ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF MANAGEMENT

COST ESTIMATION PRACTICES OF EMERGING CONTRACTORS OF ETHIOPIA:

THE CASE OF ADDIS ABABA BASED LOCAL CONTRACTORS

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FEBRUARY 2017

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COST ESTIMATION PRACTICES OF EMERGING CONTRACTORS OF ETHIOPIA: THE CASE OF ADDIS ABABA BASED LOCAL CONTRACTORS

By

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, COLLEGE OF BUSINESS AND ECONOMICS, DEPARTMENT OF MANAGEMENT IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE DEGREE OF EXECUTIVE MASTERS IN BUSINESS ADMINISTRATION (EMBA)

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DECLARATION

I, Samuel Mengistu Benti, hereby declare that the work which is being presented in this thesis entitled "Cost Estimation Practices of Emerging Contractors of Ethiopia: The case of Addis Ababa based Local Contractors" is an original work of my own and prepared under the guidance of my thesis supervisor Ato Teshome Bekele. It has not been presented for any scholastic achievement and level of study (Bachelors or Masters or PhD programs) in any other Institute, College and University. All the sources of the materials used in this dissertation paper have been duly acknowledged.

_____

Samuel Mengistu Benti

This is to certify that the above declaration made by candidate is correct to the best of my knowledge.

_____

Teshome Bekele (Ato)

February, 2017

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February, 2017

This paper is dedicated to my beloved brother, the late Michael Mengistu who passed away on 21st of September, 2009. You shall not be forgotten Bro.

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Thank you all

Samuel Mengistu

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ACRONYMS

AACE	Association for the Advancement of Cost Engineering
AoA	Analysis of alternatives
AURA	Association of Universities for Research in Astronomy
CIPS	Chartered Institute of Procurement and Supply
DOE	Department of Energy (US)
DTMR	Department of Transport and Main Roads
EAC	Estimate at Completion
EOI	Expression of Interest
EVM	Earned Value Management
FDRE	Federal Democratic Republic of Ethiopia
GAO	Government Accountability Office (US)
GSA	General Service Administration (US)
ICEAA	International Cost Estimating and Analysis Association
ISO	Chartered Institute of Purchasing and Supply
ISPA	International Society of Parametric Analysts
MoD	UK Ministry of Defense
NASA	National Aeronautics and Space Administration
NJDOT	New Jersey Department of Transport
PMBOK	Project Management Body of Knowledge
PPA	Public Procurement Agency
RFT	Request for Tender
TxDOT	Texas Department of Transportation
UTAS	University of Tasmania
WBS	Work Breakdown Structure
WSDOT	Washington State Department of Transportation

ABSTRACT

The construction sector in Ethiopia is one of the critical economic institutions in the economic development of the country. However, some firms, in this sector seem to fail quickly. And many have faced difficulty in winning tenders in bidding stage. Consequently this research has the objectives of analyzing tender cost estimation practice, identifying deficiencies requiring remedial actions and recommending solutions that can enhance the performance of local emerging construction firms. The population used was restricted to Addis Ababa based emerging construction firms. The population of 412 firms registered as Grade 5 and above, from the different category of contractors is studied. To address the research objective 135 samples are selected based on snowball sampling method and questionnaire is distributed from which 98 sample respondents replied appropriately to the questionnaire. The literature was reviewed on cost estimation and related aspects. The research tool used was a questionnaire. Data gathered are analyzed using statistical tools. As a result the study revealed that: cost estimation is one of the major causes that aggravate emerging contractors deprived success in tendering. Likewise with regard to leading practices related to quality cost estimates, the study found out that the performance of emerging contractors towards cost estimation requirements is low. Emerging firms are advised to make internal policy or guidelines for developing high quality cost estimates, to practice/ adopt a method that utilizes risk identification and uncertainty analysis techniques and to implement a system of integrated cost estimating practice via utilization of the twelve cost estimating tasks in order to ensure a high quality estimate.

Keywords: Cost estimation, Quality estimates, estimation methods, tendering

Chapter 1- INTRODUCTION

1.1 Background

The role, the construction industry plays in socio-economic development of developing countries is significant. This is due to the fact that it embraces a significant portion of both gross national product and of employment. Certainly, the creation of physical facilities constitutes more than one-half of the gross domestic investment of both developed and developing nations. In countries like Ethiopia, it corresponds to more than 60% of public capital investment. The construction industry also plays a key role in satisfying a wide range of physical, economic, and social needs and contributes significantly to the fulfillment of various major national goals. The industry's size, the nature of its operation, and its presence in every developmental activity make it an attractive area for the transfer, adoption, and development of technologies consistent with the development goals of emerging nations (Rossow, 1976).

As in most developing economies, the available civil infrastructure in Ethiopia (roads, rails, air- and sea-ports, residential and industrial buildings) is far from adequate. As such, its significance in a growing and reforming economy such as Ethiopia can hardly be exaggerated. This fact seems to be appreciated by the government which has recently launched extensive and visible construction activities in roads, Dams, rail ways, Industrial & Residential buildings and expansion of airports.

The performance of construction projects in Ethiopian construction industry is far below international standards conferring to various reports from local news media. As an example, failed construction firms, failed projects, abandoned projects, bankruptcy of construction companies and project cost overruns are some of identifications which are repeatedly stated. All these have varied negative impacts on the socio-economic development of the nation.

It is impracticable to see development of construction industry without development of construction firms. Construction firms are key and central role players of development of the industry. Majority of these firms are project based firms, which need to follow an extensive disciplines of project management principles in such a way that firms will be sustainably grow and ensure a continuing existence. Firms with poor utilization of project management practices are firms which are exposed to organizational feebleness, bankruptcy and even to failure.

Sound project management helps construction firms survive and sustain growth. The growth-oriented management strategy focuses on innovation that can increase the growth potential in the long term. Such a strategy is known to have a positive effect not only on firms' profitability but also on the company's survival in the long term. Although maintaining a high profit without growth is very difficult, growth is a crucial means for future value creation. Additionally, the growth of the firm promotes the development and survival of not just the firm itself but also that of the construction Industry of the country (Kim, 2015).

Survival and growth of a construction company depends on the number of its projects and the amount/profit they produce. The decline in construction activities led to negative annual growth rate. Sales are at the heart of every company, and construction is no exception. It is vital for firms to maintain steady stream of projects, increase its sales, make more revenue and bring in construction clients regularly.

The performance of construction industry of Ethiopia with regard to cost estimation is trivial. Among the industry, cases of project delays, abandonment, cost overrun, failure of projects and firms can be attributed to a large extent, to lack of adequate knowledge and practice of cost estimation principles during tendering stage. In addition to this, contractors initial cost estimate is one of the factors that determine the profit of the project at the end.

Poor estimates are categorized as one of the factors that hinder the firm to secure the anticipated profit amount from projects.

Cost estimating is one of the most important steps in construction sales. A cost estimate establishes the base line of the project cost especially at different stages of development of the project. A cost estimate at a given stage of project development represents a prediction provided by the cost engineer or estimator on the basis of available data. According to AACE (2016), cost engineering is defined as that area of engineering practice where engineering judgment and experience are utilized in the application of scientific principles and techniques to the problem of cost estimation, cost control and profitability.

This paper deals with one of the major problems that hinder the growth of the construction sector in general and emerging construction contractors in particular i.e. cost estimation. Accordingly, it will investigate the current cost management practices of contractors in depth in order to identify the particular areas which demand improvement interventions. It offers a result of analyzing practices of estimation in Ethiopia by assessing global best practices and conducting a survey for suggesting prerequisites for improvement. Moreover it would make a contribution to construction industry as a means of being the basis of systematical cost estimation performance analysis, and developing the practice in Ethiopia. By improving their practice, contractors can perform better in tender, maximize profit and consequently fulfill firm and project objectives. And, this is realized, to a satisfactory extent, through the implementation of best practices of cost estimations which ensures growth and survival of firms as well as the construction industry of the country.

1.2 Problem statement:

In Ethiopian, emerging local contractors seem to deviate from global best practices in estimating project costs. Among Many Local contractors, some of them seem to fail quickly. And many have faced difficulty in winning tenders in bidding stage. Poor track record of cost performance fuels this anxiety, to the extent that the potential for continued poor performance may very well jeopardize the anticipated development of the construction industry.

The subject of poor cost estimation practice has been widely addressed in different literature, (Shihunegn, 2014; Seeletse & Ladzani, 2012; Yadessa, 2015; Fetene, 2008). Nevertheless, the underlying responsibilities of the contractor in managing this chronic problem in the Ethiopian construction industry remain unclear. The main factors that are responsible for inadequate cost estimation practice among local emerging contractors are poorly understood. By performing an in-depth analysis of the roles and responsibilities of the contractor, this research is intended to unfold the industrywide perception of cost estimation performance being heavily reliant on the contractor's performance alone.

1.3 Research questions:

1. What is the status quo of emerging contractors cost estimation practice intended for construction bids in Ethiopia?
2. What are key problems of the current practice of these contractors?
3. What can be suggested to enhance estimating practice?

1.4 Research Objectives:

The research has the following objectives.

- To analyze project cost estimation practices, methods and processes utilized by emerging local contractors of Ethiopia
- Identify deficiencies requiring remedial actions
- Recommend solutions that can enhance the performance of emerging construction firms while estimating tender prices.

1.5 Significance

It is the author's belief that this research project is conducted to contribute for domestic construction industry in general and cost estimation practices of local contractors in particular. It attempts to present a guidance to provide sufficient basis on quality cost estimation practices. Hence, the significance or merit of this study lies in making a contribution to the understanding of the importance of appropriate cost estimation methods. Its findings have the following importance to local contractors, the industry and other stakeholders.

Construction firms will be benefited from this study. Findings of this research helps cost estimators of firms to develop quality cost information that business owners or managers, professional team members, and the firm itself to make informed decisions. Additionally these findings help the firm to perform better in tenders. As a result firms will sustainably grow and ensure a continuing existence.

Government as responsible stakeholder in establishing the policy for the construction industry will benefit from this study. Ethiopia doesn't have a cost estimation policy. Hence, the significance or merit of this research lies in making a contribution to government policy and decision maker's to make informed decision based on the research findings.

At the same time the finding of this research will benefit other stakeholders too. Besides helping in creation of stable and calm environment among stakeholders, research findings will, help clients in cash flow managements, supports investors in evaluation of project feasibility and assess the scope of work, serve consultants as a basis for job performance measurement, in contractor selection, as an exhibit in construction contract disagreement, and in post-work evaluation of completed jobs.

1.6 Scope and Limitation

Scope:-The scope of this research is studying cost estimation practices of emerging local contractors of Ethiopia. It concentrates on estimation at tender stage proposed by the construction entity.

Limitation:-The research addresses the existing cost estimation practice in Ethiopia. It discusses global best practices of cost estimation. Nevertheless the research is limited to cases in emerging local contractors who are based in Addis Ababa. It will not include the practices of experienced contractors. Moreover the paper is limited to cost estimation practice at tender stage.

