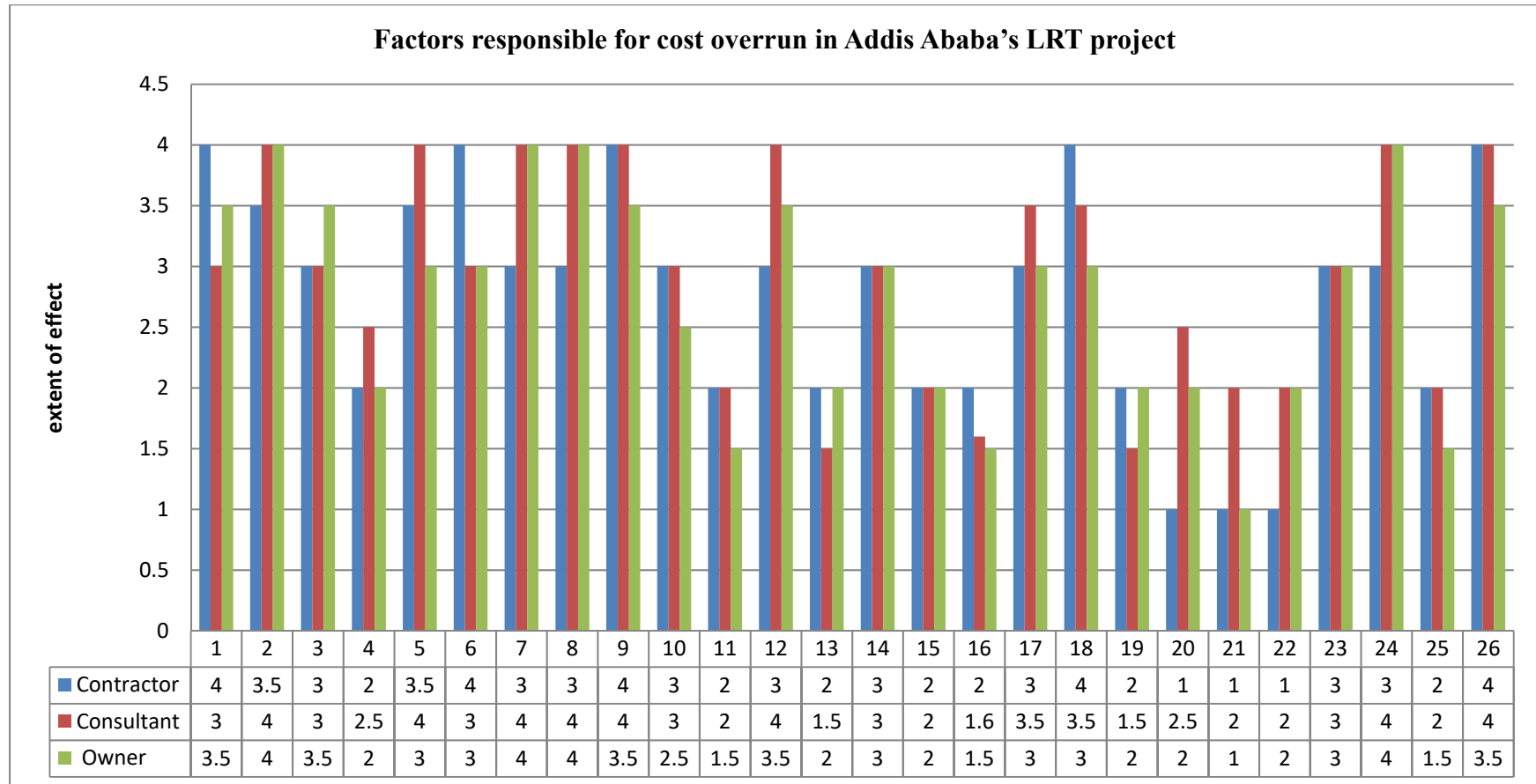


Fig 4.11 Assessment of factors responsible for cost overrun in Addis Ababa's LRT project

Factors listed above are presented in this graph the first row of the graph lists 26 of the factors selected for analysis

The following rows show the mean score obtained from the respondents answer

List of possible factors that causes cost increase/ cost overrun in Addis Ababa’s LRT project

From the analysis presented above the main five causes of cost overrun observed in this project are presented and classified with respect to the responsible party and stage of construction and as to the cause provided for the cost overrun.

