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Practice and Challenges of Project Cost Estimate in selected Grade One Building Construction Companies in Addis Ababa

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Assessment on Practice and Challenges of Project Cost Estimate in selected Grade One Building Construction Companies in Addis Ababa

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A Project work Submitted to Addis Ababa University School of Commerce in Partial Fulfillment of the Requirements for the Award of Master of Arts Degree in Project Management

June, 2020

Declaration

I, Alula Alebachew Worku, hereby declare that the work which is being presented in this research work entitled "Assessment on practices and challenges of project cost estimate in selected Grade One Building Construction Companies" is my original work and I or anyone else have not previously in its entirety or in part submitted it at any university for any other degree.

Name:**Alula Alebachew Worku**

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June, 2020

Statement of Certification

This is to certify that the work contained in the project work entitled "Assessment on practices and challenges of project cost estimate in selected Grade One Building Construction Companies", submitted by Alula Alebachew in partial fulfillment of the requirements for the degree of Degree of Master of Arts is carried out by him under my direct supervision and guidance. The contents embodied in the project work have not been submitted for the award of any other degree or diploma in this or any other university

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This is to Certify that the project work prepared by Alula Alebachew Worku, entitled: "Assessment on practices and challenges of project cost estimate in selected Grade One Building Construction Companies" submitted in partial fulfillment of the requirements for the degree of Degree of Master of Arts complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Approval Sheet

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External Examiner

Name: _____ Signature: _____ Date: _____

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Abstract

Reasonable cost estimate is a key to success of project. Estimate, which considers all the costs that are required to deliver a project, not only insures the completion of project successfully but also ensures the long-term profitability of the company. Assessment on practice and challenges of project cost estimate in selected grade one building contractors was made to identify the major challenges of preparing reasonable cost estimate and understand the impact of unreasonable cost estimate in the company's overall performance. Cost estimate is prepared by using well-known cost estimate approaches to calculate the overall cost of a project. There are many challenges while preparing a good or reasonable cost estimate. To identify the major practices and challenges of cost estimate, the research design used is descriptive design. Forty-five grade one building construction companies were selected to understand the practice and challenges of cost estimation. Of the one hundred eight sample size, ninety six respondents working in forty one Grade one construction companies were involved in responding to the questionnaire and interview questions. The collected data was analyzed by using SPSS and results suggest that most local building construction companies do not use specific cost estimation approach and most of them use traditional ways of estimating the cost of the project. Major costs like overhead cost, depreciation cost, risk and opportunity costs are not well considered as they are just calculated as some percentage of the direct cost. This is a major challenge in creating an accurate cost estimate as each and every cost related to the project are not identified and their impact is not well managed. This project work proposes adopting a suitable cost estimation approach, considering overhead, risk and opportunity costs, clients having their own cost estimators that evaluate company's estimation and companies training cost estimators.

Keywords: Project cost estimate, Challenges of cost estimate, ways of overcoming challenges, practice of cost estimate, factors considered in estimation process

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Acronyms

EAC – Estimate at Completion

LCC – Life-cycle Cost

IAC – Independent Cost Estimate

LCCE – Life-cycle Cost Estimate

GAO – Government Accountability Office

WBS – Work Breakdown Schedule

EVM – Earned Value Management

MTO – Material Take Off

BOQ – Bill of Quantity

SPSS – Statistical Package for the Social Sciences

PPA – Public Procurement Authority

BSc – Bachelor of Science

MBA– Masters in Business Administration

MSc – Masters of Science

PhD – Doctor of Philosophy

Chapter One
Introduction

1.1. Background of the Study

The construction sector builds houses, factories, roads, bridges and it is also responsible for repairing them (Hyari, 2005). The quality of the infrastructure is very important and shouldn't be compromised as it will put people's lives in danger. There are many challenges in the construction industry in developing countries and project cost estimate is one.

Cost management is the process by which one plans and manages the budget of a business or project (Bridges, 2019). The process begins with the planning phase of the project and if it is planned right and performed based on the plan, successful execution is guaranteed. (Flemming, 2012) mentions there are four components to cost management; estimating costs, tracking costs, controlling costs and maintaining cost data. Estimating is determining the costs needed before the project is started while the other components are performed after the project starts. Cost estimating is the practice of forecasting the cost of completing a project with a defined scope. The approximate total project cost, called the cost estimate, is used to authorize a project's budget and manage its costs (Marker, 2017).

Construction companies are expected to prepare detail cost break down and estimate the cost of the project to avoid loss and maximize their profit. Besides profit maximization, an estimate which is detail and considering future risks and opportunities ensure successful completion of a project and companies fate to stay in business. Before even approaching a project, it's important to get a handle on cost estimation to help keep you on task and in touch with project constraints and limitations (Collins, 2020).

Estimates with wrong considerations will seriously affect the company's profitability, delay, not able to continue the project with reasonable performance, compromised quality and lower rate of customer satisfaction are among the major problems that are related to wrong cost estimates. Companies tend not to be cautious while preparing estimates as they'll only be concerned about winning the bid. Winning the bid will grant contractors advance payment which will allow them to perform for a while in already started and with poor performance projects and the advance

payment is used as a pain killer for relieving stress because of clients' pressure. They worry about the estimate they gave the client later on when the budget the client allocated won't be enough to cover all expenses. That is when they start compromising the quality so as not to create a loss to the company which results in affecting the users of that infrastructure. Due to this, buildings might collapse, roads might produce punctures which results in putting lives in danger (Linberg, 2001).

In Ethiopia, especially on rural areas, there are lots of buildings started years back and not finished and are on the process of being terminated and given to another contractor. This is mainly because the financial document doesn't match the actual budget that is needed to complete the work; which leads to loss of quality, delay and ultimately, termination of contract. If these things happen, it will put the function, esthetics and the total lifespan of the construction in danger (Wakjira, 2011).

Projects constraints like time and quality are directly related to the cost of the project. A project with better cost estimate can handle future uncertainties on its margin of consideration. Delivering the project on time and with reasonable quality needs the fair project cost estimate not to compromise on quality and expenses related to speeding the project whenever required.

Ethiopia, as a developing country, has made a good progress in transforming the cities construction wise. And there are lots of contractors that take the lead in the transformation process. When trying to engage in a project, specifically in Ethiopia, the construction company's journey starts from buying a bid document, filling the technical as well as the financial requirements and submitting the document; the firm will win if and only if all/most requirements are met as compared to the other companies. When submitting the financial document, the firm will go to suppliers, check the price of the items necessary, consider the man power and machineries it has to exert in the project and the amount needed to administer those employees until the completion, calculate its profit and overhead costs, and determine the overall amount needed to perform the project. The company might submit unreasonable cost estimate just to win the bid without even considering the outcome (Mierowsky, 2015).

In many cases, the company that wins the project is responsible for purchasing all the infrastructures necessary, assigning man power that directly involve in the project and solve any issues related to it until the completion and handover. During this process, if the cost estimated while submitting the bid is not correct, it would greatly affect the final product with respect to quality; it might even become impossible for the contractor to finish the project which would waste the time of the client. Thus, this study assesses the practice and challenges of project cost estimate in selected grade one building construction companies in Addis Ababa.

1.2. Statement of the problem

Contractors are expected to deliver reasonable cost estimate that meets the client's requirement. Reasonable cost estimate which includes all costs that are going to affect the project will ensure the successful completion of the project and profitability of the contractor. Poor estimation could lead to the project failure; in terms of time, cost or even in the stakeholder opinion (Hatamleh, 2018). According to a study made to investigate the cause of delay in the construction industry in Ethiopia, contractor's failure to finance projects is the main reason of delay and cost overrun (Koshe, 2016). And one of the main reasons for the failure is poor cost estimation.

Because of different reasons, local contractors estimate cost of projects using traditional ways or maybe without using any tool just to win the bid and grant advance payment of the project. By most contractors, advance payment is believed to be a driving force to see the light of day or stay in business.

Wrong cost estimates can shrink project margin, due to that, the project may suffer from numerous delays which could lead to a shelved project. The client may even decide to terminate the project suffering from serious cost inaccuracies (Gaur, 2017). Moreover, projects delay and mostly fail from completion because of this critical issue. Poor customer satisfaction, loss and ultimately getting out of business will be the fate of the contractor. Contractors are expected to be professional in calculating their cost and in using their opportunities and comparing advantages to win a bid rather than simply quoting unreasonable prices.

Therefore, this study tries to identify the kind of tools or estimation approaches the companies use and provide the possible solutions for the challenges caused by project cost estimate in the construction industry.

1.3. Research Questions

After the completion of this study, the project is going to answer the following research questions;

1. What kind of cost estimation approach and process does the organizations under study follow?
2. What considerations are taken in to account while developing the cost estimate?
3. What are the challenges encountered in developing reasonable cost estimates?
4. What kind of techniques do they use to surmount the challenges?

1.4. Objective of the study

1.4.1. General Objective

The General objective of this project is to assess the practice and challenges of project cost estimate in selected grade one building construction companies in Addis Ababa.

1.4.2. Specific objectives

The specific objectives of this project are to:

- Identify the kind of cost estimation technique companies use.
- Determine how the companies are conducting the cost estimation.
- Assess the considerations taken while developing the estimate.
- Identify the challenges encountered while developing the estimate.

1.5. Significance of the study

Any delay in project completion will result in chaos to the contractor, the client and the country as a whole. Although there might be many reasons for the delay, budget is the main cause. This study mainly assesses the issue and challenges caused in many companies due to inefficient cost estimate by using different data collection mechanisms and tries to deduce the best solution so as to complete a specific project in a certain time frame.

This project work contributes to the field of project management as having a better estimate results in project completion which paves the way to a better project management. As the major constraints of project management are cost, quality and time, this concept of cost estimation deals with cost constraints which indirectly tries to come up with a solution even with respect to the time and quality of a project. It also helps other researchers to perform future researches on the cost estimation recommendation made by this study by relating it to information technology and creating general formulas which can facilitate easy and accurate calculation of costs.

1.6. Scope and Limitation

As mentioned earlier, this study reviews the basic concerns caused by project cost estimates in construction companies in Addis Ababa. It incorporates the direct, indirect, profit and overhead costs of the project and the actual practice of considering the mentioned costs.

This study is conducted only on building contractors; it doesn't consider other fields like road and waterworks. Due to the shortage of time, the prevailing conditions of people not being able to freely meet and talk because of the health impacts, only grade one contractors residing in Addis Ababa are considered for the study. Moreover, although the construction companies are very large in number, this study is going to select 45 companies and collect the data from those companies because of the time constraint. Questionnaire was developed as methodology to collect information from respondents and using SPSS software, the data was analyzed to reach to conclusion and recommendation on the major findings.

This study is limited to only building contractors practice and challenge while developing the cost estimate and it doesn't consider other fields of the industry which cost estimation practice is still a major problem in the performance of projects.

1.7. Organization of the Study

This research work is organized into five chapters. Chapter one is introduction, which generally mentions the relevance and idea behind the project. It comprises the background, the problem statement, the objectives, the scope and limitation. Chapter two is the literature review, comprises basic ideas of the terms and the related works that are done in this area. Chapter three depicts the overall methodology followed in the research work. Chapter four entails data analysis based on the collected data, summary of findings and other discussion of the study. Chapter five is about conclusions and recommendations.

1.8. Definition of key terms

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements.

Project cost management is the process of estimating, allocating, and controlling the costs in a project.

Cost estimation is the approximation of the cost of a program, project, or operation.

Overhead cost is the ongoing business expenses not directly attributed to creating a product or service.

Likert scale is a five (or seven) point scale which is used to allow the individual to express how much they agree or disagree with a particular statement.

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group.

Chapter Two

Review of Related Literature

2.1. Introduction

This chapter incorporates the theoretical review in which project cost management, cost estimation, types and techniques are discussed. It also discusses about the challenges faced in the construction industry in Ethiopia and in the world as a whole. Related works are also included to get a good grasp of the challenges related to cost estimation in Ethiopian construction.