1.7 Organization and contents of the research

This research comprises five chapters. Chapter one is the introductory chapter which provides basic information about the research including back ground and statement of the research problem, research objectives and limitations of the research. Accordingly, chapter two gives an overview of the construction projects procurement and contract planning process, theories and discussions related with cost estimation principles and guidelines. A brief discussion on global best practice of estimation is also included in this chapter. Chapter three covers the research methodology. It presents an overview of the research process, the research's approach and instrument, questionnaire design and rationale of the questions, the research sample selection and methods of analysis of the research's data. Chapter four presents analysis of the research data, findings of the research and discussions. The last chapter is devoted to the research's conclusions and recommendations.

Chapter 2- LITERATURE REVIEW

2.1 Cost Estimation

Cost estimation, which is a key factor that contributes to the success or failure of construction projects, is an essential element for successful project and program management if prepared with acceptable quality (DOE, 2011).

As defined by different literatures, cost estimating is:

- The process of collecting and analyzing historical data and applying quantitative models, techniques, tools, and databases to predict the future cost of an item, product, program, or task (ICEAA, 2013)
- A prediction of the quantity of resources needed to accomplish an activity or create an asset (Seeletse & Ladzani, 2012).
- The process of developing an approximation of the monetary resources needed to complete the project activity (PMBOK, 2008)

For the purpose of this paper cost estimation is defined as a process of inferring costs that is required to execute a task of project or any activity. In addition it can be defined as a forecasting process of cost/price of resources through developing an approximate financial resource that are necessary for the scope of an asset investment option, activity, or project. Cost estimates are essential inputs for budgeting, cost or value analysis, decision making in business, asset and project planning, or for project cost and schedule control processes. Besides professional experience, cost estimate is determined by calculating and forecasting the future cost of resources, methods, and management within a scheduled time frame, (AACE, 2007).

2.1.1 Purpose of Cost Estimate

Cost analysis is required whenever resources are allocated. Cost estimates are done for initial estimation to determine the feasibility of a project, studies, budgeting, proposals, etc. Scope, level of detail and Intended use are factors that determine the purpose of cost estimate, (DOE, 2011; Seeletse & Ladzani, 2012).

As stated in some literatures, (DOE, 2011; ICEAA, 2013), cost estimates have a general purpose such as:

- Help the owner to evaluate and select alternative solutions;
- Support the budget process by providing estimates of the annual funding and phased budget requirements required to efficiently execute work for a project or program;
- Establish cost and schedule ranges during the project development phases;
- Establish a Project Performance Baseline to obtain Critical Decision approval and to measure progress following the approval for a pictorial description of owners Critical Decision Process;
- Support Acquisition Executive approval for acquisition of supplies, services, and contracts; and
- Provide data for value engineering studies, independent reviews, and baseline changes (DOE, 2011).

More over as identified by ICEAA (2013), cost estimates can:

- Translate system/functional requirements associated with programs, projects, proposals, or processes into budget requirements
- Determine and communicate a realistic view of the likely cost outcome, which can form the basis of the plan for executing the work (ICEAA, 2013).

2.1.2 Benefits of Cost Estimating

Cost estimating helps in creating a platform to understand the project (ICEAA, 2013). Its benefits can be identified but not limited to as follows.

- Provides for the identification and objective quantification of the impact of project/ program risks (technical and schedule risks)
- Provides basis for evaluating competing systems/initiatives (cost/benefit analyses and AoAs)
- Enables proposal pricing and evaluation of proposals for cost reasonableness
- Captures cost impacts of design decisions to facilitate tradeoffs in CAIV/DTC/Target Costing
- Facilitates evaluation of the impact of new ways of doing business (e.g., in-sourcing vs. outsourcing, COTS vs. custom software) (ICEAA, 2013)

2.1.3 Application of Cost Estimates

According to (ICEAA, 2013), cost estimation can be used in different scenarios and some of its application include in helping decision makers to:

- Make decisions on program viability, structure, and resource requirements
- Establish and defend budgets
- Conduct Analysis of Alternatives (AoA)
- Create new business proposals and perform source selection
- Conduct in-process reviews of major projects
- Perform design trade-offs
- Assess technology changes

- Comply with public law
- Satisfy oversight requirements (ICEAA, 2013)

2.1.4 Limitations of Cost Estimating

As per the remark of ICEAA (2013), cost estimation is an inevitable component of project/ program/ portfolio management. Its importance and benefits cannot be undermined. However, it suffers from some limitations. Some of its limitations are listed below.

Cost estimating cannot:

- Be applied with cookbook precision
- Produce results that are better than input data, Garbage In, Garbage Out (GIGO)
- Predict political impacts
- Substitute for sound judgment, management, or control
- Make final decisions (ICEAA, 2013)

2.1.5 Key Requirements of Cost Estimation

GAO (2009) claims that, many projects are unrealistic and costs more compared to their primary estimate. This difficulty can be mitigated by setting key requirements, in order to ensure that project cost estimates are both internally and externally validated. According to GSA (2007), it is a good practice to allow project cost estimators to prefer and develop specific methodologies, techniques and procedures in such a way that they can satisfy their projects specific requirements. However their estimation shall be bounded in meeting four key requirements of cost estimation. Cost estimates shall be Accurate, Comprehensive, Well-documented and Credible, (GSA, 2007; GAO, 2009). Meeting these requirements

increases the confidence of stakeholders on the reasonableness and accuracy of the estimate.

2.1.5.1 Accurate

In accordance with GSA (2007) assertion, accuracy is one of key requirements of cost estimates, which requires cost estimates to be risk-adjusted as well as be properly adjusted for inflation.

Accurate estimates are estimates that are projected by means of most likely costs, adjusted for inflation properly, easy to adapt changes due to change in underlying assumptions or schedule, free from errors (if possible) (GAO, 2009). This requirement demands estimates to be free from optimistic as well as pessimistic projections.

As per the explanation of GSA (2007) and GAO (2009), checking for accuracy can be done by:

- Clearly understanding and investigating underlying assumptions, the methodology, the technique used, steps and procedures, and calculations.
- Verifying whether risk has been adjusted or not for every cost element of WBS of the project.
- Verifying whether each cost element of the estimate has been adjusted for inflation with proper escalation factors (GSA, 2007; GAO, 2009).

2.1.5.2 Comprehensive

GSA (2007) found out that this requirement seeks cost estimates to show all cost elements that are pertinent to the project in detail. Besides it demands that estimates to be free from double counted cost elements, (GSA, 2007; GAO, 2009).

Costs shall be estimated to a level of detail that can ensure every pertinent cost element is not lost, every possible cost have been considered, its completeness and consistency, (GSA, 2007; GAO, 2009). In addition to this, the level of detail shall assure that the estimate is free from double-counted cost elements.

Likewise GAO (2009) notes that comprehensive cost estimates can:

- describe the entire project,
- Show the consistency with the schedule, and
- Show technical reasonableness (GAO, 2009)

Comprehensiveness of an estimate can be examined against the estimate criteria and requirements. Moreover estimates shall be examined for considering all scope of the project against detailed WBS of the project (GAO, 2009). Meanwhile all assumptions and exclusions that are functions of the foundation of the estimate shall be checked in parallel, for their reasonableness and weather they are clearly identified and explained (GAO, 2009).

2.1.5.3 Well-documented

Remarks by GSA (2007) points that, a well-documented estimate helps to easily adjust or update the estimate, trace to original sources and creates ease of auditing (GSA, 2007). Well-documenting enhances the validity of cost estimates. A strict discipline in documenting creates ease of decision making for managers. Besides it enhances the credibility of the estimate (GAO, 2009). Some components of the document are but not limited to, sources of data collected, referenced date, estimation methodology, the technique used, steps and procedures, assumptions, calculations and results of each individual cost element (GAO, 2009).

Documents are required to be in a level of detail that can show the estimates quality during the period of investigation in an easy and traceable manner. It shall be also traceable and consistent along with the project schedule, milestones and deliverables (GAO, 2009).

2.1.5.4 Credible

GSA (2007), argues that data and assumptions are commonly anticipated to be exposed to uncertainty and bias. An estimate to be credible it shall clearly show the level of risk and uncertainties within its underlying assumptions and data (GSA, 2007). Sensitivity, risk and uncertainty analysis are tools that helps to define the degree of risk accompanying the estimate. Moreover this requirement demands the estimate to be verified and validated by independent body.

Sensitivity analysis, as elaborated by Karen et al, (1997), is one of tools that can determine credibility of an estimate. Estimates usually uses data and assumptions to calculate the expected cost element of a project. What if analysis will be conducted on assumptions to see whether the change in variables would change the final results drastically, slightly, or not at all? Sensitivity analysis clearly indicates how end results would be affected and also indicates the sensitivity of end results to changes in the values of specific variables while keeping other variables constant, (Karen et al, 1997; GAO, 2009; Martina, 2007; Iulian, 2011).

Risk and uncertainty analysis, as written by Staehr (2006), are another necessary tools in determining the credibility of an estimate. These analyses are able to show the variability in the estimate. Through these tools schedule changes, target changes as well as any proposed solutions can be modeled and analyzed. Using the outputs of these analyses, decision makers will be able to visualize the potential range of costs of the project so that they will be able to decide the reasonableness of the cost compared to their entire project portfolios, (Staehr, 2006; Anderson and Cherwonik, 1997; GAO, 2009; Kune et al, 2013).

It is believed that credibility of project cost estimates can best be determined thru Independent verification and validation, (Zelkowitz and IoanaRus, 2002). This ensures that entire procedures of the estimate are exhaustively reviewed in order to determine whether requirements of estimates to be satisfied are met or/ and validate, in such a way that it meets owners' business objectives. It is important for project owners to assign a third party that can conduct this. Independency allows this party to take an objective view while identifying high-risk areas early in the project so as one can mitigate risks and prepare contingencies along with the estimate, (O.Lewis, 1992; GAO, 2009; Zelkowitz and IoanaRus, 2002).