Cause of cost overrun	Pre construction Stage	Construction stage	Provided reason by respondents
1st. Delay and scope change of the contract date and items of work		XXX	Price adjustment with material
2nd. variation caused due to underground and elevated structures		XXX	Change of tunnel section in to elevated sections.
3rd. Inadequate preconstruction study.	XXX		Upgrade in method of system control.
4th. Type of project bidding and award (negotiation, lowest bidder,.....)	XXX		Lack of funding which lade to selection of particular type of contractor.
5th. Inadequate site investigation unexpected ground conditions	XXX		Rearranging and installation of utility crossings

Table 4.3.18 Major causes of cost overrun according to the respondents

Therefore according to the respondents out of the 26 factors which were presented for cost increase the main factor selected for cost overrun in the project is price adjustment of materials even though the mean score for the results were almost the same for the factors selected for cost increase the factor selected as the main reason for cost increase was based on collaboration of the respondents answer with the reasoning given by the respondents.

4.4.6. Interview data analysis on occurrence of causes of cost overrun

The respondents of the interview were asked to list three of the causes of cost overrun in Addis Ababa’s LRT project to which there results is summarized in the table below.

Cause of cost overrun	Clarification	Rank
1st. Delay and scope change of the contract date and items of work	50% of interview respondents	1st
2nd. Inadequate preconstruction study.	30% of interview respondents	2nd
3rd variation caused due to underground and elevated structures	20% of interview respondents	3rd

. Table 4.3.19 Causes of cost overrun according to interview results

4.4.7. Archival data analysis on occurrence of causes of cost overrun

From the contract document, progress reports, payment certificates and various miscellaneous archival data obtained from Addis Ababa's LRT project the following list of causes of cost overrun were observed.

Causes of cost increase from archival reports	Rating according to recurrence observed
I. Delay and scope change	1 st
II. Variations due to structure relocation and addition	2 nd
III. Utility crossing provisions	3 rd
IV. Change of scope	4 th

Table 4.3.20 Causes of cost overrun according to archival data

The next stage of the study was focused on the determination of mitigation measures being implemented to decrease or avoid the presence of cost overrun in the project the participants of the study were presented with ten specific mitigation measures which are directly or indirectly related to the causes of cost overrun and the participants of the study were asked to rate this mitigation measures as the causes of cost over run from 1. Very low (insignificant) =0-25% , 2. Low= 25-50% , 3. Medium=50%, 4. High =50-75% 5. Very High =75-100%. Representing the highest value in the analysis even though more than 10 mitigation measures can be noted as measures being implemented in railway projects and light rail transit projects around the world the factors selected and presented in this study are particulars which were considered to be directly observed in the project.

4.5 Mitigation measures used to avoid cost increase/overrun

4.5.1 Questioner data analysis on methods used to avoid cost increase/overrun

After the list of causes of cost overrun was identified and rated by the respondents the participants of the study were asked to do the same with the mitigation measures being implemented by practiced to avoid the presence or occurrence of cost overrun the results are presented below.

List of possible factors	Ms of Contractor	Ms of Consultant	Ms of Owner	Stage of construction	Average mean	rank
1. Implement cost reduction incentive proposals	1	2	1	construction	1	10
2. Initiating Scope and design changes which led to reimbursement or cost reduction	2	1	1	Pre construction	1	9
3. Perform Cost planning and Monitoring during pre-and post contract stages.	4	3	4	Construction	4	4
4. Initiated Proper coordination and interaction within parties involved in works	3	3	3	Construction	3	7
5. Perform standard cost estimation and cost control procedure	3	2	1	Pre and Construction	2	8
6. controlling claims associated with cost	2	4	4	Construction	3	6
7. Controlling and keeping re design and rework to a minimum	3	3.5	4	Construction	4	3
8. Facilitating right-of-way hand over	4	3	4	Construction	4	1
9. Appropriate geotechnical investigation before commencement of work	3	3	2.5	Pre construction	3	5
10. Careful assessment of contractual agreement (EPC)	4	3.5	4	Construction	4	2

Table 4.3.21 Mitigation measures to avoid or reduce cost overrun/increase

Spearman's Rank Correlation

Spearman’s correlation from causes of cost overrun			Spearman’s correlation from mitigation measures			
Contractor VS Consultant	Contractor VS owner	Contractor VS owner	Contractor VS Consultant	VS Consultant VS owner	Contractor VS owner	Contractor VS owner
0.9958	0.9977	0.9959	0.9424	0.9712	0.9378	

Table 4.3.22 Spearman’s correlation

Spearman’s coefficient of rank correlation is used to demonstrate whether there is the agreement or disagreement among each pair of parties it can be inferred from these results that there is a very good agreement between three parties in ranking these causes despite frequency, severity or importance index. The highest degree of agreement belongs between Consultant and owner with 99.77% correlation.

4.5.2 Interview data analysis on methods used to avoid cost increase/overrun.

The respondents were asked to state mitigation measures being implemented in Addis Ababa’s LRT project based on their answer the following mitigation measures are listed below.