2.2. Theoretical Review

2.2.1. Project Cost Management

Barnes (Barnes, 2011) defines project management as the application of processes, methods, skills, knowledge and experience to achieve specific project objectives according to the project acceptance criteria within agreed parameters. It can be incorporated under the processes of initiating, planning, executing, monitoring, controlling and closing in which planning plays a very important role through the overall process.

Project planning is at the heart of the project life cycle, and tells everyone involved where they're going, how they're going to get there and with what resources. In this stage, the project plans, deliverables and requirements are clearly defined and documented in which the project budget and schedule is identified. All the plans created during this phase will help manage time, cost, quality, changes, risk, and related issues like identifying and controlling the staff and suppliers needed ensure the delivery of the project on time, within budget, and schedule (Watt, 2014). The following figure clearly depicts the overall processes involved in project planning.

Figure 2.1. considerations taken into account in project planning (Project Management, 2019)

Good project budget and cost is vital to the completion and handover of a project. The cost needs to be planned, managed and controlled very well. Cost management is process that includes activities such as planning, estimating, budgeting, financing, funding, managing, controlling, and benchmarking costs so that the project can be completed within the approved time, budget, quality and performance (Cost Management, 2020). Marker (Marker, 2017) mentions there are four primary phases of cost management as depicted in figure 2.2.

Figure 2.2. Phases of cost management (Marker, 2017)

Resource planning is the first phase of cost management in which the resources necessary are identified provided the WBS. After the resources are identified, the next step is estimating the cost that is needed to complete the project. Based on the cost estimated, the budget will be prepared in which each and every expenditure is controlled, managed and allotted according to the plan. As can be seen in the above figure, cost estimation is one of the phased of cost management and it is the main focus of this project work. Thus, the next subtopic discusses about cost estimation.

2.2.2. Cost Estimation

Estimation is the scientific way of working out the approximate cost of an engineering project before execution of the work (Othman, January 2016). And a cost estimate approximates a project's probable cost. A cost estimate is the summation of all the costs involved in successfully finishing a project, from inception to completion (project duration). A cost estimate is more than a simple list of costs; it also outlines the assumptions underlying each cost. These assumptions (along with estimates of cost accuracy) are compiled into a report called the basis of estimate, which allows project stakeholders to interpret project costs and to understand how and where actual costs might differ from approximated costs (Marker, 2017).

The estimation process complies with a set of principles which act as a foundation for identifying and calculating right project expenses (Team, 2020). And the key principles are integrity, information accuracy and relevance, and uncertainty and risk; meaning the cost estimate should be a transparent process and the information provided is accurate considering future risks by a team that are skilled and professional.

As can be seen in the figure below, a twelve step process that result in reliable and valid cost estimates has been identified (Westland, 2019).

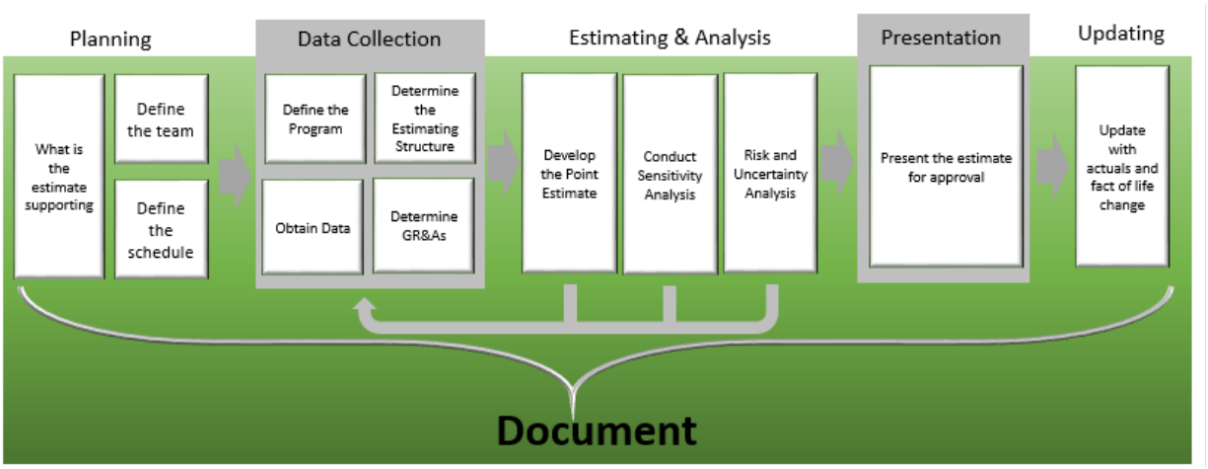

Figure 2.3. GAOs twelve step process of cost estimation (Army Cost Analysis, 2020)

First the necessity of the estimate will be determined in which a team will be organized to come up with a plan and its characteristics that helps in identifying the implications with respect to risk mitigation. Then, provided the work breakdown structure (WBS), the best estimating technique will be identified that also defines what needs to be included and excluded from the estimate in which data is collected, analyzed and a cost model is developed for each element. The next step is to conduct a sensitivity, risk and uncertainty analysis to figure out the cost, schedule and technical risks and come up with a solution. The estimate will then be documented, presented and updated whenever any change is encountered. The documentation part is very essential as it will be referred to every step of the way and it can also be used for future use.

2.2.2.1. Types of Cost Estimation

All the costs of a project fall into these categories (Mislick & Nussbaum, 2015):

i) Recurring and Non-recurring

Recurring Costs are costs that occur repetitively such as rent of an office or a machine while Nonrecurring Costs are costs that are not repetitive like start up costs or design costs in an engineering field.

ii) Fixed and Variable

Fixed Cost, as its name implies, refers to a cost that is not going to increase or decrease throughout the lifecycle of the project. And a variable cost refers to a cost that can be changed with the amount of project work.

iii) Direct and Indirect

Direct Cost is directly associated with particular tasks or/and activities in which an indirect cost is an expense on overheads.

iv) Opportunity costs

Opportunity Cost is associated with an opportunity of a choice where a party makes a choice between two different projects considering its cost.

v) Overhead costs

Overhead Costs are operating costs that are not direct labor or direct material costs such as electricity costs or property taxes.

vi) Sunk costs

Sunk Costs are costs that occurred in the past and have no relevance to estimates of future costs and revenues for alternative courses of action.

2.2.2.2. Cost Estimation Approaches

To create accurate estimates, cost estimators use a combination of estimating techniques that allow for varying levels of accuracy. The most widely used cost estimating techniques are (Marker, 2017):

Analogous Estimating

This method seeks the help of experts who have experience in similar projects, or use previous construction project's actual cost to serve as a basis for the current project. Provided relevant previously used data, deducing or coming up with future costs will be easier. If a contractor can

gain access to an estimate of different previous projects, based on the cost breakdown done earlier, the company can identify the cost estimates of a new project.

Statistical Modeling

There is statistical modeling, or parametric estimating, also uses previous project's data as key cost drivers and then predicts what the new costs would be if the duration or another aspect of the project is changed. There are different statistical agencies that collect and accumulate data which would allow the manipulation of the data to estimate the cost.

Bottom-Up Estimating

Bottom-up estimating uses estimates of individual tasks and then adds those up to determine the overall cost of the project. To figure out the cost of concrete, the company will assess the cost of Sand, pebble, water and labor individually to come up with a total cost of the concrete.

Cost-based approach

This kind of strategy bases up on direct cost estimation rather than considering external factors. The cost for every material, equipment and labor will be collected and the estimation will be generated based on the summation of individual cost. A margin of profit and overhead will be taken based on the direct cost to finalize the estimation.

Three-point Estimate

The three-point estimate is a technique which comes up with three scenarios: most likely, optimistic and pessimistic ranges. It considers best-case, average and worst-case scenarios to come up with an equation of deducing the cost.

Although a company always aspires to create the most accurate estimate, the estimator might even try to start with less accurate estimates and revise once project scope and deliverables are figured out (Marker, 2017). For providing with a reasonable handover, a good cost estimator can use one of the above techniques or a combination of them.

2.2.2.3. Characteristics of a Good Cost Estimation

The essential characteristics of any good cost estimate are completeness, reasonableness, credibility, and analytic defensibility (Mislick & Nussbaum, 2015). Completeness starts from selecting the most accurate estimating approach up to providing the best documentation. The accuracy can be improved by frequently revising the estimates and providing contingencies should there be any kind of risk. Given the process, keeping track of each and every step and documenting any change that has been made to the estimate is mandatory as it will help in any kind of misunderstanding. This will make the estimate reasonable and credible since the documentation provides every reason as to why the change has been made.

A good cost estimate should also be analytically defensible in which provided the negative risks to be forecasted, confirming the validity of the cost estimate and verifying the mathematical operation becomes a necessity.

2.2.3. The Construction Industry

It has been predicted China's vast construction industry is growing at an insatiable rate and will add USD $2.1TN to global construction output by 2030 and China has been considered as the top in the construction market (Mills, 2016). Following China are the United States and India. The construction might vary from residential to industrial construction. Residential are houses that are self-owned; the owner can either hire small contractors or can be self-built. Non-residential construction could be an office, a school, a hotel etc that could either be public or private. Another type of construction is infrastructure construction which consists of road, bridge, waterworks or airports. Industrial construction entails factories, power or gas stations.

The construction industry has a significant role to play within the overall economy of any country. How that role manifests itself will vary greatly from one nation to another, in developing countries it is likely that the extraction of raw materials and the on-site construction activity is of most importance, as the country seeks to set up a significant infrastructure, in the form of roads, railways and buildings (Ruddock, 2007).

Given a construction project with a fully-furnished design, the parties involved are the client, the contractor, the suppliers, the consultant and other regulatory bodies (Hyari, 2005). The client is

the owner of the project that could either be an individual or a company that is concerned with allocating the budget. The contractor is the one responsible for executing the project from start to end. It will hire subcontractors and other human resources, move machineries, negotiate with suppliers and perform the project. The suppliers are companies that sell materials that could be an input to the project; they either communicate with the contractor or directly with the client. The consultant is a firm that is hired by the client to make sure the project is done based on the design with the right quality; it will report to the client whenever quality is compromised. Other regulatory bodies are government representatives that make sure the contractors are working according to the rules and regulations that are declared by the government.

When considering a project, especially construction projects, the following expenses should be taken into account (Marker, 2017):

- Materials: The cost of resources like cement, reinforcement, hollow concrete blocks, finishing materials, sanitary fixtures, electrical fixtures etc.
- Labor: The cost of human resources like administrators, finance, cashier, storekeepers, project manager, project engineers, Forman, purchasers, machine operators and daily laborers etc.
- Services: The cost of additional works given to subcontractors for a service provided or different maintenance works.
- Facilities: The cost of buying or renting machineries or locations.
- Contingency costs: Costs added to the budget to deal with future risks.

2.2.3.1. Cost Estimation Techniques used in Construction Projects

Since construction costs vary with respect to the complexity of the project, different companies use different approaches as they see fit. A company might also choose different approaches for different projects based on the requirement of the client.

Ismail (Ismail, 2014) in "Construction Project Cost Estimation Technique" chooses a combination of parametric estimation and vendor bid analysis. Vendor bid analysis is a technique he calls 'get the information from the source'. He mentions that would use the vendor bid

analysis technique to collect accurate prices from the client and the historical actual rate per unit from parametric estimation and apply the rates to the new project's BOQ.

An article on construction cost estimation ("construction cost estimating", 2020) suggests three types of cost estimating techniques in construction projects:

- Estimating with unit rates: this technique considers unit rates provided MTO. The total cost is estimated by multiplying the unit price of a material by the quantities from the MTO.
- Resource based estimating: provided MTO and a schedule, this technique plans the resources necessary by using calendars and schedules. This method takes productivity in to account
- Factor Estimating: this method is used when MTO or schedule is not available. Construction costs are factored in by using material costs as a basis.