Likewise, Independent Validation and Verifications:

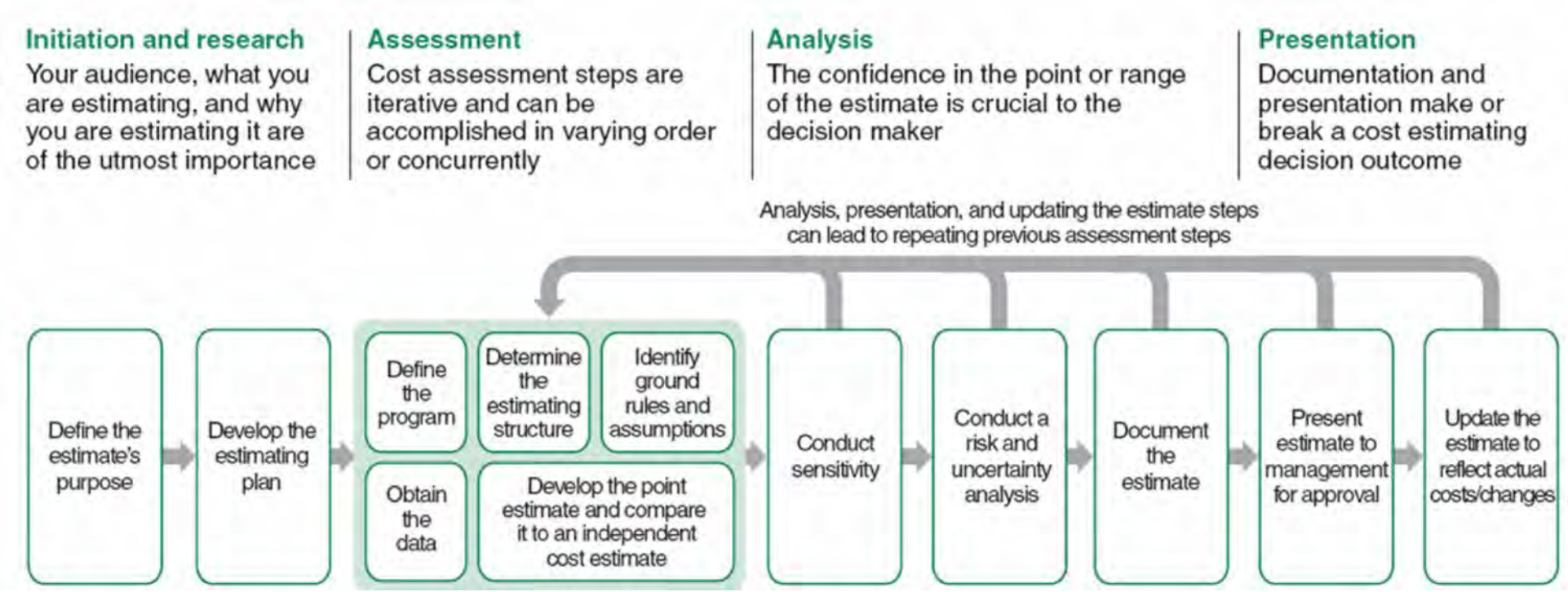
- Reduces defect creation
- Increases defect detection
- Mitigates risk
- Creates greater visibility at the financial matter level.
- Provide decision makers with additional insight into a program's potential costs, (O.Lewis, 1992; GAO, 2009; Zelkowitz and IoanaRus, 2002).

2.1.5 Best Practices of Cost Estimation Process

Karen (2015), claims that quality cost estimates, which fulfills the four key requirements of cost estimation can be developed via the cost estimation process, which is prearranged by way of 12 cost estimating tasks as presented in the under diagram. This process is known to be the best practice for quality cost estimates. GSA (2007) and GAO (2009) argues that, if these 12 tasks of the process are executed carefully, a high quality of cost estimate, which is accurate, comprehensive, well-documented and credible, can be ensured and bring to reality.

These set of tasks are initially developed by Government Accountability office (GAO) of the United States as one of its purposes to “Address best practices for ensuring credible project/ program cost estimates for both government and industry”, (Karen, 2015). Literatures also show that the whole guide of cost estimation which is published by GAO has been adopted by Japan. Moreover Karen (2015) claims that governments of Canada, Great Britain, India and Peru are some of countries that pursue the guide to enhance their own cost estimation management as per this best practice.

Figure 1 A Reliable Process for Developing Credible Cost Estimates



Source GAO, 2007

GSA (2007) and GAO (2009) presented these tasks in different prearrangement. Herein under are the twelve (12) tasks of cost estimating process, as identified in GSA (2007).

Task 1: Understand the Subject Project, Process or Organization

This task, as remarked in GSA (2007), intends to collect relevant data from the customer and helps estimators to understand needs and expectation of the requesting customer as well as the scope of the project (GSA, 2007). It is a constituent of:

1. Gathering all relevant data for evaluation. Discuss schedule, data, expectations and resource requirements with the requesting customer. If an estimate has been prepared before, review and incorporate lessons learned from the last effort.
2. Evaluating the mission, objectives, and goals of the project, process or organization, and assessing the operating environment and life cycle phase within the appropriate context.
3. Reviewing all related project, process or organizational documentation, including existing technical baselines, previous estimates, budget data and program data, such as work flows and schedules (GSA, 2007).

Task 2: Identify All Elements, Tasks or Components of the Subject Project, Process or Organization

GSA (2007), elaborates that, this task intends to determine the whole cost estimation schedule, work breakdown and work plan to ensure that the estimation come across to cover all necessary requirements in such a way that it can meet the intended goal (GSA, 2007). The task is a function of:

1. Determining if a work breakdown structure, work plans, or related documentation of process steps and resource requirements exist; otherwise, work with the appropriate personnel to create.
2. Creating a cost estimating work breakdown structure or similar schedule or timeline to govern the cost estimation process.
3. Ensuring that the cost estimating work breakdown structure satisfies all relevant requirements for cost data, including budgeting, earned value management, project planning and contracts, to enable improved cost estimation, future data collection, and performance measurement and management (GSA 2007).

Task 3: Establish a Common Baseline

This task is declared in GSA (2007) as that intends to create a common baseline document that all stakeholders of the project can understand and consider the estimate in an easy way only by using this single document. Above and beyond it intends to create a document of pertinent communication records, consensus and agreements that have been made among stakeholders of the project. By doing so, using identical assumptions, requirements, and elements will be assured among stakeholders, (WSDOT, 2008; GSA, 2007). It comprehends activities such as:

1. Documenting the relevant milestones, schedule, management strategy, implementation/deployment plan, test strategy, security considerations, and acquisition strategy.
2. Describing the characteristics, configuration, quality standards, security requirements, operational concept, and risks associated with the project, process or organization for use by the cost estimator.

3. Regularly reviewing the baseline documents with appropriate program or project staff to ensure that they are up-to-date and that any changes to the project, process or organization are incorporated into cost estimate (GSA 2007).

Task 4: Develop Rules and Assumptions

This task, as remarked in GSA (2007), intends to clearly develop uniform background to establish the whole estimation process (GSA, 2007). It is a constituent of:

1. Establishing a set of programmatic, technical, and schedule rules and assumptions to define the scope of the estimate (i.e., what costs are being included and what costs are excluded).
2. Achieving consensus on the rules and assumptions with stakeholders, project or program staff, and other impacted parties to ensure their validity.
3. Fully documenting the rules and assumptions (GSA, 2007).

Task 5: Select the Cost Estimation Methodology

GSA (2007) elaborates that, this task intends to let the estimator to choose one or a combination of these techniques depending on project scope, estimate purpose, project maturity, and availability of cost estimating resources, among the many cost estimating methods that are available, (DOE, 2011; GSA, 2007). The task is a function of:

1. If an estimate has been prepared before, reviewing the methodology previously used. Otherwise, researching methodologies used to estimate costs of similar projects, processes or organizations of an equivalent type, size, duration, and

impact. In either case, identifying and incorporating lessons learned from previous efforts.

2. Identifying legislation, regulations and guidelines controlling or influencing the cost estimate and the methodology employed.
    - Determine the availability of data.
    - Select the methodology (ies) (GSA, 2007).

Task 6: Select / Construct the Cost Model

This task is declared in GSA (2007) as that intends to allow the estimators either to choose a suitable model/ tool that are readily available, or to create a model that can assure best estimate product. This model selection step considers data and resource availability, schedule, and cost, (NASA, 2015; GSA, 2007). It comprehends activities such as:

1. Reviewing available choices and make a selection. If no suitable alternatives exist, explore the option of creating a model.
2. Fully documenting the factors leading to your decision and be prepared to defend the choice.
3. Ensuring that the model includes all direct and indirect costs including the cost of shared services and associated management and administrative costs (GSA, 2007).

Task 7: Gather and Normalize Data

This task, as remarked in GSA (2007), intends to equip the estimator with sufficient data preferably with primary sources. Primary data, which are obtained from the original source, are considered the best in quality, and are ultimately the most useful. Though secondary

data have the possibility of being lower in quality, the estimator doesn't have to exclude these data from his/her consideration. Whereas the estimator shall have to carefully check these data before usage. During planning the overall estimation period, it is quite necessary to be aware that this task is known to be one of most difficult, time-consuming, and costly activities in cost estimation, (DOE, 2011; GSA, 2007). It is a constituent of:

1. Identifying data needed and potential data sources.
2. Reviewing, interview, and/or survey data sources to obtain data.
3. Identifying shortcomings or gaps in the availability of data, and in the accuracy, timeliness, and structure of data collection techniques for each data source.
4. Normalizing data as necessary to overcome identified shortcomings in the data.
5. Standardizing key groupings.
6. Converting data to common units of measure (GSA, 2011).

Task 8: Develop a Point Estimate

GSA (2007), elaborates that, this task intends to create point estimate of cost which is discounted for future year as well as which is adjusted for risk (GSA, 2007). The task is a function of:

1. Populating the selected model with the normalized data collected.
2. Verifying the rules and assumptions.
3. Running the model to calculate cost.
4. Reconciling initial estimate to source data or previous estimates, if available.
5. Ensuring the result includes all direct and indirect costs.

6. Phasing the estimate across the appropriate units of time (e.g. fiscal year, accounting period).
7. Adjusting for inflation and discount future-year costs to obtain net present value (GSA, 2007).

Task 9: Conduct a Risk Assessment and Estimate Amounts to be Held in Reserve

This task is declared in GSA (2007) as that intends to introduce risk adjusted cost estimate using the outputs of risk assessment output and management plan, in such a way that opportunities to be maximized and threats to be minimized, (NASA, 2015; GSA, 2007). It comprehends activities such as:

1. Determining the level of risk analysis needed.
2. If a risk assessment has been prepared, reviewing the risks identified. Otherwise, working with appropriate program or project staff to identify risks and assess their probability of occurrence and potential impact.
3. Determining the cost impact of known risks, including the cost of proposed or on-going risk-mitigation activities.
4. Determining the probability that the actual cost will differ materially from the point estimate.
5. Performing qualitative and/or quantitative risk analysis and apply results to the point estimate to determine the risk-adjusted total cost.
6. Assessing the need for a “risk reserve” to accommodate unplanned costs (GSA, 2007).

Task 10: Document the Cost Estimate

This task, as remarked in GSA (2007), intends to deliver a written validation for the cost estimation. This task requires documenting information in such a way that the final product clearly shows how the estimation was done to create ease of audit as well as further replication. Information to be documented are but not limited to, basis of estimates, ground rules, assumptions, and drivers used in developing the cost and schedule estimates, including applicable model inputs, rationale or justification for analogies, and details supporting cost and schedule estimates, (NASA, 2015; GSA, 2007). It is a constituent of:

1. Documenting the cost estimate and all underlying assumptions associated with each task of the cost estimation process.
2. Determining the quality of the cost estimate and its fitness for use.
3. Conducting peer review.
4. Subjecting to relevant security standards, storing the cost estimate and all supporting documentation in an accessible location and medium, so that the cost estimate can be readily updated, repeated or audited by others (GSA, 2007).

Task 11: Obtain Independent Review and Approval

GSA (2007) elaborates that, this task intends that all cost estimates to be independently reviewed to reduce risk and enhance quality of estimate. The independent body can be a group of experts, peer groups within the organization or outside the organization, or other group which is suitable & qualified. These Independent bodies shall be experienced estimators who are familiar with the type of activities/ work within the project, and who are not involved in the process of estimation of the project which is under review. Then after comment review and correction will be done to adjust the estimate reflecting the independent review (WSDOT, 2008; GSA, 2007). The task is a function of:

1. Arranging for an independent third party to review the cost estimate, the methodology selected, and any underlying assumptions for both accuracy and appropriateness.
2. Presenting and defending the estimate to project or program leaders.
3. Obtaining and assessing customer feedback, conducting a lessons learned analysis upon estimate completion, and documenting and retaining this feedback (GSA, 2007).