- ❖ Facilitate right-of-way hand over to avoid delay
- ❖ Control and keep scope changes to a minimum
- ❖ Facilitating coordination of Ethiopian public sector development agencies
- ❖ Careful assessment of contract document to substantiate the validity of claims

4.6 Impact assessment of cost increase

Impact assessment of cost increase

Bankable feasibility study estimate =400,234,004.25 million USD		
Increase observed	Cost in USD per Km	Base fair in Ethiopian birr/passenger
0.00 USD	11.68 million USD	0.48 ETB/Km
Contract price=475,000,000 million USD		
Increase observed	Cost in USD per Km	Base fair in Ethiopian birr/passenger
74,765,995.75 million USD	13.68 million USD	0.57 ETB/Km
Contract price + Cost increase according to questioner =494,950,000		
Increase observed	Cost in USD per Km	Base fair in Ethiopian birr/passenger
19,950,000 million USD	14.45 million USD	0.59ETB/Km
Contract price + Cost increase according to desk study=498,750,000 million USD		
Increase observed	Cost in USD per Km	Base fair in Ethiopian birr/passenger
23,750,000 million USD	14.56 USD per Km	0.6ETB/Km
Percentage of cost increase observed from bankable feasibility study to Cost increase according to desk study = 25% or 98,515,995.75 million USD		

Table 4.3.23 Impact assessment and total percentage overrun

The data presented above clearly shows the impact of cost overrun in Addis Ababa’s LRT due to the cost increase observed in the project the cost of ridership has increased from 0.48 ETB/Km to 0.6ETB/km which would make it economically unviable in short to medium distances but due to silent economic benefits such as carbon emission reductions and long term economic benefits the LRT project still remains economically viable. The main causes noted for construction cost increase are price adjustment with material, variation caused due to underground and elevated structures, inadequate preconstruction study , type of project bidding and award (negotiation, lowest bidder,.....) , variation caused due to underground and elevated structures , Inadequate preconstruction study , Inadequate site investigation and unexpected ground conditions .

The next chapter of this study presents conclusion of the study and recommendation for future LRT project. Based on the findings of this study with regards to cost management practice and cost overrun mitigation measures which can be implemented in future projects.

CHAPTER 5

5. Conclusion and recommendation

5.1 Conclusions

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 and transportation projects and specifically railway projects are one of the main elements construction which are affected by cost increase and the main reason for cost increase stated in rail way projects was cost underestimates coupled with ridership overestimates further, in most cases, the project contingencies were insufficient and unrealistically optimistic.

Even though rail ways, bus rapid transit systems and light rail transit systems are modes of transportation of the future generation the initial construction of such projects is relatively higher than other transportation systems such as road transportations but with regards to clean and environmentally conscience mode of transport with high carrying capacity railway are becoming more and more the convenient.

Therefore, identification of the presence of cost overrun, factors leading to cost overrun and analyzing its impact is a prerequisite to minimize or avoid cost overrun so as to reduce its consequential effects. Hence, the main objectives of this thesis is to identify and analyze the presence of cost overrun, cost management practice and major factors leading to cost overrun of Addis Ababa's LRT project. To achieve these objectives, the study used desk study, unstructured interviews and questionnaire survey as a research instruments. The information gathered from the survey was analyzed using the mean score method and correlated using Spearman's rank correlation coefficients for structured part of the questionnaires. The analysis of results from the desk study and structured questionnaires was carried out using descriptive statistics including percentages and means.

The results obtained in this processes have been discussed and presented in the previous chapter. Therefore, based on the results from the analysis, the following major conclusions have been derived and summarized in accordance with the objectives of the research:

- I. From the results of section two of the survey study on construction cost management practice of Addis Ababa's LRT project we can draw the following conclusions the highest priority is given to cost in relation to time and quality of construction by the contractor which is an indication of the type of contract and the contractor's obligation to fulfill only the minimum requirement of construction with respect to quality.

- II. Furthermore the main tool under use for cost management in Addis Ababa's LRT project was work break down (WBS) reports /progress reports and labor, plant, material actual versus forecast and the use of other methods of cost management tools specially by the consultant and owner was insignificant and the main reason cited for lack of use was
- ❖ Type of contract which limits involvement of owner and consultant.
 - ❖ Omission of a representative bill of quantity
 - ❖ Lack of complete and representative design and documentation except for the conceptual design
- III. With regards to estimation process from the archival study and respondents answer the main case noted for variation between feasibility study estimate and contract price were
- ❖ Delay between feasibility study estimate and contract estimate
 - ❖ Lack of experience in estimation of such kind of projects
- IV. Even though the main reasoning provided for use of cost estimation in Addis Ababa's LRT project was for monitoring project execution lack of proper application of the process due to the problems mentioned above and lack of comparison with the cost base line were also observed further more lack of appropriate documentation was also noted as one of the problems with regards to estimation.
- V. The main method of estimation being implemented in Addis Ababa's LRT project was analogous estimation methodology or estimation based on past projects, which applies cost per/Km as the main tool for determining the cost of the project.
- VI. The use of Cost control in Addis Ababa's LRT project is mainly focused in monitoring the efficiency of performance of resource in the construction of underground utility relocation, execution and elevated station construction by tracking the cost of the project at regular update cycles when payment as per the contract is due.
- VII. To summarize the main problem observed in Addis Ababa's LRT project were.
- ❖ Lack of proper and standardized cost management process which is inclusive of three of the parties involved in the study.
 - ❖ Lack of documentation and experience in such kind of project especially with regards cost estimation, control and budgeting by the owner.