A book on Project Management for Construction (Hendrickson, 2008) mentions the following approaches of cost estimation:

- Production function: tries to come up with an estimate by relating the amount or volume of output to the various inputs of labor, material and equipment.
- Empirical cost inference: estimates the cost by relating the cost of constructing a facility to a few important characteristics or attributes of the system by providing a statistical technique.
- Unit costs for BOQs: given the unit cost for each material or task in the BOQ, this method calculates the total cost as the summation of the products of the quantities multiplied by the corresponding unit costs.
- Allocation of joint costs: This method requires each expenditure item to be assigned to particular characteristics of the operation basic costs will be classified and then be allocated proportionally to various tasks which are subdivisions of a project.

2.2.3.2. Cost Considerations in Construction Projects

Activities involved in cost management process are planning, estimating, budgeting, financing, funding, managing and controlling costs. And if planning and estimating are not performed properly, the whole process gets affected in a horrific way. The first thing to consider in estimating is actual cost, which are the costs incurred while procuring of the items. The construction materials necessary will be listed and price for those items will be collected and used as an input. As the price is collected, the inflation should be well thought-out. Then, overhead costs should be considered. An article suggests the following items to the included as overhead costs("Overhead Costs", 2020):

- office expenses: office rent, office equipments, utilities, taxes paid to customs office for an income generated
- Salary: for permanent employees like managers, engineers, administrative staffs.
- Miscellaneous cost: marketing and advertising costs, legal fees, travel expenses, expenses for auditors.
- Costs for a specific project: project specific salaries, temporary office facilities, utilities (water, electricity, generator), sanitation facilities (temporary toilets).

Before submitting the bid document, visit to the site is mandatory. The following risk/opportunity factors will be observed:

- Access to site: if there is no path/road to get access to the site where machineries will freely pass by, the contractor is responsible for making one which needs extra cost.
- Productivity: site location will also help in identifying the productivity of the laborers. The area needs to be well-seen with respect to weather condition, the culture of employees, culture of consultants etc, as low productivity means high cost and the vice versa.
- Site protection: the contractor has to see if there is any site protection is necessary. If shoring is required, it is the responsibility of the contractor which means much more expense.

Project size, quality and location, timeframe given to the project, market condition will also need to be considered whenever cost estimation is involved.

2.2.3.3. Challenges to Cost Estimation

The industry faces so many difficulties and problems every step of the way. One major challenge is cost estimation through the bidding process which could lead to different unwanted problems. This study assesses the issues related to cost estimation in selected companies.

A reasonable cost estimate means an estimate that is not too high so a company won't lose the bid and not too low so a company won't get loss rather it is an estimate that allows a company to generate a rational profit once a project is handed over. Followed are the challenges faced in order to get a reasonable cost estimate (Amade, 2014):

- Availability of cost for materials / machineries: the cost for materials might not be locally available so as to identify the cost.
- Volatile market condition: the market condition might show an increase or a decrease at a certain point in time. Inflation of cost creates a big problem as you can never be too sure of the actual cost for a specific material
- Work load / experience of the cost estimator: the assigned estimator being inexperienced greatly affects the cost estimation. The estimator could also be well-experienced but there could be too many projects that need to be submitted which might make him/her lose focus due to the load.
- Complexity in the nature of the project: the nature of the project also creates a problem as complex project require too much time and experience.
- Low involvement of the top management: the involvement of the top management is mandatory but due to different engagements, they fail to take part in the estimation process.
- Poor calculation of overhead costs: failure to calculate the previously mentioned overhead costs will put the whole project in jeopardy.
- Clarity of bid document in terms of drawing and specification: the client might fail to clearly prepare the bid document. Since the estimator fills the cost based on the provided bid document, the contractor fails to deliver the project just because the document is not prepared efficiently.

This and different challenges like carelessness, failure to visit site might make project completion very difficult, even impossible, if it's not well thought of.

2.2.4. The Construction Industry and Ethiopia

Developing countries face different challenges with respect to the construction industry and their economy are currently confronted by severe difficulties owing to a combination of lower commodity prices, higher energy costs, falling exchange rates and rising inflation (Ofori, 2001). Ethiopia, as a developing country, is striving to meet the needs of the people in the construction aspect. There are different public and private completed and ongoing constructions that are either contracted to a Chinese or Ethiopian company throughout the country. Through the process, there are many challenges the clients or contractors face. This research work considers the challenges faced due to cost estimation.

In Ethiopia, whenever there is a large project concerned, the client goes through a bid process. Professionals in the client side will prepare a bid document; interested and qualified contractors will buy the document and have the technical as well as the financial document filled by their employees. Financial document is the document where by any costs related to the project will be estimated and filled. In the financial filling process, most companies use a specific cost estimating technique in which they'll go around looking for suppliers, provide the needed materials and collect a proforma. Based on the proforma collected from different suppliers, they'll consider the profit, overhead and other issues like labor or machineries and fill out the document. The cost estimated has to be reasonable as it will be compared with other contractor's document to win the bid.

In order to win a bid, contractors compromise the estimate, as less cost means a more chance to involve in the project. When the estimate is compromised, it would create a huge problem in the overall process. Inaccurate cost estimates have significant effects on project delivery, and thus give rise to cost overrun, financial loss, unnecessary risk, loss of reputation and credibility of estimator, claims and disputes on construction projects (Awosina, 2018). In Ethiopia's case, projects might even halt because of that; which creates a catastrophe to the client, the contractor and the country as a whole.

2.3. Empirical Studies

Factors Affecting Effective Project Cost Management on Nashcon Construction PLC mentions poor allocation of direct, indirect and joint cost as one of the problems (Azanaw, 2018) in which one of the reason is the estimated cost during submission of the bid document.

Assessment of Project Cost Overrun for the case of Ethiopian Shipping and Logistics Services Enterprise Construction Projects selected six projects to perform the assessment on to deduce that the projects are under budgeted (Tesfaye, 2018). As a solution, the research work states the concerned bodies should make realistic cost estimation.

Factors affecting Project Cost and Time Overrun on Addis Ababa University Building Projects also pointed out improper planning and poor scope definition (Mulugeta, 2018) as one of the different challenges.

Evaluating Construction Project Performance on Pillars Engineering PLC mentions the challenges faced in cost and time overrun status of the projects (Kibru, 2019).

Determinant Factors Affecting Schedule and Cost Overruns on Water/Sewerage Construction Projects figured out the top ten determinant factors affecting schedule delay perceived by the client, consultants, and contractors. Some factors are bureaucracy in Government agencies, Government tendering system of choosing the lowest bidder, escalation of local material prices, ineffective project planning and scheduling, and insufficient estimation of original contract duration (Mulu, 2019).

As can be seen from the above research works, cost estimation plays a significant role on whether a project is handed over to the client with the right quality or not. Provided a good project management, with the right cost estimate in consideration with all issues, can guarantee an excellence in delivery.

2.4. Conceptual Framework

Based on the theoretical and empirical studies performed above, the following conceptual framework was generated.

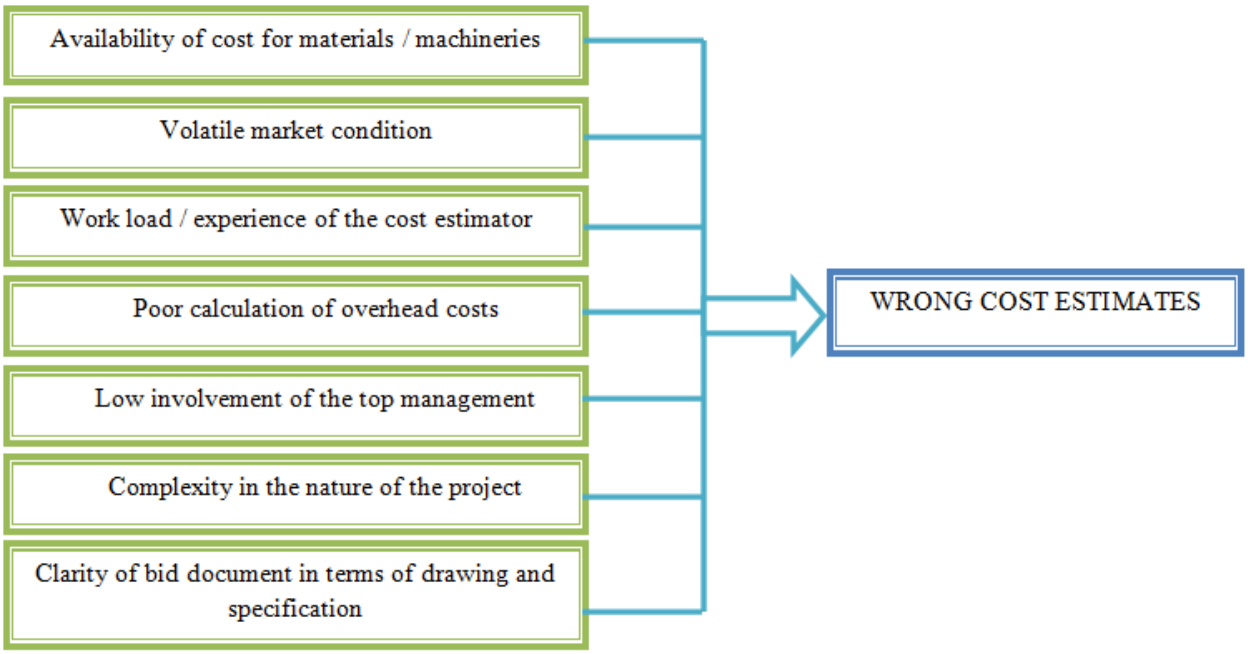

Figure 2.4. Conceptual framework (Self developed by researcher)

Chapter Three
Research Methodology

3.1. Introduction

"Research is a systematic study of a problem attacked by a deliberately chosen strategy which starts with choosing an approach to preparing blue print (design) acting upon it in terms of designing research hypotheses, choosing methods and techniques, selecting or developing data collection tools, processing the data, interpretation and ends with presenting solution/s of the problem" (Grover, 2015). Thus, to move further with this study, this chapter incorporates research approach, design, population and sampling, and data collection. The sample size determination, the analysis tools and the presentation model used in this research work is also mentioned in this chapter. Afterwards, the collected data will be analyzed so as to uncover and discuss about results in the next chapter.

3.2. Research Approach and Design

3.2.1. Research Design

Research design is the framework of research methods and techniques chosen by a researcher. The design allows researchers to work on research methods that are suitable for the subject matter and set up their studies up for success (Bhat, 2020). Bhat also mentions that the key elements of a research design are the methods used for the implementation of collecting and analyzing data, type of research methodology used, data sources selected, measurement taken and the time line stated for the research work.

The type of research design used in this study is descriptive research in which survey is used as a tool. This is so because an interview and a questionnaire is provided to the respondents and based on the survey, the collected data is statistically analyzed to draw conclusions. Cross-sectional design was also used in this research work so as to look at the prevailing characteristics in the construction industry. It also helps in providing information about what is currently happening related to cost estimation while trying to involve in a construction project

3.2.2. Research Approach

"Research approaches are plans and the procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation" (Creswell, 2017). Given a specific approach, data is collected, analysis methods are selected and the collected data is analyzed, interpreted and presented with a finding. Thus, choosing the right type of approach helps in coming up with a good plan in which a good plan generates a good result.

Creswell mentioned that there are three types of research approaches:

i) Qualitative
ii) Quantitative
iii) Mixed

A research is said to be qualitative if it is descriptive or exploratory, that is, if it tries to answer the 'why' and 'how' of the specific question where as a research is quantitative if it can be measured and expressed in numerical form. On the contrary, mixed approach is a combination of the two. There are situations where you have to measure and require an explanation of your data at the same time; that's when you use a mixed approach.

This study uses a mixed approach because based on the collected data, there is a situation where the data has to be measured and a situation where the data collection method has explanatory questions. For example, the respondent might get to choose an answer from the provided options; in this case, the number of respondents who chose a specific answer is counted and it will help in coming up with a deduction. During an interview, the respondent might also need to explain why challenges, for example, are caused due to cost estimate in the construction industry; this also helps in seeing the perspective of the respondent so as to lead to a finding. That is why mixed approach is used in this study since both qualitative and quantitative data are available and might be deduced.