Task 12: Update Cost Estimates on a Regular Basis.

This task is declared in GSA (2007) as that intends to create updates to cost estimates. As time progresses, it is understood that the estimate will no more accurately depicts the expected cost due to changes. Besides as time advances, better and additional information will become available. Changes happen due to but not limited to modification of scope, unexpected increases in labor rates, schedule extensions, variance in escalation rates, project reprioritization, etc. All such changes should be treated in such a way that all associated items to be adjusted accordingly and in a manner that the change will be verified. Meanwhile, it is to be noted that own performance at project implementation phase is one of the best inputs for cost estimate. Each cost estimation update process should be directed by the twelve tasks which ensure quality estimates (NASA, 2015; DOE, 2011; GSA, 2007). It comprehends activities such as:

1. Scheduling planned updates to the cost estimate at regular intervals or after discrete events that impact the underlying assumptions of the estimate (e.g. as a project moves through its life cycle phases or milestones). Including these updates in the cost estimating work breakdown structure.

2. Maintaining regular contact with project/program staff or customers to find out about changes to internal or external factors or assumptions that would impact the cost estimate.

3. Updating cost estimates as needed and communicate updates to impacted projects, programs and organizations for inclusion into their processes, including the budget process (GSA, 2007).

Consistently GAO (2009) has also lists the twelve tasks with different prearrangements (GAO, 2009). The following table shows the twelve tasks as presented by GAO.

Table 1 The Twelve Cost Estimation tasks

Step	Description	Associated Task
1	Define estimate's purpose	• Determine estimate's purpose, required level of detail, and overall scope; • Determine who will receive the estimate
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
3	Define program characteristics	• In a technical baseline description document, identify the program's purpose and its system and performance characteristics and all system configurations; • Any technology implications; • Its program acquisition schedule and acquisition strategy; • Its relationship to other existing systems, including predecessor or similar legacy systems; • Support (manpower, training, etc.) and security needs and risk items; • System quantities for development, test, and production; • Deployment and maintenance plans.
4	Determine estimating structure	• 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
5	Identify ground rules 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
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
7	Develop point estimate and compare it to an independent cost estimate	• Develop the cost model, estimating each WBS element, using the best methodology from the data collected, and including all estimating assumptions; • 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; • Sum the WBS elements to develop the overall point estimate; • Validate the estimate by looking for errors like double counting and omitted costs;

		• Compare estimate against the independent cost estimate 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
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
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
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; • 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 (prefer more detail over less); • 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
11	Present estimate to management for approval	• Develop a briefing that presents the documented life-cycle cost estimate; • Include an explanation of the technical and programmatic baseline and any uncertainties; • Compare the estimate to an independent cost estimate (ICE) and explain any differences; • Compare the estimate (life-cycle cost estimate (LCCE)) or independent cost estimate 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
12	Update the estimate to reflect actual costs and	• Update the estimate to reflect changes in technical or program assumptions or keep it current as the program

	changes	passes through new phases or milestones; • Replace estimates with EVM EAC and independent estimate at completion (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

Source: GAO (2009)

2.1.7 Mapping the steps to Requirements of Cost Estimates

In this paper it has been discussed that quality cost estimates, which fulfills the four key requirements of cost estimation can be developed via the cost estimation process, which is prearranged as twelve cost estimating tasks. At this moment it is worth to map these tasks with corresponding key requirements of cost estimates, in such a way that one can check the intended quality of the estimate without difficulty. GA0 (2009), describes how to correlate the tasks with requirements as presented in the following table.

Table 2 Mapping the steps to Requirements of Cost Estimates

Cost estimate characteristic	Cost estimating step
Well documented	
The estimate is thoroughly documented, including source data and significance, clearly detailed calculations and results, and explanations for choosing a particular method or reference • Data are traced back to the source documentation • Includes a technical baseline description • Documents all steps in developing the estimate so that a cost analyst unfamiliar with the program can recreate it quickly with the same result • Documents all data sources for how the data were normalized • Describes in detail the estimating methodology and	1. Define the estimate's purpose 3. Define the program 5. Identify ground rules and assumptions 6. Obtain the data 10. Document the estimate 11. Present the estimate to management

rationale used to derive each WBS element's cost	
Comprehensive	
The estimate's level of detail ensures that cost elements are neither omitted nor double counted • Details all cost-influencing ground rules and assumptions • Defines the WBS and describes each element in a WBS dictionary • A major automated information system program may have only a cost element structure	2. Develop the estimating plan 4. Determine the estimating approach
Accurate	
The estimate is unbiased, not overly conservative or overly optimistic, and based on an assessment of most likely costs • It has few, if any, mathematical mistakes; its mistakes are minor • It has been validated for errors like double counting and omitted costs • Cost drivers have been cross-checked to see if results are similar • It is timely • It is updated to reflect changes in technical or program assumptions and new phases or milestones • Estimates are replaced with EVM EAC and the independent EAC from the integrated EVM system	7. Develop the point estimate and compare it to an independent cost estimate 12. Update the estimate to reflect actual costs and changes
Credible	
Discusses any limitations of the analysis from uncertainty or biases surrounding data or assumptions • Major assumptions are varied and other outcomes recomputed to determine their sensitivity to changes in assumptions • Risk and uncertainty analysis is performed to determine the level of risk associated with the estimate • An independent cost estimate is developed to determine if other estimating methods produce similar results	7. Develop the point estimate and compare it to an independent cost estimate 8. Conduct sensitivity analysis 9. Conduct risk and uncertainty analysis

Source: GAO 2009

2.1.8 Cost Estimating Methods

A cost estimate at a given stage of project development represents a prediction provided by the cost engineer or estimator on the basis of available data. These Estimators use different techniques of cost estimation that can lead to the final pricing.

The choice of estimating method depends on several factors. The end-use of the estimate, the amount of time and money available to prepare the estimate, estimating tools and data available, the level of project definition, design information available, and the timing or phase of the project are factors that influence which method to use (Seeletse & Ladzani, 2012). Different literatures classify estimation techniques in variety of ways, (Keith Potts, 2008; PMBOK, 2013; Asteway, 2008). Virtually all cost estimation is performed according to one or some combination of the following basic approaches:

2.1.8.1 Parametric methods

As described by ISPA (2008), parametric cost estimation method is “a technique that develops cost estimates based upon the examination and validation of the relationships which exist between a project's technical, programmatic, and cost characteristics as well as the resources consumed during its development, manufacture, maintenance, and/or modification”. It can be a simple or complex model. It provides numerous advantages as an estimating tool. Parametric estimates are: efficient, Objective, Consistent and Flexible.

The implicit assumption of parametric cost estimating is that the same forces that affected cost in the past will affect cost in the future. In order for parametric models to have any validity, they must be based on or proven using actual project data. The major advantage of using a parametric methodology is that the estimate can usually be conducted quickly and is easily replicated. Parametric models are used in the early design stages to get an idea of

how much the product (or project) will cost based on a few physical attributes (such as length, area, weight, volume, and power) (Dysert, 2008).

2.1.8.2 Historical bid-based methods

The use of historical data from recently bid contracts, as discussed by NJDOT (2016), is the most common method used during and after design stage where bill of quantity of items can be prepared. Under this approach, specifications will be summarized with items developed for major elements of work so that quantities and historical unit prices can be applied to these items (NJDOT, 2016). This method is commonly used to develop Engineer's Estimates.

2.1.8.3 Cost-based estimate methods

Shihunegn (2014) remarked that this method uses bill of quantities for estimation. However unlike historical bid based method, rates are fixed based on determined breakdowns of contractors cost for labor, material, equipment etc. Moreover indirect costs such as overhead and profit will be added to infer the final cost. The method is highly useful for projects which have no similar previous projects (Shihunegn, 2014).

2.1.8.4 Risk-based estimate methods

Risk-based cost estimation as discussed by Shihunegn (2014), is a method which considers risk and uncertainties early and often in the project development process. It identifies critical cost areas and directly treats with uncertainty and risk management tools for an enhanced cost estimate. These identified risk and uncertainties are used to mitigate, eliminate, or account for the possible variation in the outcomes (Shihunegn, 2014).

TxDOT (2015) described the benefits of risk-based estimating to be:

- Improved delivery of projects and program management.
- Better use of available resources.
- Greater credibility with the public and other stakeholders.
- Increased satisfaction as a result of more efficiently and effectively meeting public needs.

2.1.9 Cause and Effects of inaccurate Estimates

(Yadessa, 2015), argues that lack of project preparation is one of the difficulties encountered in the implementation of cost estimation. Poor up-front prediction of cost can cause serious problems of cost overrun in many areas later in the project, to the extent of failure. It affects every stakeholder of the project directly or in directly. Furthermore poor estimates can lead construction firms to bankruptcy. Hence managers shall be vigilant, and need to get to the root cause of the problem (Yadessa, 2015; Fetene, 2008).

Despite the fact that inaccurate cost estimates have many reasons, the major contributors of inaccurate estimates are technical problems on how to estimate project costs and also insufficient project information at the early stages of the project (Allotey, 2014). Other causes contributing to poor estimates are, but not limited to (MoD, 2008):

- Unrealistic timescales
- Inexperienced and poorly trained staff
- Poorly adhered to processes

- Poorly defined, documented and tracked assumptions,
- Too few comparator programs,
- Inadequate, out-of-date or improperly recorded data,
- Inappropriate Forecasting methodologies and,
- No supported rationale or basis for the forecast.

2.1.10 Key Factors that influence Estimating Practice

Cost estimation is one of key components of project managers' job functions. They design and devise ways to improve their companies and departments. However, WSDOT (2015), proves that factors inside and outside the company can affect their estimation for better or worse. Perfect Estimation does not exist, but taking steps to mitigate any negative effects of estimating can help ensure project success. As a practice cost estimation can be considered as more of an art than a science (WSDOT, 2015). Hence it requires a thorough understanding of project scope, past price history, and current market conditions, as well as with a generous application of human judgment.

WSDOT (2015) and DTMR (2015) describe some key factors that may affect the project Estimating Practice. The factors can be: geographical considerations, quantity considerations, item availability, scheduling/lead time, difficult construction/Site constraints, estimating lump sum items, force account, timing of advertisement, expected competition/contractor availability, other contracts, specialty work, standard items vs. nonstandard items, first time used, soil conditions, permit conditions, allowances, construction contingencies, other funding sources/ agreement work for others, project scope, constructability, construction program, environmental and heritage issues, traffic issues, risk, method of delivery.

According to AACE (2016), Over and above the degree of project definition, quality of cost estimate is also affected by other systemic risks such as:

- Level of non-familiar technology in the project.
- Complexity of the project.
- Quality of reference cost estimating data.
- Quality of assumptions used in preparing the estimate.
- Experience and skill level of the estimator.
- Estimating techniques employed.
- Time and level of effort budgeted to prepare the estimate.
- Unique/remote nature of project locations and the lack of reference data for these locations.
- The accuracy of the composition of the input and output process streams.