- ❖ Lack of representative bill of quantity and complete design prior to contract.
 - ❖ Delay between feasibility study estimate and contract estimate.
- VIII. From the desk study and survey analysis performed in section four of this study currently there is a 5% and 4.2 % of cost increase observed respectively when comparison with the contract price was performed and a grand total of 25% cost increase was observed from the feasibility study estimate which is the problem of most rail way projects around the world according to the literature provided in chapter 2 of this study under estimation of price of the project and over estimation of rider ship which still remains to be seen in Addis Ababa's LRT project, but the increase of the rate for rider ship from 0.48ETB/km to 0.6ETB/Km make it uneconomical for the end user over short to medium distance even if the speed , unhindered traffic, passenger load capacity and carbon emission reduction may justify this cost.
- IX. The main cause of cost increase/overrun observed in Addis Ababa's LRT project include
- ❖ Delay and scope change of the contract date and items of work, the responsible parties for this cause were the client/owner. This resulted in Price adjustment with material at construction stage.
 - ❖ Variation caused due to underground and elevated structures at construction stage the reasoning provided include Change of tunnel section in to elevated sections and problems observed at six of the junctions presented in the previous chapters, responsible parties for this cause were client/owner and contractor.
 - ❖ Inadequate preconstruction study prior to the construction period which led to change in the control system and conceptual design of works and the main responsible parties for this were the client/owner and contractor.
 - ❖ Type of project bidding and award (negotiation, lowest bidder...) which was caused due to lack of foreign currency and appropriate funding or loan to execute the project and the main responsible party noted was the owner/client.
 - ❖ Finally Inadequate site investigation and unexpected ground conditions even though the ripples of this problem are shown in the construction stage of the project its roots belong in the pre construction stage and the main responsible party is the contractor.

- X. Mitigation of cost increase/ over run being implemented during this period of the study include
- ❖ Facilitating right-of-way hand over: even though right of way was one of the major problems observed the contractor has not been compensated for this delay as a result it was not considered as a cost for cost increase.
 - ❖ Careful assessment of contractual agreement
 - ❖ Controlling and keeping re design and rework to a minimum
 - ❖ Perform Cost planning and Monitoring during pre-and post contract stages.
 - ❖ Performing Appropriate geotechnical investigation before commencement of work

5.2 Recommendations and future research

5.2.1 Recommendation

Based on the findings of the research, the following improvements were recommended for future projects with respect to cost management practice, reduction and or eradication of cost increase/overrun in LRT projects over all and specifically urban LRT projects.

- I. Extensive and standardized use of construction management tools and practices which can reduce and even avoid the occurrence of cost overrun.
- II. Increasing man power, machinery and level of construction of domestic contractors to avoid loss of foreign currency.
- III. Conducting clear and complete feasibility study estimates which are representative the actual cost of the project.
- IV. Resolve all right of way (ROW) problems before commencement of the project.
- V. Preparation of a complete and representative design and bill of quantity before contract award.
- VI. Conduct a complete, extensive and representative geotechnical site investigation.
- VII. Increase the involvement of the owner/ client in design stage of the project and coordination of the parties involved in the project.
- VIII. Providing the personnel performing estimating duties with the right training and information as early in the estimating process as possible by stakeholders.
- IX. Increase coordination of parties which are involved in public construction works such as AACRA, AAWSA, EEPCO , ERA and ETC because there is a clear lack of cooperation

which led to wastage of resource and delay but currently not covered in the realm of this study.

- X. Improve Proper documentation and study of design and contract documents which can aid to reduce the cost of future projects.

5.2.2 Recommendation for Future Research

This research has presented the current cost manage practice, identification of the presence of cost overrun, the causes of cost overrun and mitigation measures being at this stage of the project but further study and documentation is required to gain a complete and representative stage of the status of cost overrun at the completion of the project further more from the study conducted the following suggestions are recommended to be studied

- ❖ Further study of justification of ridership cost of the project with current price and compatibility of the project with current traffic.
- ❖ Development of standardized cost management practice for loan based public sector projects
- ❖ Effect of construction cost overrun and maintenance cost on the feasibility and payback period of the LRT project.
- ❖ Advantage and disadvantage of the project on the current traffic conjunction and alleviation of increasing transport cost and passenger overload.

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