3.3. Description of Study Variables

The major variables considered in this project work are availability of cost for materials / machineries, work load / experience of the cost estimator, complexity in the nature of the project, low involvement of the top management, poor calculation of overhead costs and clarity of bid

document in terms of drawing and specification. These are the variables that could lead to wrong cost estimates and in order to identify which challenges are mostly experienced, questionnaire was disseminated to bodies that are directly involved in the estimation process.

3.4. Types, Sources of Data and Data Collection Method

The types of data used in this research work are both qualitative and quantitative data. The survey given to respondents is closed and the interview is going to be open-ended which makes the data quantitative and qualitative respectively.

Both primary and secondary data sources are used in this study. The primary data sources used in this study are collected through methods of:

- **Interview**: An interview to the general managers, deputy general managers and project managers is conducted so as to get a grasp of how the overall process is performed in the selected six grade one construction companies.
- **Questionnaire**: questionnaire is distributed to the office engineers who work as cost estimation experts in the construction companies so the assessment would be easier to manage and to see the different perspectives of the people involved in the process.

Secondary data sources like research articles and books have been reviewed to clearly realize appropriate cost estimate, approaches and the challenges faced in the construction industry. The main tool used for secondary data is the Internet.

3.5. Target Population and Sample Design

The target population for this research work is grade one contractors. For conducting a questionnaire, out of the 133 grade one building contractors mentioned in PPA, 45 companies have been chosen. From the selected 45 companies, two office engineers that are experts in the cost estimation process are chosen to fill the questionnaire. And for the interview, 6 grade one contractors have been chosen which are EteteConstruction, Bamacon Engineering PLC, Messay Oli Construction PLC, Akwos Construction PLC, Genale Construction PLC and Dawit Emiru BC. As mentioned earlier, interview is conducted with the general managers, deputy general managers and project managers; these people also fill the questionnaire and the interview is

carried out just to see their point of view. Out of the many projects a contractor is pursuing, one specific project has been selected and the project manager for that project is interviewed.

Due to the prevailing conditions like not being able to freely communicate with a group of people, data availability and time constraint, convenience sampling technique has been chosen. Yamane's model was use to determine the confidence level in which the formula is:

$$n = \frac{N}{1+N*e^2}$$

Where:

n is sample size
N is population size
e is margin of error

Which according to this study is:

$$45 = \frac{133}{1+133*e^2}.$$

This makes e (the margin of error) 8.05 which means the confidence level is 91.95%.

3.6. Data Analysis and Presentation

In the process of data analysis, both quantitative and qualitative methods were used. A questionnaire was analyzed by quantitative method using SPSS as a tool. More than 130 variables were created from the questionnaire. For questions that only require choosing one option, one variable were created. For questions that might have more than one response, all the options were taken as a variable in which the options provided were selected or not selected. This helps in encoding all the options the participants selected. For every choice of a variable, consecutive numbering was used; meaning 1 was used for a certain option then 2, based on the number of options available. This could make it easier to encode the data as only numbering would be used.

After all data was encoded, the output was generated for every variable. Based on that, a summary of all variables were depicted in a tabular form and each and every findings were discussed. Interview was analyzed by qualitative method which would help to cross check or clarify and cross check the reliability of the data collected through questionnaire. It was then discussed and summarized in combination with the questionnaire.

3.7. Ethical Considerations

Bell (Bell, 2007) in "The Ethics of Management Research: An Exploratory Content Analysis" mentions the eleven categories of ethical principles including harm to participants, dignity, informed consent, confidentiality, anonymity, deception, affiliation, honesty and misrepresentation. Through this research process, no physical, psychological or privacy related harm will be caused to any participants and they are fully informed of everything they participate in. The individuals' or organizations' anonymity will be protected and dishonesty or misleading information will be avoided. Any professional or personal relationship that may affect or influence the study is stated.

Any data used from secondary documents is cited and the questionnaire has been prepared with full honesty so as to reach the goal of this study. The confidentiality of the participants is also secured in the questionnaire filling process or any other data collection methods. This study will do no harm what so ever for the construction industry rather it will guide them to a better solution and it is of mutual benefit to the researcher as well as the participants as it tries to come up with a solution for the problems caused due to cost estimation.

Chapter Four
Results and Discussion

4.1. Introduction

This chapter mainly discusses about the results that are generated from this research work. It mentions the number of participants that were involved in responding to the questionnaire and the interview conducted and their experience in the industry as well as the educational level. It clearly describes the cost estimation approaches that the companies use, the cost consideration in the process, the challenge they face that leads to produce inaccurate estimate, the number of ways they follow to overcome the challenges and other issues.

Each and every questionnaire was interpreted and discussed one by one basing up on the results in the previous sub section and the interview conducted. This chapter clearly discusses about the data collected in the close-end questions and the frequencies that a specific answer was obtained in percentage as per the statistics collected from the SPSS. The data was then analyzed and interpreted. Starting from subtopic 4.3, results and discussions are organized orderly based on the research questions. The interview conducted was interpreted in the required subtopics and Annex F shows the interview response of every participant.

4.2. Response Rate and Demographic Data

As a data collection method, questionnaire and interview was chosen and prepared as can be seen on annexes A & B. As mentioned in chapter three, 45 grade one building contractors (listed in annex C) were selected in which two office engineers were chosen to fill the questionnaire. Six construction companies were also selected to collect questionnaire and conduct interview on the general managers, deputy general managers and project managers of those companies. This results in a total of 108 questionnaires.

Table 4.1. Total questionnaire collected and the participant's position

Categories of Respondents based on position	No of respondents	No of respondents in %
General Manager	5	5.2
Deputy General Manager	4	4.2
Project Manager	6	6.3
Office Engineer	81	84.4
Total	**96**	**100.0**

(Own Survey, 2020)

Out of the 108 questionnaires, 96 questionnaires (88.9%) were collected from the participants. The remaining 12 (11.1%) questionnaires were not collected because two companies of the selected don't have deputy general managers and the rest were not volunteer to respond on time. Unfortunately, none of the participants bothered to answer the extra open-ended questions which was why interview was conducted to some of the office engineers in addition to the managers.

Table 4.2. Educational background summary of the participants

Educational Background	No of respondents	No of respondents in %
BSc	91	94.8
MBA	5	5.2
Total	**96**	**100.0**

(Own Survey, 2020)

94.8% of the participant's educational background, meaning 91 out of the 96 participants, is Bachelor of Science and 5.2%, that is 5 out of 96 participants, is Masters in Business Administration.

Table 4.3. Experience of the participants

Experience	No of respondents	No of respondents in %
Less than 3 Years	17	17.7
3 to 5 Years	34	35.4
6 to 10 Years	27	28.1
above 10 Years	18	18.8
Total	**96**	**100.0**

(Own Survey, 2020)

In the level of experience, 35.4% of the participants are in the range of three to five years of experience while 28.1% have six to ten years. Respondents below three years and above ten years experience are less than 20%.

4.3. Practice of Cost estimation approaches

This and the next subtopic discuses about the results in relation to the actual practice of the respondents reply on cost estimation approach used. The people that directly involve in the cost estimation process are the office engineers in which the respondents were 70people out of the 81. The response to whether they use an estimation approach or not is depicted in table 4.4 in which 53 people (75.7%) selected 'yes' and 17people (24.3%) chosen 'no'.

Table 4.4. Practice of cost estimation approaches

Practice of cost estimation approach	**No of respondents**	**No of respondents in %**
Yes	53	75.7
No	17	24.3
Total	**70**	**100**

(Own Survey, 2020)

The participants who answered 'yes', that is 53respondents, were asked to choose the type of approach they use. The following is the result of the cost estimation approach used by the respondents.

Table 4.5. Types of approach used by respondents among the 53 participants

Approach	**No of respondents**	**No of respondents in %**
Cost-based approach	27	50.94
Analogous estimating	1	1.8
Three-point estimating	2	3.77
Don't know the name	23	43.39
Total	**53**	**100**

(Own Survey, 2020)

Thus, out of the 75.7% who said they use an approach, 50.94% of the respondents mentioned that they use the easiest of all approaches, which is cost based approach and 43.39% of the respondents don't know the name of the approach they are using. Those who didn't know the name of the approach were also interviewed so as to get the notion of the type they are using.

After interviewing the participants who chose 'I don't know the name', it was realized that they are also using cost based approach which is an approach that bases up on individual material cost without considering other external factors. This type of approach only considers direct cost and other costs that need to be considered are just put in some percentage; those costs will not be estimated independently which creates a huge problem based on the complexity of the project.

4.4. The practice of the 12step GAO estimation process

The detailed twelve GAO steps to cost estimation were provided in the questionnaire as it would help in knowing which individual steps the companies usually follow. The Likert scale was used as a mechanism, given every detailed step, the respondents can either choose Always, Frequently, Occasionally, Rarely and Never. Since the process is detailed, the sample data analyzed by the use of SPSS and the summary in percentage can be seen in the annexes D & E.

The participants were 70office engineers who are directly involved in the cost estimation process and the main points will be summarized as follows. Thus, 81.4% of the respondents replied that they rarely use cost estimating approach and 12.9% of the respondents replied that they never use cost estimation approach. From this, one can understand that the use of cost estimation approach is not applicable or contractors don't use any formal approach to estimate the cost.

Regarding training and support, 74.3% of the participants responded that they've never attended or experienced any training and support session which makes it obvious that contractors are not building the capacity of their employees. It also states 86.6% of the respondents replied that they clearly define what the estimate includes and excludes but 88.6% of the participants responded that they never identify schedule or budget constraints, inflations assumptions and travel costs in their estimate. Thus, it can be understood that costs directly related to a project are the only considerations taken into account.

84.3% of the respondents never consider technological assumptions and new technologies to be developed which implies contractor's notion of adapting to new technology to reduce cost or add value is also poor. 68.6% of the participants responded that they never collect data and normalize it to consider it for cost accounting and analysis of the effects of inflation, learning curve and quantity adjustments; 88.6% also said they never analyze the data for its severity and probability.

From the above data, it can be deduced that documents of previous data for future use and increasing of learning curve is not practiced by contractors. This will expose contractors to deal with the effect of inflation and other issues that negatively affect their performance because of their poor effort to increase their learning from experience and documented data.

Cronbach's alpha was used to measure the internal consistency or reliability as Likert scale has been used to respond to the 12step GAO questions. Reliable calculator created by Del Siegle was used and the result can be seen in the table below in which the respondents are 70, the questions incorporated were 76 and the Cronbach's Alpha is 0.96 which indicates a high level of internal statistics.

Table 4.6. Reliability statistics

Cronbach's Alpha	0.9633658			
Split-Half (odd-even) Correlation	0.9322261			
Split-Half with Spearman-Brown Adjustment	0.9649245			
Mean for Test	265.22857			
Standard Deviation for Test	35.744399			
KR21 (use only 0 and 1 to enter data for this)	1.5370902		Questions	Subjects
KR20 (use only 0 and 1 to enter data for this)	1.6064463		76	70

(Own Survey, 2020)

4.5. Considerations incorporated in Estimation

Subtopic 4.5 up to 4.7 discusses the considerations taken into account during cost estimation. The listed considerations the estimators incorporate in the estimate were direct cost, indirect cost, overhead cost, sunk cost, risk and opportunity cost, project size, project quality, location, time and market condition.

Table 4.7. Respondents who have agreed consideration taken during estimation among the 70 participants

Considerations taken during estimation	No of respondents	No of respondents in %
Direct cost	69	98.57
Indirect cost	58	82.86
Overhead cost	47	67.14
Sunk cost	1	1.43
Risk and opportunity cost	18	25.71

Project size	32	45.71
Project quality	48	68.57
Project location	15	21.43
Time	22	31.43
Market Condition	64	91.43

(Own Survey, 2020)

98.57% of the participants chose direct cost while 91.43% chose market condition and 82.86% considered indirect cost as major costs while preparing the estimates. The major parts of estimation like risk and opportunity cost (25.71%) and project location (21.43%) were not given more emphasis according to the respondents reply. Therefore, contractors are not considering their opportunities and risks while estimating project cost and mostly traditional ways are considered while calculating overhead.