2.1.11 Project Cost Estimator

According to different literature estimator can be defined as:

- A knowledgeable professional assigned to evaluate the probable cost of projects (WSDOT, 2015).
- A person responsible for estimating a specific Work Breakdown Structure (WBS) lowest level cost form (AURA, 2016).

The term 'Cost Estimator' used in this paper refers to someone as described in (MoD, 2009) whose training, qualifications, skill and experience are applied competently to a main job that consists of that type of predictive work.

Estimator is a key person in projects or portfolios whose function is predicting the most economic costs for construction in a way that is traceable, clear and consistent. In fact the role of estimators is a function of success and failure of projects (Brook, 2004). Despite the

fact that cost estimators follow/ use differing approach for estimation, there are basic skills that every estimator uses.

The validity and reliability of an estimate depends on the validity and reliability of its bases for preparing the estimate. Consequently, the validity and reliability of the estimate depends on the knowledge and experience of the estimator (Seeletse & Ladzani, 2012).

(Seeletse & Ladzani, 2012) states that, in addition to prediction of cost, estimator's roles and responsibilities are:

- Planning and review of specifications
- Compiling data for operations
- Researching potential jobs
- Site study
- Negotiations
- Meetings with field team, and
- Value engineering.

Hereunder are seven points as discussed by Misronet (2016), in which a qualified estimator should possess.

1. A thorough understanding of architectural drawings
2. A sound knowledge of building materials, construction methods and customs prevailing in the trade
3. A fund of information collected or gained through experience in construction work, relating to materials required, hourly output of workers and plant, overhead expenses and costs of all kinds
4. An understanding of a good method of preparing an estimate
5. A systematic and orderly mind

6. Ability to do careful and accurate calculations
7. Ability to collect, classify and evaluate data that would be useful in estimating (Misronet, 2016).

2.2 Tendering

The word tender and the word bid are used interchangeably in different literatures. Hence, in this paper the two words are used synonymously.

Tendering can be defined as:

"The process of preparing and submitting for acceptance a conforming offer to carry out work for a price, thus converting the estimate to a bid" (Patil, 2016).

"The process by which bids are invited from interested contractors to carry out specific packages of construction work. It should adopt and observe the key values of fairness, clarity, simplicity and accountability, as well as reinforce the idea that the apportionment of risk to the party best placed to assess and manage it is fundamental to the success of a project" (Finch, 2011).

In perspective of contractors, tendering is a tool to win the right to deliver a construction project. Tendering especially for big and complex projects can be a very costly exercise equally for employer and bidders, but this would be money well spent if the targets achieve successfully (Laeeq, 2015).

When talk about tendering, it is involved with some kind of complicated process and procedure. Before any tendering process can be done, professional team and employer must make sure all necessary tender documents have been prepared, checked and approved, (Patil, 2016).

What types of tendering that employer want to choose depends on nature of contract, complexity of the construction, expertise needed, type of project, size of project, location (local or international), budget, time of the procedure to take (Patil, 2016). Public projects (Except for some projects like security related works) tend to make open tender to ensure the procurement and works to be done in fairly manner without prejudice.

As per (Laeeq, 2015), a proper tendering process fulfills two objectives;

1. The employer gets competitive and realistic price for the project that he intends to undertake and
2. The contractor or the bidder, upon making due investigations before submitting his tender, fully understands the requirement or nature of the proposed work and Employer's requirement.

2.2.1 Type/ Category of Tenders

Different literatures categorize tendering in different ways. Some literatures also combine contract types and project delivery mechanisms with tendering. For instance:

The Estimation and the Tendering process in Construction Industry (Laeeq, 2015) and ISO 1048-1 Standard procurement Tendering Procedure identified four categories, (Ogunsanmi, 2013) identified 9 categories, Article 33 of Procurement and Property Administration Proclamation, Proclamation No. 649/2009 (Federal Negarit Gazeta, 2009) identified six categories and the Australian Constructors Association, (2006) identified five categories.

For the purpose of this paper the five category used by Australian construction association will be discussed. According to this literature the five types of tender are:

1. Open or Public Tenders
2. Selected or Approved Tenders

3. Pre-Qualified Tenders
4. Direct Negotiation
5. Two Stage Tendering

2.2.1.1 Open or Public Tenders

Open tendering, as mentioned by Abinet (2015) allows anyone to submit a tender to supply the goods or services that are required. This type of bid allows the client to advertise the tender offer in the local newspaper giving detail and key information of the proposed works and inviting interested contractor with an equal opportunity to submit the tender, (ISO, 10485-1; FDER Proclamation 649/2009, Article 51; Abinet, 2015; Laeeq, 2015).

Abinet (2015) and Laeeq (2015) write that some of the most important advantages of open or public tenders to any project include:

- Suitability for simple and low risk construction projects
- Offers the greatest competition and has the advantage of allowing new or emerging suppliers to try to secure work.
- Attracts a most economical bid due to open invitation for a large number of competitors
- Allow any interested contractor to tender. Therefore it gives opportunity for an unknown contractor to compete for the work.
- Allow many contractors to tender for one job, since the tender list can be as long as needed.
- Allow the tender list to be made without bias.

On the other hand these literatures i.e., Abinet (2015) and Laeeq (2015) comprehend that this method has some drawbacks including:

- It doesn't give contractors who are new to the area or those starting new businesses the chance to tender or establish themselves.

- Open tendering has been criticized for attracting tenders / expressions of interest from large numbers of suppliers, some of whom may be entirely unsuitable for the contract and as a result it can waste a great deal of time, effort and money.
- The administration costs of floating such a tender are comparatively high
- Public accountability may be questioned if the lowest offer is not accepted.
- Does not attract reputable and established contractor unless they are forced to, due to lack of work.

2.2.1.2 Selected or Approved Tenders

Selective tendering is one alternative developed to address the limitations of the open tendering procedure. In this method, a pre-selected list of possible suppliers is prepared that are known by their track record to be suitable for a contract of the size, nature and complexity required. Consultants or experienced clients may maintain 'approved' lists of prospective suppliers and then regularly review performance to assess whether suppliers should remain on the list. Purposes of this type of tendering are to improve the quality of the bids received, to ensure that contractors with the necessary experience and competence are given the opportunity to submit the necessary bids, due to urgency work involved, for specific reasons of the employer, like security reasons in government projects, to make the tendering procedure more manageable and to alleviate burden on the parties involved, (ISO, 10485-1; FDER Proclamation 649/2009; Abinet, 2015; Laeeq, 2015).

Merits/ advantage of selected of approved tenders as identified by Abinet (2015) and Laeeq (2015) include, but not limited to:

- Contractors are known and evaluated by the employing authority and be assured as is possible that they will meet their contractual obligations.
- Give clients greater confidence that their requirements will be satisfied
- Reduce the wasted effort that can be involved in open tendering.
- Only the competent contactors were invited to tender, then the lowest can be accepted.

- Reduces the cost of tendering (economic use of resources, reduced tender documentation, shorter tender periods, better management of the tender process, etc.)
- Suitable where there are only limited or no suppliers for the specified quality and economy
- Suitable when repeated advertisement didn't attract required bidders via to open tendering.

Despite all the merits of selected or approved tenders, (Abinet, 2015; Laeeq, 2015) identified that these type of tenders also have their downsides such as:

- Exclude smaller suppliers or those trying to establish themselves in a new market.
- Reduce the availability of work for other contractors, especially to new contractors.
- Tender Price may invariably higher than would have been in open tendering.
- Creates greater chance of collusion
- Favoritisms may occur in the short listing.

2.2.1.3 Pre-Qualified Tenders

Pre-Qualified Tendering method is a multi-staged process which is used to shortlist potential suppliers before then seeking detailed bids from the shortlisted bidders. In this process an expression of interest (EOI) is prepared often as a preliminary stage that may result in a Request for Tender (RFT). This process may in turn lead to a tender process or directly to a negotiation with one or several preferred contractors. The Client invites expressions of interest by way of public advertisement for Pre-Qualification for a specific project or specific types of projects, (ISO, 10485-1; UTAS, 2012; Abinet, 2015; Laeeq, 2015).

Pre-Qualified Tenders are often used in the major infrastructure and construction industry where solutions to problems are high value, high risk and very specific (UTAS, 2012).

UTAS (2012), Abinet (2015) and Laeeq (2015) write that some of the most important advantages of Pre-Qualified Tenders to any project include but not limited to:

- Useful when the number of players, market size or the approach to solving a problem is largely unknown.
- Suitably used when the information required from tenderers is specific but the owner is unsure of the capability of contractors to provide the required goods and services.
- Mostly recommended for complex projects with high risk & high cost.

2.2.1.4 Direct Negotiation

Negotiation tendering is extensively used in the engineering and construction industry, (Abinet, 2015). Negotiating with a single supplier may be appropriate for highly specialist contracts, or for extending the scope of an existing contract. Negotiated contracts take many forms. It is very much dependent upon the type of construction and the requirement by the client for factors such as speed, quality, repetition, cost, desire to retain the services etc, (ISO, 10485-1; FDRE Proclamation 649/2009, Article 51; Abinet, 2015; Laeeq, 2015).

Literatures, ISO (10485-1), FDRE (Proclamation 649/2009 Article 51), Abinet (2015) and Laeeq (2015), agrees that direct negotiation can be applied to the following type of contract:

- In partnering type of contracts under the so called win-win formula.
- Where the employer has a long term business relationship with the contractor.
- In situations where the parties are in a relationships of holding and subsidiary companies.
- Where the contractor is involved in the financing of the project.
- In situations where the employer finds it advantages to employ the same contractor to continue an initial or existing contract for the new works

- Where there is a pressing need to have a very early start of work on the site and to complete the works on a fast tract basis.
- In special circumstances e.g. Security reasons, emergencies etc., where it is expedient to secure the services of a particular contractor only.
- Where there is only a single contractor who is the only one available or with either the special skill or resources to carry out the particular works.
- The employer's resources are either limited or constrained thereby making the use of the other tendering impractical.

In accordance with the suggestion of Laeeq (2015), the maintenance of positive relationships during the negotiation process is essential. As well trust, partnering and mutual benefit of the contract to both parties during negotiations and the actual contract works is required.

Abinet (2015) and Laeeq (2015) write that some of the most important advantages of direct Negotiation tenders to any project include:

- It can reduce the costs of tendering and allow early contractor involvement
- Only reputable contractor are invited for negotiation.
- The contractor can contribute his expertise during design stage.
- Reduces the availability of work for other contractors.
- Early Commencement of work on site. It shortens the period involved in appointing the contractor.
- Reduce risk of failure
- Suitable when and only one can provide required quality of work or service.
- Changes or requests more on existing material where the new supply shall not deliver the same service.
- Creates consistence with ongoing conditions due to technical or economic reasons
- Suitable when repetition of the same work required
- Suitable when continuity of consulting service required

- Suitable where delay create serious problem and emergency is required

But no matter how useful Direct Negotiation tendering method is, it does not come without drawbacks. Here are its disadvantage, as identified by Abinet (2015) and Laeeq (2015):

- Competitive element is reduced
- Unless the structure of the negotiation is clearly set out there is potential for an adversarial atmosphere to develop, even before the contract has been awarded.
- The cost is likely higher than competitive tender.
- Should the negotiations be deadlock or prove eventually unsuccessful, this causes wastage of valuable resources on both sides and loss of time for the employer, thereby delaying the overall selection of suitable contractor.