4.6. Risk and Opportunity cost considerations and factors

As to the consideration of future risk and opportunity costs, the respondents were asked whether they consider risk and opportunity costs in their estimates or not; and if they do consider it, the factors they consider were listed.

Table 4.8.Consideration of future risk and opportunity costs

Consideration of risk and opportunity cost	**No of respondents**	**No of respondents in %**
Yes	21	30
No	49	70
Total	**70**	**100**

(Own Survey, 2020)

Out of the 70 responders, 21 participants responded ‘yes’ (30%) and 49people (70%) selected ‘no’ as depicted in the above table.

Table 4.9. Respondents who have agreed to consideration taken during estimation among the 21 participants

Factors considered as risk and opportunity cost	**No of respondents**	**No of respondents in %**
Weather condition	11	52.38
Error in design or specification	8	38.1

Changes in design	7	33.33
Access to site	7	33.33
Site protection	4	19
Labor productivity	15	71.43

(Own Survey, 2020)

Only 30% of the participants consider future risk and opportunity costs in their estimates. Even from the considered risk and opportunities, labor productivity takes 71.43% and weather condition takes 52.38%. However, major issues like site protection and access to site have low rating. These issues directly affect the contractors' performance and financial capacity since access to site and site protection are the responsibility of the contractor according to the general condition of contract prepared by PPA.

If there is no access to site, the contractor has to move machines and do everything necessary to get access as machineries and cars have to go in to dump and collect materials necessary for the completion of the project. Thus, the contractor will be required to spend different unknown expenses just because the responsible person failed to visit the site and mentioned there is no access; the same goes for site protection. This kinds of necessary but unspecified cost will play a huge role in loss which in worst case leads to termination of the project.

4.7. Overhead costs

When trying to produce an accurate estimate, overhead costs are one of the major costs to be considered. The major overhead costs to be considered were listed and the response is depicted in the following table.

Table 4.10. Respondents who have agreed on the overhead cost considerations among the 70 participants

Overhead costs considered during estimation	**No of respondents**	**No of respondents in %**
Office expenses	9	12.86
Staff salary	14	20
Miscellaneous cost	8	11.43
Depreciation expense	1	1.43
Job overhead costs	26	37.14
Project specific salaries	49	70
Temporary office facilities	4	5.7

Other temporary enclosures	3	4.28
Temporary utilities	8	91.43

(Own Survey, 2020)

Out of the mentioned overhead costs, project specific salaries (70%) and job overhead (37.16%) are the only considerations with relatively high ratings. However, according to the interview made, it was realized that these cost are included as some percentage of the direct cost. The direct calculation of overhead costs is not done and it is not even clear to the respondents. Depreciation expenses and temporary office facilities are not given much thought although they should be considered with great emphasis to ensure the sustainability of the company.

4.8. Challenges of Cost Estimation

Based on the data analyzed and the findings, this subtopic incorporates the explanation and interpretation of the challenges caused by cost estimation before a bid is won, after project handover and the major difficulties in preparing an accurate cost estimate.

4.8.1. Challenges in Competing

The first close-end question related to cost estimation was the challenges companies face in trying to compete in or win a bid. The mentioned challenges were unreasonable price by other contractors, corrupted bidding procedures, over-estimating, clarity of bid document in terms of drawing and specification, office engineer's capacity to provide good estimate and project location.

Table 4.11. Respondents who agreed to major challenges in competing in / winning a bid among the 96 participants.

Challenges in competing in a bid	**No of respondents**	**No of respondents in %**
Unreasonable price by other contractors	89	92.7
corrupted bidding procedures	82	85.4
over-estimating	17	17.7
clarity of bid document	45	46.9
limited capacity of the office engineer	21	21.9
Project location	7	7.3

(Own survey, 2020)

Since the participant can choose more than one option in this question (and others as well), the options were analyzed as 'selected' or 'not selected' in SPSS. Selected means the option was chosen by the participant and not selected means the vice-versa. Thus, as it can be seen in the above table, the respondents who selected unreasonable cost estimate by other contractors as a major challenge to compete in or win a bid are large in number. Corrupted bidding procedure (85.4%) is the second reason selected by the participants as another challenge. This was also considered as the biggest issue because contractors will bribe the employees of the client to make them win regardless of the consequences.

The major reason behind the unreasonable cost as per the additional interview response is contractors trying to stay in business and debt that needs to be paid will make them restless. No matter the difficulty in the future, whenever a bid is won, projects generate advance payment and contractors use the advance payment as a pain killer to release them from the financial stress. Unfortunately, what they don't want to understand is that this is only a short time solution as the new project will create more problems since it's poorly estimated.

4.8.2. Challenges after site handover

Out of the respondents, people involved in the cost estimation process are 72.9% and the ones not directly involved are 26% as can be seen in table 4.5. All of the respondents that are involved in the estimation process are office engineers. Although there are 81 participants whose position in the company is office engineer, the ones involved in the process are 70. This is so because the rest of them are not directly involved, they are the ones in charge of the coordination from the interview that has been gathered.

Table 4.12. Involvement in cost estimation process

Involvement in the estimation process	**No of respondents**	**No of respondents in %**
Direct Involvement	70	72.9
Indirect Involvement	26	27.1
Total	**96**	**100**

(Own Survey, 2020)

Respondents that are not directly involved in the cost estimation process were 26, which are five general managers, four deputy general managers, six project managers and eleven office

engineers. They were required to fill additional two questions, which are challenges related to cost estimation and budgeting after project handover discussed here and how they overcome those challenges to be discussed in the next subtopic.

Table 4.13. Respondents who have agreed to challenges after handover among the 26 participants

Challenges after site handover	**No of respondents**	**No of respondents in %**
Failure to maintain construction quality	12	46.15
Failure to maintain project time	23	88.45
Failure to deliver the purpose of the project	5	19.2
Financial loss	17	65.38
Shifting of resources from one project to another	21	80.76

(Own Survey, 2020)

In addition to the questionnaire, they were also interviewed so as to get a good grasp of the subject in concern. 88.45% and 80.76% of the respondents agreed failure to maintain time and shifting of resources from one project to another respectively, as a major challenge after project handover.

From the interview that was also conducted, failure to maintain time is a major issue because of financial issues they will be forced to pend the project at hand. Pending of the project means the contractors won't get any interim payments as they have stopped the project temporarily. In order to move forward, they must shift resources from one project to the other or get a new project and use the advance payment of that new project to continue the pending one which creates a loop.

Financial loss was also mentioned as a huge challenge by 65.38% of the participants. Since they shift resources, they will affect the other project. Whenever there is payment, it will keep on being distributed to fill the different holes available in which no profit will be generated; worst case is financial loss.

4.8.3. Difficulties in preparing reasonable estimate

70 of the respondents directly involved in the estimation process were also asked the difficulties in preparing a reasonable cost estimate.

Table 4.14. Respondents who have agreed difficulties in preparing reasonable estimate among the 70 participants

Difficulties in preparing reasonable estimate	**No of respondents**	**No of respondents in %**
availability of cost for materials	49	98.57
availability of cost for machineries or fixtures locally unavailable	51	82.86
volatile market condition	62	67.14
workload of the estimator	19	1.43
complexity in the nature of the project	19	45.71
low involvement of the top management	29	68.57
experience of the estimator	36	21.43
poor calculation of overhead costs	29	31.43
clarity of bid document in terms of drawing and specification	29	91.43

(Own Survey, 2020)

From the options provided under major difficulties in preparing reasonable cost estimate, 88.57% of the participants responded volatile market condition as a major reason. Availability of cost of materials and machineries were 70% and 72.86% respectively. In the interview conducted from top management, they also mentioned experience of the estimator as a barrier. It was stated that, even though they are experienced, work load and negligence to fill the estimate carefully sometimes plays a role in the loss of the company. If the negligence creates a major problem in the estimate and if that was observed after project handover, it was mentioned that contractors might be subjected to terminate the project early which becomes a waste of time for the contractor and will diminish the image of the company.

4.9. Ways to overcome challenges

This subtopic discusses about ways to surmount the challenges caused due to cost estimation. The top management and 11 of office engineers were asked if there are ways to overcome those challenges faced due of inaccurate cost estimation.

Table 4.15. Respondents who have agreed on ways to overcome challenges among the 26 participants

Ways to overcome challenges	**No of respondents**	**No of respondents in %**
Training cost estimators	10	38.46
shifting of resources from one project to another	21	80.77
changing the specification of the materials	17	65.38
terminating the contract on time	9	34.61

(Own Survey, 2020)

The same 26 participants were the respondents for the ways to overcome the challenges faced due to inaccurate cost estimation and an interview was conducted for this one as well. From the data analyzed and the summary below, 80.77% of the respondents selected shifting of resources from one project to another as a solution. It was stated that contractors will shift materials from active site to another to decrease client pressure because of poor performance emanating from failure to deliver the required resource on site. This is a short term solution and is also considered as a problem because it is going to affect the performance of additional active projects and will put the company in jeopardy.

Changing the specification of the material mentioned in the contract and treating them as variation was also chosen by 65.38% of the participants. It has been mentioned in the interview that contractors are also forced to pay informally to the client representatives and consultants to change the material to a higher cost and treat it as a variation. This is again a problem for the client as it would incur additional cost for the changed material.

Chapter Five
Conclusion and Recommendation

5.1. Introduction

This research work mainly tried to assess the practices and challenges of project cost estimation in grade one building construction companies in which the basic notion was to identify the type of cost estimation technique companies are using, how those companies are accomplishing each and every step, the considerations taken while estimating, the challenges encountered in trying to win a bid or after they won and ways to overcome those challenges.

Provided the objectives and an aim to answer the research questions, a questionnaire and an interview were prepared and 45 companies were selected. From those companies, 108 respondents were chosen which are 90 office engineers (two from each company), 6general managers, 6 deputy general managers and 6 project managers. The office engineers were chosen because they are the people directly related to the estimation process. The other management staffs were selected because they have experience in that as they might have passed through that process and can still be directly or indirectly involved. Due to the time constraint and other current issues that limit us from contacting a lot of people, convenience sampling was used.

The questionnaire was prepared and disseminated; 96 filled questionnaires were replied. Out of the returned questionnaires, 81 were from office engineers (70 from people directly involved in the estimation and 11 from those that coordinate and assess the estimates), 5 were from general managers, 4 was from deputy general managers (2 were missing because the selected companies didn't have deputies) and 6 was from project managers (each project manager selected from 1 company). Additional interview was conducted on 26 participants (general managers, deputy general manager, project managers and the 11 office engineers).

After data was collected, SPSS was used as a tool to analyze and produce results. Each and every close-end questions were encoded in to the tool and based on the data encoded, analysis of the results was performed.

5.2. Summary of Findings

Of the 96 respondents, 94.8% were BSc and 5.2% were MBA holders and with respect to experience, 17.7% chose less than 3years, 35.4% chose 3 to 5years, 28.1% chose 6 to 10year and 18.8% chose above 10years.

As to the challenges in competing, 92.7% selected unreasonable price by other contractors, 85.4% selected corrupted bidding procedures and 46.9% selected clarity of bid document. The participants directly involved in the bidding procedure were 72.9% and those that are indirectly involved were 27.1%. And in response to the challenges caused after site handover, 88.45% chose failure to maintain project time and 80.76% chose shifting of resources from one site to another. Those that are directly involved in the estimation process were also asked about the difficulties in preparing a reasonable cost estimate and 70% chose availability of cost for materials, 72.6% selected availability of cost for machineries or fixtures locally unavailable and volatile market condition were chosen by 88.57% of the participants.

Participants that are indirectly involved in the estimation process were asked to check the ways they use to overcome the challenges caused by cost estimation and training cost estimators was selected by 38.46%, shifting of resources from one project to another was chosen by 80.77% and changing the specification of the materials mentioned in the contract and treating the item as variation were chosen by 65.38% of the participants. As to the response to whether they use an estimation approach or not, 75.7% selected ‘yes’ and 24.3% chosen ‘no’ and out of the 75.7% who responded they use an approach, 94.33% said they use cost-based approach based on the questionnaire and the interview conducted.