2.2.1.5 Two Stage Tendering

Laeeq (2015) discusses that, two stage selective tendering combined elements of competition and negotiation into a formula where the employer could utilize the contractor's expertise at an early stage of the project cycle so as to maximize innovation, ingenuity and quality and simultaneously optimize cost, time and resource input. In the first stage, a limited appointment is agreed allowing the supplier to begin work and in the second stage a fixed price is negotiated for the contract. It can be used to appoint the main contractor early or more commonly as a mechanism for early appointment of a specialist. In this process, the Contractor starts his role on preliminary design and concept, at a very beginning of the project. The purpose of the entities working together is to prepare the design and all relevant detail of the project and finally to agree on to a fixed price to enter into a design and build project. If no agreement being reached, the employer has an option to abandon the tendering exercise and re-tender the works using any other tendering procedure, (ISO, 10485-1; FDRE Procurement 649/2009; Laeeq, 2015; Abinet, 2015).

Literatures: (ISO, 10485-1; FDRE Proclamation 649/2009, Article 51; Abinet, 2015; Laeeq, 2015), agrees that the application of two stage selective tendering might be appropriate where:

- The project has a very complicated nature
- The time of selection of the contractor, the magnitude of the work may not be known with sufficient certainty
- It is an essential pre-requisite for works to be finished by an early completion date.
- In contracts of large complex plants or works of a special nature.
- The owner is unable to formulate detailed specifications
- The owner inters in to contract for research, experiment, study or development
- When the owner like to negotiate with suppliers

Abinet (2015) and Laeeq (2015) write that some of the most important advantages of two stage selective tendering to any project include but not limited to:

- Gives benefit to the Employer in cost, accuracy and time saving.
- The contractor will be paid early and can plan resources in a more efficient and accurate way due to his involvement in employer's design team.
- The Contractor will be able to give valuable advice or suggestion at an early stage, based on his experiences on similar project.
- Avoidance of disputes and any problems related to construction work on post-contract which cause delay and unforeseen expense.
- Benefit of the contractor's expertise in constructability, specialist knowledge in proprietary systems, project scheduling and resulting in value for money.
- Early commencement of work
- Saving of time due to the overlap of the design and tendering stage.
- The procedure utilizes the best aspects of both competition and negotiation to arrive at the most favorable arrangement at an optimum firm price before work commences.
- Since the contractor is part of the project team at a very stage of the project, this results in better communication and information flow.

- Fewer claims and disputes in the post contract award stage due to the contractor's involvement at the design / pre contract stage

On the other hand these literatures i.e., Abinet (2015) and Laeeq (2015) comprehend that this method has some drawbacks including:

- The Contractor is no longer in competition, and as a result cost may be increased gradually at post contract stage.
- Its application requires a high level of familiarity and commitment on the part of employers and contractors.
- The tender process is relatively more expensive and longer than other common procedures.
- If the second stage be a deadlocked or result in no acceptable agreement being reached, the tender process has to be initiated all over again. This incurs a time and cost penalty to the project.
- This procedure requires a high level of commitment, integrity and good faith on part of both sides.

2.2.2 Tender Documents

CIPS (2013) noted that, a tender document is a compressively written invitation sent to potential suppliers of a good or service to inform them about the information required for the buyer to choose among them. After the client decides to whom to award the tender, this document will be signed and becomes a contract document. Hence it becomes an agreement between two parties which they intend to be legally binding with respect to the obligations of each party to the other and their liabilities. The contract thus binds the contractor to construct the works as defined, and the employer to pay for them in the manner and timing set out, (ISO, 10485-3, 2008; CIPS, 2013; Abinet, 2015).

CIPS (2013), Abinet (2015) and Oleriny (2015), describes that, a tender document contains the necessary application papers and contains additional information that the suppliers must deliver in order to apply for the tender and enter the selection process. A typical set of documents prepared for tendering will include: a cover letter, an invitation to tender, Instruction to bidders, the form of the tender, Information about final date of submission including date, time and place, bid submission forms and bid security forms, number of copies required to be submitted, legal documents and qualification demonstration requirements, bid validity period, reservation to show the power of the client to rejects all bids, price adjustments that may apply during implementation, the terms and conditions of the contract, a bill of quantities, the specifications, designs/drawings and/or plans, the quality requirements, the evaluation criteria and the tender return label. Depending on the type of the project and requested work, other additional documents vary, (ISO, 10485-3, 2008; CIPS, 2013; Abinet, 2015; Oleriny, 2015).

The applying suppliers must deliver the complete tender documentation by the deadline to be able to participate in the bidding process (Seeletse & Ladzani, 2012).

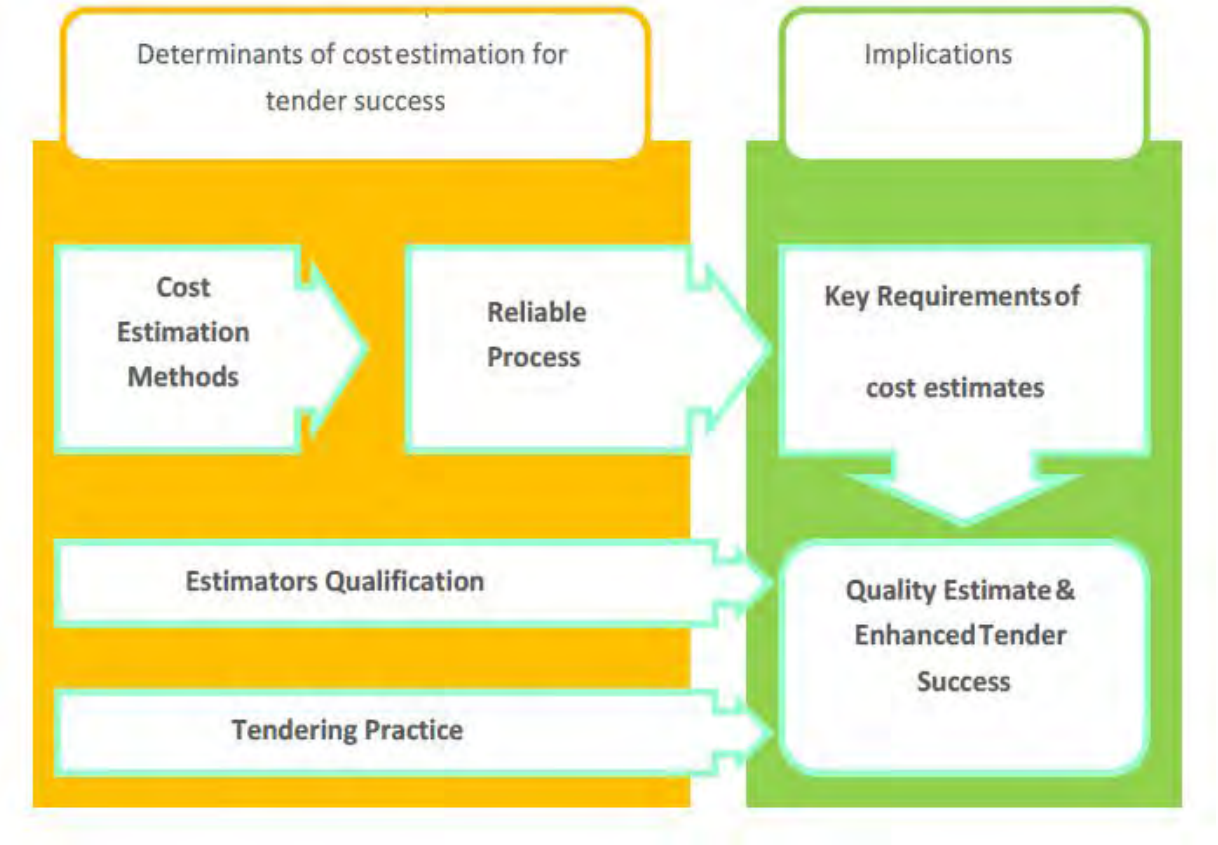
2.2.3 Tender Evaluation Criteria

Oleriny (2015) discusses about the criteria upon which a supplier is usually chosen are the proposed technical offer, prices and costs, delivery times and terms, availability and quality. Some literatures have set the following criteria for tender technical evaluation, (PPA, 2006; Abinet, 2015; CIPS, 2013; Oleriny, 2015).

- Legal Status and Grade of Contractors
- Annual Construction Turnover
- Liquid Asset
- Construction Experience
- Proposed Equipment
- Proposed Personnel
- Proposed Work Program and Methodology

2.3 Conceptual Framework

Figure 2 Conceptual Framework of the Study



Source: Developed by the researcher from preliminary literature review

Chapter 3 - RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is the step by step procedure/ method dealing with identifying problem, collecting facts or data, analyzing these data and reaching at certain conclusion either in the form of solutions towards the problem concerned or certain generalization for some theoretical formulation. This chapter describes the formulation of a research design and methodology adopted to achieve the stipulated goals for the study. The chapter begins with the elements of the research process which include research design, area of study and sample design. Subsequently, the chapter explains the sources of data and the research instrument. The steps involved were elaborated in detail and had been carried out systematically in order to achieve a high degree of reliability and validity.

3.2 Research Type

Research could be descriptive or exploratory. For the purpose of this research, after investigative the objectives of the study and recognizing the lack of previous study and published literature on Addis Ababa based emerging local contractors, an exploratory descriptive research design had been chosen, because it would conclusively describe the practice and state-of-the-art of the population under study. Exploratory descriptive research would suits best because according to Sekaran (2003), an exploratory study research was implemented when a researcher had little knowledge about the situation or had no information on how similar problems or research issues had been solved in the past. It embarks on investigating and finding the real nature of the problem. In addition, solutions and new ideas could surface from this type of research. This research which deals with investigation of the practical problem of project cost estimation is undertaken on the basis of observation of construction projects. The research questions are designed to explore cost estimation practice of local contractors and the causes and impacts of poor estimates. It can

be categorized as exploratory and descriptive. The research is exploratory because it is initiated from practical problems and investigates whether effects of poor estimates exist or not. It is also descriptive because it tries to describe the practice of local emerging contractors that undertakes different construction projects basing Addis Ababa. The descriptive research method adopted in this study is expected to disclose an accurate picture of the respondents' opinion that might help to assess the current practice of cost estimation among local emerging contractors as well as cause and effect of poor estimate and identify possible and practical measures for enhancing the practice among Addis Ababa based emerging local contractors.

3.3 Research Approaches

There are two basic approaches to research: quantitative and qualitative. The former involves the generation of data in quantitative form which could be subjected to accurate quantitative analysis in a proper and rigorous manner and in the form of a data base from which to realize characteristics or relationships. In quantitative research, samples of a population are studied (observed or questioned) to establish its characteristics, in short, a quantitative approach attempts to produce "real answers" from "hard data", whereas a qualitative approach is concerned with subjective evaluation of opinions, behavior and attitudes. Research in such a situation is a purpose of the researcher's insights and impressions, and the techniques involved are projective techniques, focus group interviews and depth interviews. Qualitative methods are not good at giving direct answers, but are good at developing more questions, because of consistent use of "soft data" (Higgins, 2009).