The practice of the 12step GAO estimation process was also taken in to account and Cronbach’s alpha was used to measure the reliability which is 0.96 that implies a high level of internal statistics. For considerations taken in to account while cost estimating, 98.57% chose direct cost, 91.43% chose market condition and 82.86% selected indirect cost. 30% of the participants responded that they consider risk and opportunity cost as a factor and of those respondents, labor productivity and weather condition was chosen by 71.43% and 52.38% respectively. As to the overhead cost consideration, 70% chose project specific salaries was and 37.14% chose job overhead costs.

5.3. Conclusion

After the results have been retrieved on the data collected from the questionnaire as well as the interview, the following conclusions were drawn.

The challenges were divided in to three; challenges in trying to win a bid, after a bid is won and challenges in preparing a reasonable cost estimate. Based on the analysis, the main challenge (related to estimation) in trying to win a bid is the unreasonable cost that is submitted by other contractors. The reason other contractors perform under-estimation is the desperate measure they take in trying to stay in business. They also want to take the relieve off of paying the different debt they might have on different organizations or banks from the advance payment collected. But advance payment is collected from the client to capacitate the contractor in performing his duties in the specific project and solve any cash shortage that will hinder the performance of the project.

Major issues faced after project handover is the failure to finish the project on the set time frame. This is so because contractors will be forced to pause the project due to inaccurate cost estimates and if they are not making any progress, they can't claim for any interim payment as they won't be able to prepare any payment certificate. This will give rise to shifting of resources from one project to another. This is also mentioned as a challenge which in turn will create a problem of pausing other active projects. It's obvious that financial loss is going to be another challenge caused due to improper cost estimation as resources keeps being dispersed to different projects trying to fill different gaps. The problem with many contractors is that they always try to solve the current small complications regardless of the major catastrophes that might be caused in the future.

The main difficulties mentioned in preparing a reasonable cost estimate are volatile market condition and the cost for materials, machineries or fixtures being unavailable. In addition, the interview with the top management also disclosed inexperience and negligence in the cost estimators that might go as little as not getting the profit margin they anticipated and as huge as termination of the project.

Shifting of materials from active site to another was also mentioned as one of the chief ways to surmount the challenges faced after project handover. This would help the contractors as stress reliever that is imposed by the client. Changing the specification of the material mentioned in the contract and treating it as variation was also stated as a major means to overcome the challenge. In order to change the specification, contractors have to pay illegal fee to the consultants and representatives of the client as it would help them to give new and somehow enormous price for the new material.

As to the approach they use, many participants chose cost-based approach which is assumed to be the easiest approach that mainly considers direct cost. Different other costs like overhead cost, risk and opportunity cost won't be contemplated; they would just put a 20% or 25% addition of the total cost by considering it as overhead plus profit. This is an inaccurate way of cost estimation because the costs other than direct cost could clearly exceed the provided percentage.

The above and other reasons imply that many contractors don't consider their opportunities and risks while estimating project cost and those that do, only consider weather condition and labor productivity as a main factor. Factors like site protection and access to site have low score though these issues greatly affect the financial stability of the contractor as it is the responsibility of the company to assess and include it in the financial bid document.

As it can be seen in the above paragraph, the direct calculation of overhead costs is not performed, just a percentage of the direct cost. From the interview conducted, it was analyzed that it is not clear to the respondents what kind of costs to include as overhead costs because they are only used to putting a 25% addition to the total direct cost. Main factors like depreciation expenses, temporary office facilities, enclosures and utilities are not realized although they are the costs that ascertain the permanence of the company.

With respect to the 12 steps GAO estimation process, the respondents one way or another use some of the detailed steps. And some indicate that contractors fail to build the capacity of their estimators by giving trainings, estimators don't follow a formal usage of estimation approach, and costs other than direct costs are not considered. It has been deduced that contractors have a hard time in trying to perform tasks by adapting new technology so as to reduce costs or time exerted in a certain project. And since contractors are poor in documenting data and performing

analysis of previous projects performed, they might be obliged to make the same mistake again and fail to improve on the tasks being performed as there is no learning from previous data or experience.

5.4. Recommendation

This subsection entails the recommendation of this research work based on the data collected, analyzed, interpreted and presented. From the issues mentioned and discussed so far, this study suggests the following recommendations:

- Contractors should adopt a suitable cost estimation approach which will be applicable to the company and consider all the necessary cost considerations and lessons learned (estimated financial document and actual project output) that could help them in future decision making and in improving their learning curve.

- Contractors must give consideration to Overhead cost that must be identified and calculated independently and not just as some percentage of the direct cost. Calculating the overhead cost like depreciation cost and other expenses is necessary for the sustainability of the company.

    - Risk and opportunity costs should also be clearly specified. Site visit is mandatory for considering risk and opportunity costs like site protection and access to site. Thus, the responsible person should visit the site and see if it needs access to site or site protection and make the necessary calculation based on the observation.

- To avoid the challenges of cost estimation, Clients must hire their own professional cost estimators that estimate a project from start to end. Whenever a bid is placed, they will compare it to the estimation that they've performed and pass it if and only if it is within the margin of the estimation. This would avoid the notion of least evaluated bidder which in turn circumvent unreasonable cost estimate.

- Cost estimators must be trained by professionals who have mastered cost estimation so as they could be able to grasp the approach they need to use for their industry, the different costs that need to be considered whenever estimation is performed.

- Contractors must be open to adapting new technologies related to the field as it would help in saving their time as well as money.

- Government statistics agencies report on inflation and related issues every month. Contractors should follow the report and deduce the inflation curve as it would help in forecasting the future costs of materials.

If these recommendations are strictly taken in to account, challenges related to cost estimation in the construction industry can be minimized and project completion with the given time frame can be guaranteed making the clients and the contractor satisfied and sustaining the development of the country.

5.5. Suggestion for further Studies

Due to the time constraint and the prevailing conditions, this project work has focused on assessing the practice and challenges of project cost estimate in selected grade one building construction companies in Addis Ababa. The following are suggestions for further studies:

- Assessment on the practice and challenges of cost estimate can be performed on other construction sectors like road, waterworks, electro-mechanical engineering etc in the country as a whole.

- Researchers can come up with an effective calculation of making overhead costs easier. Software can be developed which can be updated and customized as per the company's needs.

- Study of the best cost estimation approach for the construction industry can be performed so companies could adapt and use the approach as per their desire.

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ANNEX

Annex A– Questionnaire

Subject:-Request to participate in a research work

Dear Sir/Madam,

My name is Alula Alebachew and I'm a post graduate student in department of Project Management at Addis Ababa University, School of Commerce. I am doing my postgraduate research work on "**Assessment on practice and challenges of project cost estimate in selected Grade One building construction companies in Addis Ababa".** For successful commencement of this study, to look into the issues from different perspectives by involving professionals who have experience in the construction industry is mandatory which is why I kindly request you to spare some time to look in to the next 4 pages of questionnaire and respond to the questions stated.

Your honest and correct response is highly appreciated to produce a fruitful result.

Thanking you in advance for your time and consideration!

Yours Sincerely,

Alula Alebachew

Addis Ababa University

School of Commerce

Part I ~ General Issues

1. How long is your work experience in construction industry?
   - ☐ Less than 3 years
   - ☐ From 3 to 5 years
   - ☐ From 6 to 10 years
   - ☐ Above 10 years
2. What is your educational background?
   - ☐ Diploma
   - ☐ BSc
   - ☐ MSc
   - ☐ MBA
   - ☐ PhD
   - ☐ If others, please specify. _____
3. What is your position in this firm?
   - ☐ General Manager
   - ☐ Deputy General Manager
   - ☐ Project Manager
   - ☐ Office Engineer
4. What are the challenges you face in trying to compete in /win a bid?
   - ☐ Very low / unreasonable price by other contractors
   - ☐ Corrupted bidding procedures
   - ☐ Over-estimating
   - ☐ Clarity of bid document in terms of drawing and specification
   - ☐ Office Engineer's capacity to provide good estimate
   - ☐ Project location
5. Are you involved in the cost estimation process?
   - ☐ Yes
   - ☐ No
6. If your answer to **Q#4** is **NO**:

   6.1. Please mention some of the challenges related to cost estimation and budgeting after project handover.

☐ Failure to maintain construction quality

☐ Failure to maintain project time

☐ Failure to deliver the purpose of the project

☐ Loss

☐ Shifting of resources from one project to another

If others, please specify.

_____

_____

_____

_____

6.2. Provided the challenges, how do you overcome them?

☐ Train cost estimators for other projects

☐ Shifting of resources from one project to another

☐ Changing the specification of the material mentioned in the contract and treating the item as variation

☐ Terminating the contract on time

If others, please specify.

_____

_____

_____

_____

7. If your answer to Q#4 is **YES**, please proceed to **part II.**

Part II ~ for a professional involved in the cost estimation process

1. Do you use a cost estimation approach?

☐ Yes

☐ No

2. If your answer to Q#1 is YES, which of the following approach do you use?

☐ Cost based Approach

☐ Analogous Estimating

☐ Three-point Estimate

☐ Bottom-Up Estimating

☐ I don't know the name

3. Given the 12step GAO estimation process, tick (✓) on the frequency of occurrence your company might perform while preparing detailed estimates.

Steps	**Frequency (Using Likert Scale)**				
	Always	Frequently	Occasionally	Rarely	Never
Initiation and Research					
Step 1: Define Estimate's Purpose					
Determine estimate's purpose, required level of detail, and overall scope					
Determine who will receive the estimate					
Step 2: Develop Estimating Plan					
Determine the cost estimating team and develop its master schedule					
Determine who will do the independent cost estimate					
Outline the cost estimating approach					
Develop the estimate timeline					
Assessment					
Step 3: Define Characteristics					
Identify the estimation purpose and its system and performance characteristics and all system configurations					
Any technology implications					
The estimation acquisition schedule and acquisition strategy					
The relationship to other existing systems, including predecessor or similar legacy systems (example previous data and experience)					
Support (manpower, training, etc.) and security needs and risk items					
System quantities for development, test, and production					
Deployment and maintenance plans as part of the estimation					
Step 4: Determine Estimating Approach					

Define a work breakdown structure (WBS) and describe each element in a WBS dictionary (a major automated information system may have only a cost element structure)					
Choose the best estimating method for each WBS element					
Identify potential cross- checks for likely cost and schedule drivers					
Develop a cost estimating checklist					
Step 5: Identify Rule and Assumptions					
Clearly define what the estimate includes and excludes					
Identify global and program-specific assumptions, such as the estimate's base year, including time-phasing and life cycle					
Identify program schedule information by phase and program acquisition strategy					
Identify any schedule or budget constraints, inflation assumptions, and travel costs					
Specify equipment the government is to furnish as well as the use of existing facilities or new modification or development					
Identify prime contractor and major subcontractors					
Determine technology refresh cycles, technology assumptions, and new technology to be developed					
Define commonality with legacy systems and assumed heritage savings					
Describe effects of new ways of doing business					
Step 6: Obtain Data					
Create a data collection plan with emphasis on collecting current and relevant technical, programmatic, cost, and risk data					
Investigate possible data sources					
Collect data and normalize them for cost accounting, inflation, learning, and quantity adjustments					
Analyze the data for cost drivers, trends, and outliers and compare results against rules of thumb and standard factors derived from historical data					
Interview data sources and document all pertinent information, including an assessment of data reliability and accuracy					
Store data for future estimates					
Step 7: Develop Point Estimate (estimate between the best and worst case extremes)					
Develop the cost model by estimating each WBS element, using the best methodology, from the data collected					
Include all estimating assumptions in the cost model					

Express costs in constant-year dollars					
Time-phase the results by spreading costs in the years they are expected to occur, based on the program schedule					
Add the WBS elements to develop the overall point estimate					
Provided the overall point estimate					
Validate the estimate by looking for errors like double counting and omitted costs;					
Compare estimate against the Independent Cost Estimate (ICE) and examine where and why there are differences					
Perform cross-checks on cost drivers to see if results are similar;					
Update the model as more data become available or as changes occur and compare results against previous estimates					
Analysis					
Step 8: Conduct Sensitivity Analysis					
Test the sensitivity of cost elements to changes in estimating input values and key assumptions					
Identify effects on the overall estimate of changing the program schedule or quantities					
Determine which assumptions are key cost drivers and which cost elements are affected most by changes					
Step 9: Conduct Risk and Uncertainty Analysis					
Determine and discuss with technical experts the level of cost, schedule, and technical risk associated with each WBS element					
Analyze each risk for its severity and probability					
Develop minimum, most likely, and maximum ranges for each risk element					
Determine type of risk distributions and reason for their use					
Ensure that risks are correlated					
Use an acceptable statistical analysis method (e.g., Monte Carlo simulation) to develop a confidence interval around the point estimate					
Identify the confidence level of the point estimate					
Identify the amount of contingency funding and add this to the point estimate to determine the risk-adjusted cost estimate					
Recommend that the project or program office develop a risk management plan to track and mitigate risks					
Step 10: Document the Estimate					
Document all steps used to develop the estimate so that a cost analyst unfamiliar with the program can recreate it quickly and produce the same result					

Document the purpose of the estimate, the team that prepared it, and who approved the estimate and on what date					
Describe the program, its schedule, and the technical baseline used to create the estimate					
Present the program's time-phased Life-Cycle Cost (LCC)					
Discuss all ground rules and assumptions					
Include auditable and traceable data sources for each cost element and document for all data sources how the data were normalized					
Describe in detail the estimating methodology and rationale used to derive each WBS element's cost					
Describe the results of the risk, uncertainty, and sensitivity analyses and whether any contingency funds were identified					
Document how the estimate compares to the funding profile					
Track how this estimate compares to any previous estimates					
Presentation					
Step 11`: Present Estimate to Management					
Develop a briefing that presents the documented Life-Cycle Cost Estimate (LCCE);					
Compare the estimate to an ICE and explain any differences;					
Compare the estimate (LCCE) or IAC to the budget with enough detail to easily defend it by showing how it is accurate, complete, and high in quality;					
Focus in a logical manner on the largest cost elements and cost drivers;					
Make the content clear and complete so that those who are unfamiliar with it can easily comprehend the competence that underlies the estimate results;					
Make backup slides available for more probing questions;					
Act on and document feedback from management;					
Request acceptance of the estimate					
Step 12: Update Estimate					
Update the estimate to reflect changes in technical or program assumptions or keep it current as the program passes through new phases or milestones;					
Replace estimates with Earned Value Management (EVM) Estimate at Completion (EAC) and independent EAC from the integrated EVM system;					
Report progress on meeting cost and schedule estimates;					
Perform a post mortem and document lessons learned for elements whose actual costs or schedules differ from the estimate;					

Document all changes to the program and how they affect the cost estimate					

4. What consideration do you incorporate in your estimate? (you can choose more than one)

   ☐ Direct Cost
   ☐ Indirect Cost
   ☐ Overhead Cost
   ☐ Sunk Cost
   ☐ Risk and Opportunity Cost
   ☐ Project Size
   ☐ Project quality
   ☐ Project location
   ☐ Time
   ☐ Market condition

5. What is the major difficulty in preparing reasonable cost estimate?

   ☐ Availability of cost for materials
   ☐ Availability of cost for machineries / fixtures which are not locally available
   ☐ Volatile market condition
   ☐ Work load of the cost estimator
   ☐ Complexity in the nature of the project
   ☐ Low involvement of the top management
   ☐ Experience of the estimator
   ☐ Poor calculation of overhead costs\
   ☐ Clarity of bid document in terms of drawing and specification

6. Do you consider future risks or opportunities in your cost estimation?

   ☐ Yes
   ☐ No

6.1. If your answer to Q#6 is **YES**, what kind of risk/opportunity factors do you consider?

   ☐ Weather condition
   ☐ Errors in design or specification
   ☐ Changes in design
   ☐ Access to site
   ☐ Site protection

- ☐ Labor productivity

7. If you consider overhead costs, what kind of costs do you consider?
   - ☐ Office Expenses
   - ☐ Staff salary
   - ☐ Miscellaneous indirect overhead costs (like travel expense, marketing and advertisements, legal fees, contracted professional expenses like auditors, charitable donations)
   - ☐ Depreciation expense
   - ☐ Job overhead costs
   - ☐ Project Specific Salaries
   - ☐ Temporary office facilities
   - ☐ Other temporary enclosures (like storage spaces, railing, ramps, walls or protections)
   - ☐ Temporary utilities (like temporary water, electricity, generator, sanitation facilities, temporary toilets, drinking water

Annex B – Interview

To General Managers (5people), Deputy General Managers (4people) , Project Managers (6people), Office Engineers (11people)

1. Why do you think contractors quote very low or unreasonable prices?
2. In competing in a bid or after site handover, what do you consider as a major challenge and why?
3. How do you calculate overhead costs?

To office engineers who use a cost estimation approach but don't know the name

1. How is cost estimated?

Annex C

Companies chosen for data collection

No	Grade One Building Contractor
1	Adam Construction (Samuel Bogale)
2	Africawit Construction PLC
3	Mesay Oli B.C
4	Alas Construction PLC
5	Atem Building Contractor
6	Bamacon Engineering P.L.C.
7	Beha Consturction (Behailu Tefera Seifu)
8	Bereket Endashaw Building Contractor
9	Berhan Tobiaw Mareye
10	Bright Construction PLC
11	Crafts Construction PLC
12	Dawit Girmay Building Contractor
13	Demera Engineering Construction
14	Dugda Construction PLC
15	Elmiolindo Construction P.L.C.
16	Equator Engineering Construction PLC
17	Etete Construction
18	FE Construction PLC
19	Flintstone Engineering
20	GAD Construction PLC
21	Genale Construction PLC
22	Giga Con.P.L.C. (G/Hiwot Girmay)
23	Gutema Firisa Building Contractor
24	Justice Building Contractor P.L.C.
25	Kassa & Sons Construction P.L.C.
26	Koracon Construction
27	Kulubi Construction
28	Lorat Construction
29	Lucy Engineering P.L.C.
30	Magercon P.L.C.
31	Mela Engineering & Construction P.L.C.
32	Melcon Construction PLC
33	N.K.H. Construction P.L.C.
34	Nasew Construction P.L.C.
35	Orbit Engineering & Construction P.L.C.
36	Radar Construction
37	Rama Construction PLC

38	SA Construction P.L.C.
39	Santa Maria Construction P.L.C.
40	Tiku Berhane Building Contractor
41	Tilahun Abebe General Contractor
42	TNT Construction
43	United Construction P.L.C.

45 selected companies for data collection

Annex D

Sample Data collected and analyzed for the GAO 12step process on SPSS tool (70 respondents)

Frequency of Determine estimate's purpose, required level of detail, and overall scope	No of respondents	No of respondents in %
Always	5	7.1
Frequently	46	65.77
Occasionally	18	25.7
Rarely	1	1.43
Total	70	100

Step 1 Defining Estimates' Purpose: Determine estimate's purpose, required level of detail, and overall scope

Frequency of Collect data and normalize them for cost accounting, inflation, learning, and quantity adjustments	No of respondents	No of respondents in %
Always	2	2.85
Frequently	1	1.43
Occasionally	2	2.85
Rarely	17	24.3
Never	48	68.57
Total	70	100

Step 6 Obtain Data: Collect data and normalize them for cost accounting, inflation, learning, and quantity adjustments

Frequency of Collect data and normalize them for cost accounting, inflation, learning, and quantity adjustments	No of respondents	No of respondents in %
Always	1	1.43
Frequently	1	1.43
Occasionally	2	2.85
Rarely	29	41.44
Never	37	52.85
Total	70	100

Step 12 Update Estimate: Document all changes to the program and how they affect the cost estimate

Annex E

Summarized Data collected and analyzed for the GAO 12step process in percentage (out of 70 respondents)

Steps	Frequency (Using Likert Scale)				
	Always	Frequently	Occasionally	Rarely	Never
Initiation and Research					
Step 1: Define Estimate's Purpose					
Determine estimate's purpose, required level of detail, and overall scope	7.1	65.7	25.7	1.4	0
Determine who will receive the estimate	85.7	10	2.9	1.4	0
Step 2: Develop Estimating Plan					
Determine the cost estimating team and develop its master schedule	7.1	4.3	20	61.4	7.1
Determine who will do the independent cost estimate	12.9	84.3	1.4	1.4	0
Outline the cost estimating approach	1.4	1.4	2.9	81.4	12.9
Develop the estimate timeline	37.1	60	1.4	1.4	0
Assessment					
Step 3: Define Characteristics					
Identify the estimation purpose and its system and performance characteristics and all system configurations	2.9	0	32.9	21.4	42.9
Any technology implications	2.9	0	32.9	22.9	41.4
The estimation acquisition schedule and acquisition strategy	0	31.4	62.9	4.3	1.4
The relationship to other existing systems, including predecessor or similar legacy systems (example previous data and experience)	17.1	17.1	7.1	54.3	4.3
Support (manpower, training, etc.) and security needs and risk items	4.3	1.4	1.4	18.6	74.3
System quantities for development, test, and production	7.1	20	8.6	37.1	27.1
Deployment and maintenance plans as part of the estimation	1.4	1.4	36.2	5.8	55.1
Step 4: Determine Estimating Approach					
Define a work breakdown structure (WBS) and describe each element in a WBS dictionary (a major automated information system may have only a cost element structure)	12.9	18.6	14.3	30	24.3
Choose the best estimating method for each WBS element	3.8	1.3	2.5	43.8	48.8
Identify potential cross- checks for likely cost and schedule drivers	4.3	71.4	21.4	2.9	0
Develop a cost estimating checklist	1.4	78.6	8.6	11.4	0
Step 5: Identify Rule and Assumptions					
Clearly define what the estimate includes and excludes	2.9	88.6	5.7	2.9	0
Identify global and program-specific assumptions, such as the estimate's base year, including time-phasing and life cycle	4.3	24.3	64.3	7.1	0

	Identify program schedule information by phase and program acquisition strategy	1.4	11.4	1.4	65.7	20
	Identify any schedule or budget constraints, inflation assumptions, and travel costs	1.4	7.1	1.4	1.4	88.6
	Specify equipment the government is to furnish as well as the use of existing facilities or new modification or development	5.7	38.6	20	28.6	7.1
	Identify prime contractor and major subcontractors	22.9	42.9	34.3	0	0
	Determine technology refresh cycles, technology assumptions, and new technology to be developed	1.4	0	5.7	8.6	84.3
	Define commonality with legacy systems and assumed heritage savings	11.4	0	28.6	47.1	12.9
	Describe effects of new ways of doing business	0	1.4	2.9	31.4	64.3
Step 6: Obtain Data						
	Create a data collection plan with emphasis on collecting current and relevant technical, programmatic, cost, and risk data	1.4	37.1	31.4	30	0
	Investigate possible data sources	1.4	74.3	22.9	1.4	0
	Collect data and normalize them for cost accounting, inflation, learning, and quantity adjustments	2.9	1.4	2.9	24.3	68.6
	Analyze the data for cost drivers, trends, and outliers and compare results against rules of thumb and standard factors derived from historical data	0	1.4	0	31.4	67.1
	Interview data sources and document all pertinent information, including an assessment of data reliability and accuracy	0	0	10	28.6	61.4
	Store data for future estimates	12.9	55.7	30	1.4	0
Step 7: Develop Point Estimate (estimate between the best and worst case extremes)						
	Develop the cost model by estimating each WBS element, using the best methodology, from the data collected	25.7	35.7	35.7	2.9	0
	Include all estimating assumptions in the cost model	2.9	0	28.6	64.3	4.3
	Express costs in constant-year dollars	0	1.4	0	4.3	94.3
	Time-phase the results by spreading costs in the years they are expected to occur, based on the program schedule	1.4	2.9	1.4	65.7	28.6
	Add the WBS elements to develop the overall point estimate	32.9	44.3	15.7	1.4	5.7
Provided the overall point estimate						
	Validate the estimate by looking for errors like double counting and omitted costs;	32.9	58.6	8.6	0	0
	Compare estimate against the Independent Cost Estimate (ICE) and examine where and why there are differences	21.4	1.4	37.1	1.4	38.6
	Perform cross-checks on cost drivers to see if results are similar;	37.1	21.4	37.1	1.4	2.9
	Update the model as more data become available or as changes occur and compare results against previous estimates	0	38.6	35.7	18.6	7.1
Analysis						
Step 8: Conduct Sensitivity Analysis						
	Test the sensitivity of cost elements to changes in estimating input values and key assumptions	18.6	0	0	7.1	74.3