Creswell and Vicki (2007) describes quantitative research as one in which the investigator primarily uses post positivists claims for developing knowledge (cause and effect) by use of specific variables, hypothesis and questions to yield statistical data. The approach seems to capture both qualitative and quantitative aspects of the study, (Zikmund, 2000). However it is predominantly quantitative in nature which involves the use of primary and secondary data in order to answer the research questions and achieve its research objective.

3.4 The Research Process

Research process consists of a series of steps necessary to carry out research and the desired sequencing of the actions to be undertaken. The research process is a simple way of effectively locating information for a research project.

The current research takes a quantitative approach and is conducted in the following stages, namely: problem identification, literature review, research design, data collection, data analysis and result interpretation and reporting. The approach entails researching to assess the current practice of cost estimation, identifying possible and practical measures that can enhance cost performance in construction projects among construction firms. These objectives are achieved through the implementation of the research methodologies that are mainly literature review and questionnaire survey. The literature review focuses on best practices of cost estimation and helps in the identification of factors and categories, research methodology and analysis of data. Four cost estimation key requirements and twelve tasks that can ensure meeting the four key requirements, if implemented properly, are identified. These tasks are compiled and structured into questions to evaluate the status quo of the practice at the captioned study area. In order to collect the necessary data, a questionnaire that consists of the following four major sections is carefully designed and tested in light of attaining high response rates from respondents. These are: the general background information of the respondents and their organization, Tendering, Proposal management & estimating team, and cost estimation. The designed questionnaire is distributed to implore perception of professionals in emerging construction firms which are based in Addis Ababa. Analysis of the data obtained from the questionnaire is undertaken through statistical methods, visual examination, tabulating and categorizing. After analyzing the collected data, findings and results are interpreted and discussed. Finally, research conclusions were drawn and provide the basis on which recommendations are given.

3.5 Data Source and data collection

There are two types of research data collection, namely: primary and secondary data collection. When the data is collected either through survey or through experiment, it is defined as primary data. If the researcher performs an experiment, one can observe a number of quantitative measurements or data that help to examine the truth contained in the hypothesis. But when a survey is undertaken, data can be collected through observation, personal interview, telephone interview, by mailing of questionnaires and other methods.

Secondary data can be collected by the user or someone other than the user. It is rapid and can be relatively inexpensive to collect if available through open source channels. It plays an important role in the literature survey assessment, helping to define the key issues. The secondary data used in this research are obtained from various local and global sources, including cost estimation guidelines, reports, journal articles, conference papers, dissertations and theses. Since the secondary data collected were found inadequate, it becomes necessary to collect primary data. The primary data used in this study are collected through a questionnaire survey. A questionnaire designed from extensive literature review of estimation practices in construction projects and from secondary data sources are distributed to construction firms that based in Addis Ababa so as to assess the current practice among emerging construction firms under the study area and come up with possible solutions/recommendations to enhance the practice.

3.6 The target population

The targeted population selected for this research to evaluate and analyze cost estimation practice is of Addis Ababa based emerging construction firms. The research samples are taken from the different category and classes of these firms (Table 3). The categories are Water Well Drilling Contractors, Water works contractors, Sanitary works contractors,

Electro-Mechanical contractors, Electrical equipment installation contractors, Electrical contractors, General contractors, Building contractors and road contractors. However the research sample is limited to:

1. Contractors who acquire certificate of competence from Addis Ababa, the capital. It doesn't include contractors who acquire competence certificate from regional government bodies.
2. Contractors of Grade 1 - Grade 5
3. Contractors who have joined the industry from 2006 - 2008 E.C. (2013/14 - 2015/16 G.C)

All secondary data of the population, including firms contact address and year of registration is collected from three government certificate of competence issuing bodies, namely, Ministry of Construction, Ethiopian Energy Authority and Ministry of Water, Irrigation & Electricity (Table 3).

Table 3 The target population

Certificate of Competence Issuing Body	Category		
	Building Contractor	General Contractor	Road Contractor
Ministry of Construction	**229**	**78**	**8**

Certificate of Competence Issuing Body	Category		
	Electro-Mechanical Contractor	Electrical Contractor	Electrical Equipment's Installation Cont.
Ethiopian Energy Authority	**37**	**17**	**5**

Certificate of Competence Issuing Body	Category		
	Water Well Drilling Contractor	Water Works Contractor	Sanitary Contractor
Ministry of Water, Irrigation & Electricity	**7**	**27**	**4**

Source: Secondary data

Respondents who are designated for data gathering belongs to firms as identified above. Likewise some respondents who used to be staffs of these firms are also carefully chosen for data gathering. A wide range of personnel involved in different construction activities among these firms are targeted depending on their direct exposure to construction project cost estimation activities. For this study, the questionnaires are distributed to sample respondents mainly through office and project site visits and hand to hand distribution of the questionnaire, email and Tele fax. The questionnaire is accompanied with a cover letter explaining the purpose of the research.

3.7 Sample Size Determination

Determining the sample size for a study is a crucial component of study design. The purpose is to include sufficient numbers of subjects so that statistically significant results can be detected.

Using too few subjects results in wasted research resources and statistically inconclusive findings which make it difficult to determine whether a particular treatment or intervention will be effective and to identify directions for future studies. Thus, using the appropriate number of subjects optimizes the probability that a study will yield interpretable results and minimizes research waste. From a statistical perspective, studies with the optimal number of subjects have sufficient i.e. neither too much nor too little for statistical "power" to detect findings (Anderson et.al, 2011).

Here are the formulae used for sample size determination: - (Creative Research Systems, 2012)

$$SS = \frac{Z^2 * (p) * (1 - p)}{C^2}$$

Correction for Finite Population

$$\text{New SS} = \frac{SS}{1 + \frac{SS-1}{pop}}$$

Where:

SS=Sample Size

Z = Z value (1.96 for 95% confidence level- tells you how sure you can be)

P = percentage picking a choice, expressed as decimal (.5 used for sample size needed)

C = confidence interval (also called margin of error) is the plus-or-minus figure usually, expressed as decimal (.07 = ±7)

Pop= Population (412)

Putting all these values into the above formulae, yields a sample size of 133 and this was rounded up and a sample of 135 contractors was taken for this study.

3.8 The research Questionnaire survey

Due to the large number of emerging local contractors which are based in Addis Ababa, a questionnaire survey is found suitable for this research. A questionnaire is a printed self-report form designed to elicit information that can be obtained through the written responses of the subjects. The information obtained through a questionnaire is similar to that obtained by an interview, but the questions tend to have less depth (Burns & Grove 1993). According to Leedy et al. (2005), questionnaires can be used for the acquisition of qualitative data using quantitative scales. There are two types of survey questions from which to select: closed-ended and open-ended. The questionnaire survey adopted in this research utilizes closed-ended/ structured questionnaires. Closed questions are easier to analyze and often provide fixed alternatives. However, one open-ended question is also added to know the position of the respondents in his/her firm.

Questionnaires were decided upon because of the following:

- They ensured a high response rate as the questionnaires were distributed to respondents to complete and were collected personally by the researcher.
- They required less time and energy to administer.
- They offered the possibility of anonymity because respondents' names were not required on the completed questionnaires.
- There was less opportunity for bias as they were presented in a consistent manner.
- Most of the items in the questionnaires were closed, which made it easier to compare the responses to each item.

Before distributing the final questionnaire, a pilot questionnaire survey is performed to test for its validity and sufficiency.

The validity is tested by referring to 3 experts. The first expert is an academician as well as a researcher who have more than 19 years of experience. The second expert is a practitioner who has more than 16 years of experience and is familiar with the local construction industry, and the third expert is a statistician. Both experts are asked to review critically the design and structure of the questionnaire. As a result more questions were added to ensure higher representativeness. Rephrasing of some questions was done to clarify the questions and more appropriate alternative response choices were added to the closed-ended questions to provide for meaningful data analysis (Burns & Grove, 1993). The revised questionnaires are then distributed among the selected samples of the population.

The non-probability sampling method, involving convenience and snowball sampling techniques, is used for this study as applied by other researchers on construction cost research works in other parts of the world, (Sambasivan and Soon, 2007; Baloyi and Bekker, 2011; Dibonwa, 2008). The non-probability method is ideal when you do not know the

likelihood that any element of population is selected for study. According to Uma (2000), where members of a special population are difficult to get responses from sample elements selected at random, snowball sampling method are commonly preferred as convenience. This sampling comes under the class of non-probability sampling techniques. As the name implies, sample elements are identified by convenience and through referral networks. The questionnaires are distributed through acquaintances and these in turn distribute to their acquaintances working in construction firms basing Addis Ababa. According to Sambasivan and Soon (2007), this sampling method enables to obtain a large number of completed questionnaires quickly and economically. One hundred thirty five sets of questionnaires are distributed to potential respondents from construction firms of water well Drilling companies, water works construction, sanitary works construction, electro-mechanical companies, electrical equipment installation companies, electrical construction, General construction, Building construction, road construction and anyone working within emerging local construction firms depending on direct exposure to construction project cost estimation. Face to face deliveries are preferred to promote respondents and to raise the response rate but other different means such as email and fax services are also employed. Follow-ups are made through telephonic and email communications.

3.9 Questionnaire design

Good questionnaire design is a key to obtaining good survey results and warranting a high rate of return (Zikmund, 2000). The questionnaire design in this study utilized the information sourced from the extensive literature review. The global best practice of project cost estimation would be relevant to local estimation practice context in Addis Ababa based contractors. After reviewing the global best practice that can ensure quality estimate, if implemented properly, twelve tasks have been identified to distinguish the situation among Addis Ababa based local emerging contractors. Over and above, the following points are also addressed:

- While adopting the tasks, checks have been made whether or not they are relevant for the underlying local conditions.

- The identified twelve tasks for quality estimates have been sub tasked with associated tasks based on the literature survey.

Taking all the above into account, the questionnaire is designed carefully to get high response rate from respondents who have and used to have direct exposure to construction project cost estimation and who are mainly owners of construction firms, manager of firms and professionals comprising of Building Engineers, Civil Engineers, Construction Technology & Management Professionals, Electrical Engineers, Sanitary Engineers, Mechanical Engineers and Quantity surveyors. The designed questionnaire that consists of four major sections is basically aimed at acquiring data on the general background information of the respondents and their organization, tendering, assessment of firms Proposal management & estimating team and cost estimation practice of these firms.

The structured questionnaire is answered based on Likert's-scale of five and four ordinal measures of agreement to each statement (Susan, 2004) as shown in the following sections. Likert's-scale is important to know respondents' outlooks or attitudes about something. The reasons for adopting this simple scale are:

- To easily administer and analyze the collected data.
- To provide simplicity for the respondent to answer. Because this scale is more efficient in the sense that a respondent is able to complete more closed-ended items than open-ended items in a given period of time (Polit & Hungler, 1993).

The respondents should indicate how closely their approaches match with the question or statement on a ranking scale. Respondents are asked about their degree of practice on the tasks that can ensure quality estimates. For each task, practices of its associate tasks are asked. The level of frequency of their practice is categorized on a five point scale as shown in Appendix I.

For proposal management and estimating team of firms that are under the study, respondents are asked to highlight the professional background of the estimator through a closed ended question. After data is collected on estimators, professional background of these estimators are identified and measured to enhance estimation is recommended in light of professional background of estimators.