	Identify effects on the overall estimate of changing the program schedule or quantities	8.6	41.4	45.7	4.3	0
	Determine which assumptions are key cost drivers and which cost elements are affected most by changes	30	41.4	27.1	1.4	0
Step 9: Conduct Risk and Uncertainty Analysis						
	Determine and discuss with technical experts the level of cost, schedule, and technical risk associated with each WBS element	11.4	20	0	35.7	32.9
	Analyze each risk for its severity and probability	4.3	0	4.3	2.9	88.6
	Develop minimum, most likely, and maximum ranges for each risk element	1.4	2.9	4.3	11.4	80
	Determine type of risk distributions and reason for their use	1.4	2.9	4.3	4.3	87.1
	Ensure that risks are correlated	1.4	1.4	2.9	5.7	88.6
	Use an acceptable statistical analysis method (e.g., Monte Carlo simulation) to develop a confidence interval around the point estimate	0	1.4	10	10	78.6
	Identify the confidence level of the point estimate	0	4.3	4.3	7.1	84.3
	Identify the amount of contingency funding and add this to the point estimate to determine the risk-adjusted cost estimate	0	1.4	2.9	7.1	88.6
	Recommend that the project or program office develop a risk management plan to track and mitigate risks	1.4	0	8.6	11.4	78.6
Step 10: Document the Estimate						
	Document all steps used to develop the estimate so that a cost analyst unfamiliar with the program can recreate it quickly and produce the same result	15.7	30	28.6	25.7	0
	Document the purpose of the estimate, the team that prepared it, and who approved the estimate and on what date	1.4	5.7	51.4	31.4	10
	Describe the program, its schedule, and the technical baseline used to create the estimate	1.4	7.1	48.6	31.4	11.4
	Present the program's time-phased Life-Cycle Cost (LCC)	0	4.3	4.3	77.1	14.3
	Discuss all ground rules and assumptions	11.4	5.7	4.3	4.3	74.3
	Include auditable and traceable data sources for each cost element and document for all data sources how the data were normalized	14.3	42.9	38.6	2.9	1.4
	Describe in detail the estimating methodology and rationale used to derive each WBS element's cost	2.9	2.9	2.9	70	21.4
	Describe the results of the risk, uncertainty, and sensitivity analyses and whether any contingency funds were identified	0	4.3	7.1	8.6	80
	Document how the estimate compares to the funding profile	0	4.3	5.7	14.3	75.7
	Track how this estimate compares to any previous estimates	0	43.5	35.5	14.5	6.5
Presentation						
Step 11`: Present Estimate to Management						
	Develop a briefing that presents the documented Life-Cycle Cost Estimate (LCCE);	21.4	42.9	30	1.4	4.3
	Compare the estimate to an ICE and explain any differences;	0	4.3	4.3	4.3	87.1
	Compare the estimate (LCCE) or IAC to the budget with enough detail to easily defend it by showing how it is	0	1.4	5.7	5.7	87.1

accurate, complete, and high in quality;					
Focus in a logical manner on the largest cost elements and cost drivers;	1.4	1.4	7.1	5.7	84.3
Make the content clear and complete so that those who are unfamiliar with it can easily comprehend the competence that underlies the estimate results;	1.4	1.4	5.6	5.6	86.1
Make backup slides available for more probing questions;	1.5	1.5	6	3	88.1
Act on and document feedback from management;	30	38.6	28.6	2.9	0
Request acceptance of the estimate	29	34.8	34.8	1.4	0
Step 12: Update Estimate					
Update the estimate to reflect changes in technical or program assumptions or keep it current as the program passes through new phases or milestones;	27.1	24.3	28.6	20	0
Replace estimates with Earned Value Management (EVM) Estimate at Completion (EAC) and independent EAC from the integrated EVM system;	0	2.9	4.3	10	82.9
Report progress on meeting cost and schedule estimates;	27.1	35.7	30	2.9	4.3
Perform a post mortem and document lessons learned for elements whose actual costs or schedules differ from the estimate;	0	5.7	0	34.3	60
Document all changes to the program and how they affect the cost estimate	1.4	1.4	2.9	41.4	52.9

Annex F

Participants response to the conducted interview

Top Management interview response to the three questions raised (a total of 26 respondents)

Respondents	Raised Questions		
	Reason for unreasonable price	**Major challenge in competing and after site handover**	**How do u calculate Over head cost**
Respondent 1	To win a bid and stay in business	Shifting of resources Pending project for some time Not being able to get interim payment	As percentage of direct cost
Respondent 2	To be relieved from debt stress To win a bid and stay in business	Low price by other contractors Failure to maintain time	As percentage of direct cost
Respondent 3	To engage the resources of the company	Pending the project Not being able to get interim payments	As percentage of direct cost
Respondent 4	To get advance payment	Financial loss	As percentage of direct cost
Respondent 5	To be relieved from debt stress To win a bid and stay in business	Unreasonable price by other contractors	As percentage of direct cost
Respondent 6	To be relieved from debt stress To win a bid and stay in business	Inexperience of estimators Workload and negligence of estimators	As percentage of direct cost
Respondent 7	To win a bid and stay in business	Shifting of resources	As percentage of direct cost
Respondent 8	To win a bid and stay in business	Shifting of resources	As percentage of direct cost
Respondent 9	To be relieved from debt stress To win a bid and stay in	Low price by other contractors Failure to maintain time	As percentage of direct cost

	business		
Respondent 10	To be relieved from debt stress To win a bid and stay in business	Low price by other contractors Failure to maintain time	As percentage of direct cost
Respondent 11	To be relieved from debt stress To win a bid and stay in business	Financial loss	As percentage of direct cost
Respondent 12	To win a bid and stay in business	Inexperience of estimators Workload and negligence of estimators	As percentage of direct cost
Respondent 13	To be relieved from debt stress To win a bid and stay in business	Low price by other contractors Failure to maintain time	As percentage of direct cost
Respondent 14	To get advance payment	Low price by other contractors Failure to maintain time	As percentage of direct cost
Respondent 15	To get advance payment	Financial loss	As percentage of direct cost
Respondent 16	To win a bid and stay in business	Inexperience of estimators Workload and negligence of estimators	As percentage of direct cost
Respondent 17	To win a bid and stay in business	Financial loss	As percentage of direct cost
Respondent 18	To be relieved from debt stress To win a bid and stay in business	Inexperience of estimators Workload and negligence of estimators	As percentage of direct cost
Respondent 19	To be relieved from debt stress To win a bid and stay in business	Low price by other contractors Failure to maintain time	As percentage of direct cost
Respondent 20	To win a bid and stay in business	Financial loss	As percentage of direct cost
Respondent 21	To win a bid and stay in business	Financial loss	As percentage of direct cost

Respondent 22	To be relieved from debt stress To win a bid and stay in business	Inexperience of estimators Workload and negligence of estimators	As percentage of direct cost
Respondent 23	To be relieved from debt stress To win a bid and stay in business	Shifting of resources	As percentage of direct cost
Respondent 24	To be relieved from debt stress To win a bid and stay in business	Low price by other contractors Failure to maintain time	As percentage of direct cost
Respondent 25	To engage the resources of the company	Shifting of resources	As percentage of direct cost
Respondent 26	To get advance payment	Inexperience of estimators Workload and negligence of estimators	As percentage of direct cost

Respondents response to the interview conducted regarding type of estimate used (23respondents)

Respondents	Question Raised: how is cost estimated
Respondent 1	Collecting cost of materials, labor, and machinery rental price for direct cost calculation. The profit and over head is done as 35 % of percent of the total cost
Respondent 2	Estimating cost by considering the price of materials and deducting the cost of materials that are available in the company like formwork. Machinery rental price is also taken below market price to win the bid. Overhead and profit is taken 30% of the direct cost
Respondent 3	Cost estimation by discussing with sub contractors and suppliers. Adding 15% margin for over head and profit for subcontract work and 30% for materials supplied by suppliers.
Respondent 4	Collecting cost of materials, labor, and machinery rental price for direct cost calculation. The profit and over head is done as 35 % of percent of the total cost
Respondent 5	Estimating cost by considering the price of materials and deducting the cost of materials that are available in the company like formwork. Machinery rental price is also taken below market price to win the bid. Overhead and profit is taken 30% of the direct cost
Respondent 6	Collecting cost of materials, labor, and machinery rental price for direct cost

	calculation. The profit and over head is done as 35 % of percent of the total cost
Respondent 7	Cost estimation by discussing with sub contractors and suppliers. Adding 15% margin for over head and profit for subcontract work and 30% for materials supplied by suppliers.
Respondent 8	Estimating cost by considering the price of materials and deducting the cost of materials that are available in the company. Machinery rental price is also taken below market price to win the bid. Overhead and profit is taken 30% of the direct cost
Respondent 9	Cost estimation by discussing with sub contractors and suppliers. Adding 15% margin for over head and profit for subcontract work and 30% for materials supplied by suppliers.
Respondent 10	Estimating cost by considering the price of materials and deducting the cost of materials that are available in the company. Machinery rental price is also taken below market price to win the bid. Overhead and profit is taken 30% of the direct cost
Respondent 11	Estimating cost by considering the price of materials and deducting the cost of materials that are available in the company. Machinery rental price is also taken below market price to win the bid. Overhead and profit is taken 30% of the direct cost
Respondent 12	Cost estimation by discussing with sub contractors and suppliers. Adding 15% margin for over head and profit for subcontract work and 30% for materials supplied by suppliers
Respondent 13	Cost estimation by discussing with sub contractors and suppliers. Adding 15% margin for over head and profit for subcontract work and 30% for materials supplied by suppliers.
Respondent 14	Collecting cost of materials, labor, and machinery rental price for direct cost calculation. The profit and over head is done as 35 % of percent of the total cost
Respondent 15	Estimating cost by considering the price of materials and deducting the cost of materials that are available in the company. Machinery rental price is also taken below market price to win the bid. Overhead and profit is taken 30% of the direct cost
Respondent 16	Cost estimation by discussing with sub contractors and suppliers. Adding 15% margin for over head and profit for subcontract work and 30% for materials supplied by suppliers.
Respondent 17	Collecting cost of materials, labor, and machinery rental price for direct cost calculation. The profit and over head is done as 35 % of percent of the total cost
Respondent 18	Estimating cost by considering the price of materials and deducting the cost

	of materials that are available in the company. Machinery rental price is also taken below market price to win the bid. Overhead and profit is taken 30% of the direct cost
Respondent 19	Collecting cost of materials, labor, and machinery rental price for direct cost calculation. The profit and over head is done as 35 % of percent of the total cost
Respondent 20	Cost estimation by discussing with sub contractors and suppliers. Adding 15% margin for over head and profit for subcontract work and 30% for materials supplied by suppliers.
Respondent 21	Collecting cost of materials, labor, and machinery rental price for direct cost calculation. The profit and over head is done as 35 % of percent of the total cost
Respondent 22	Cost estimation by discussing with sub contractors and suppliers. Adding 15% margin for over head and profit for subcontract work and 30% for materials supplied by suppliers.
Respondent 23	Collecting cost of materials, labor, and machinery rental price for direct cost calculation. The profit and over head is done as 35 % of percent of the total cost