3.10 Questionnaire format and sections

The questionnaire, 11 pages long, was divided into 4 sections. It included Likert scale measurement, close-ended questions and 1 open-ended question. It was designed in such a way that only straightforward, concise, brief and short answers were required. Upon trial, the questionnaire could be answered within 20 - 25 minutes. Data for analysis would result from measurement of one or more variables that had been included in the questionnaire. The four sections were:

Section 1: Demographic

This Section aimed at gaining demographic data. It consists of inquiries on general background information of the respondent professional's field of expertise, their position in the organization and duration of professional work experience, category of the organization and class of organization in which the respondent is representing. This information could assist the researcher when interpreting the results, for example, whether respondents lacked knowledge of cost estimation because they were uneducated, or whether they have direct exposure to construction project cost estimation activities or not.

Section 2: Tendering

The second part of the questionnaire focuses on tendering. It asks respondents about mostly used tendering method and their success rate in competitive bidding. Besides if

success rate is low, it enquire respondents' opinion weather it is related with their cost estimation practice.

Section 3: Proposal management & estimating team

The third section incorporates questions that enquire identification of the responsible person for cost estimation in the firm and his/ her professional background.

Section 4: Cost estimation

This section consists of enquires on estimation practices as per respondents perspective. Enquires consist of frequency of estimation methods used, cause and effects of poor estimation practice in the firm and the cost estimation process in which the firm follows against the twelve tasks as identified in the literature review for ensuring quality estimate. The questionnaire developed and used is presented in appendix 1.

3.11 Method of Analysis

After the data was collected it was organized and analyzed. For analysis of closed-ended questions, a computer program called Statistical Package for Social Sciences (SPSS) was used. Data was analyzed by using both inferential and descriptive statistics. Frequency tables were drawn and part of data was presented in bar graphs.

For the variables stated in the questionnaire, respondents are requested to indicate the degree of impact/ severity/ importance or frequency of occurrence. The degree of causes and effects of cost estimation is categorized into three scales and the other practices with Likert scales into five scales. (Le-Hoai et al, 2008; Nefkote, 2014; Al-Khalil and Al Ghafly, 1999; Assaf and Hejji, 2006; Apolot et al, 2012) used Severity Index (SI), Frequency Index (FI), Importance Index (II) and mean value data analysis methods to identify, to rank and to

examine the importance in terms of degree of occurrence and level of severity for problems in construction projects. The same method is adopted in this study to analyze and assess the research data collected. Data are analyzed using Equation 1 to 4 and other statistical methods. These equations are described as follows (Assaf and Hejji, 2006):

a) The Severity Index (SI) for each of the variables is computed with the formula:

$$\text{SI (\%)} = \left(\frac{\sum_{i=1}^{4} A_i N_i}{4 \sum_{i=1}^{4} N_i} \right) \text{x } 100\% \qquad (1)$$

Where A is the constant expressing the weighting given to each response, it ranges from 1 for none to 4 for very high; N is the frequency of the responses.

b) Similarly, the Frequency Index (FI) for each of the variables is computed with the formula:

$$\text{FI (\%)} = \left(\frac{\sum_{i=1}^{5} B_i N_i}{5 \sum_{i=1}^{5} N_i} \right) \text{x } 100\% \qquad (2)$$

Where B is the constant expressing the weighting given to each response, it ranges from 1 for never to 5 for high; N is the frequency of the responses.

c) Importance Index (II) for each of the variables is computed as a product of both severity and frequency indices. It is given by:

$$\text{II (\%)} = \left[S.I(\%) \times F.I(\%) \right] / 100 \qquad (3)$$

d) Ranking of variables is made using the Importance Index (II), Frequency index or severity index by assigning the first rank for the highest value, the second rank to the next highest value and so on.

The data collection and analysis methods explored in the literature review are used to provide appropriate formulae upon which to test the research findings in local construction firms. The four formulae: (1) the Severity Index, (2) the Frequency Index, (3) Importance Index, (4) Mean value play a significant role in analysing the practice of cost estimation, with possible solutions/recommendations to enhance the practice.

Responses were then ranked based on their severity/ importance indices. Then these indices were grouped to reflect the scale of the respondents' answers to the evaluation of the practice as follows:

Index range - $75 < Is \leq 100$, most severe/ Most important

Index range - $50 < Is \leq 75$, moderately severe/ moderately important

Index range - $25 < Is \leq 50$, slightly severe/ slightly important

Index range - $0 < Is \leq 25$, non-severe/ non-important

The translation of mean value is analysed based on the following criteria as per designed by Best (1977)

The score b/n 1.00-1.80 mean lowest frequency/ importance (Lowest)

The score b/n 1.81-2.61 mean low frequency/ importance (Low)

The score b/n 2.62-3.41 mean average frequency/ importance (Average/ Medium)

The score b/n 3.42-4.21 mean good frequency/ importance (High)

The score b/n 4.22-5.00 mean frequency/ importance satisfaction (Highest)

As per the literature review of this paper, quality cost estimate is an estimate which realizes the four key requirements of cost estimation i.e., accuracy, comprehensiveness, well documentation and credibility. The review also shows that these requirements can be achieved/ developed via the cost estimation process, which is prearranged as 12 cost estimating tasks. Thus this research survey used these twelve cost estimating tasks as a tool

to draw conclusions about the local practice in such a way that the status quo of the four key cost estimating requirements among local emerging contractors can be inferred. Tisha (2010), Karen (2015) and Carol (2009) used the twelve steps of cost estimates to audit estimation practices. The underneath table shows mapping of the twelve tasks with their associate cost estimation requirements, as used by this research.

Table 4 Mapping of the twelve tasks with their associate cost estimation requirements

Cost estimate requirement	Related Steps
Well documented	1 - Define the estimate's purpose 3 - Define the project 5 - Identify ground rules and assumptions 6 - Obtain the data 10 - Document the estimate 11 - Present the estimate to management
Comprehensive	2 - Develop the estimating plan 4 -Determine the estimating approach
Accurate	7 - Develop the point estimate and compare it to an independent cost estimate 12 - Update the estimate to reflect actual costs and changes
Credible	7 - Develop the point estimate and compare it to an independent cost estimate 8 - Conduct sensitivity analysis 9 - Conduct risk and uncertainty analysis

Source: GAO, 2009

Chapter 4 - DATA PRESENTATION AND RESULTS

4.1 Introduction

Chapter four presents the way the questionnaires are distributed, responses are retrieved and subsequent analysis of the data collected through the questionnaire survey from respondents working for construction firms who are/ were staffs of emerging firms within the vicinity of Addis Ababa, Ethiopia. The principal purpose of the survey is to assess the practice of cost estimation of captioned firms and then to find out the critical factors that are required to be given due attention in order to substantially enhance estimation practice of these firms within the study area.

4.2 Questionnaire Response Rate

Hand-to-hand delivery was preferred to get more response rate and to promote respondents but several alternative means such as tele-fax and email are also employed. Moreover, phone calls are frequently made to remind respondents for completing the questionnaire. A total of 135 questionnaire sets were aimed to distribute to firms; i.e., 70 to building contractors, 30 to general contractors, 3 to road contractors, 13 to electro-mechanical contractors, 6 to electrical contractors, 2 to electrical equipment installation contractors, 2 to water well drilling contractors, 8 to water works contractors and 1 to sanitary work contractors.

From the total of 135 questionnaires distributed, 98 responses are received (Table 5). These are 53 from building contractors, 18 from general contractors, 2 from road contractors, 9 from electro-mechanical contractors, 5 from electrical contractors, 1 from electrical equipment installation contractor, 2 from water well drilling contractors, 7 from water works contractors and 1 from sanitary work contractor. The overall response rate is 73% (Table 5).

Table 5 Questionnaire distribution and response

Certificate of Competence Issuing Body	Category	population	Number Distributed	Number of Responses	Percentage of responses received
Ministry of Construction	Building Contractor	229	70	53	76%
	General Contractor	78	30	18	60%
	Road Contractor	8	3	2	67%
Ethiopian Energy Authority	Electro-Mechanical Contractor	37	13	9	69%
	Electrical Contractor	17	6	5	83%
	Electrical Equipment Installation Contractor	5	2	1	50%
Ministry of Water, Irrigation & Electricity	Water Well Drilling Contractor	7	2	2	100%
	Water Works Contractor	27	8	7	88%
	Sanitary Works Contractor	4	1	1	100%
	Total	412	135	98	73%

Source: Primary Data

N.B. Population is limited to:

1. Contractors who acquire certification from Addis Ababa, the capital. It doesn't include contractors who acquire competence certificate from regional government bodies.
2. Contractors of Grade 1 - Grade 5
3. Contractors who have joined the industry from 2006 - 2008 E.C. (2013/14 - 2015/16 G.C)

4.3 Demographic Profile of Respondents

4.3.1 Gender of Respondents

The respondent's gender profile indicates, as shown in the table below, majority of respondents are male which accounts 82.7 percent of the sample respondents whereas female respondents account for 17.3 percent of the sample respondents. The response showed that majority of respondents of the questionnaire were all men in what seems to testify the remark by Amaratunga et al. (2005) that the construction industry is typically a male dominated industry.

Table 6 Gender of respondents

Gender	Frequency	Percent (%)
Male	81	82.7
Female	17	17.3
Total	98	100

Source: Primary data

4.3.2 Age of Respondents

Respondents come from all ages of working life. The age of majority of the respondents as shown from table 7 is between 41-50 years of age numerically 34.7 percent. Whereas 25.5 & 16.3 percent fall between ages of 36-40 & 25-35 respectively. The rest falls above 51.

Table 7 Age of Respondents

Age category	Frequency	Percent (%)	Cumulative percent
25 - 35 Yrs.	16	16.3	16.3
36 – 40 yrs.	25	25.5	41.8
41 – 50 yrs.	34	34.7	76.5
51 - 55 yrs.	11	11.2	87.8
Over 55 yrs.	12	12.2	100
Total	98	100	

Source: Primary data

4.3.3 Position in the enterprise

With regard to respondent's position in their organization, 20.4% of respondents are General Managers/ Deputy General Managers, 18.4 & 11.2% of Project managers & Admin & Finance head of their firms respectively, and Majority of respondents i.e., 27.6 & 22.4 % are Contract Administrators & office engineers of their firm respectively.

Table 8 Respondents position in the enterprise

Position	Frequency	Percent (%)	Cumulative percent
General/Deputy Manager	20	20.4	20.4
Project Manager	18	18.4	38.8
Office Engineer	22	22.4	61.2
Contract Admin	27	27.6	88.8
Admin/ Finance	11	11.2	100
Total	98	100	

Source: Primary Data

According to the preceding information, it can be concluded that respondents that are involved in the current research survey are well experienced, keen to cost estimation activities of their firms and are likely to shoulder responsibilities with a greater probability of being responsible.

4.3.4 Education Level Attained

Education level attained by respondents as indicated by the table 9 below, majority of the respondents were first degree holders which is 49 percent of the total respondents which is followed by Advance/normal diploma holders 26.5 percent and the least is (3%) for who have attained education under college level. The rest, 21.4% of respondents are post graduate degree holders.

Table 9 Education Level of Respondents

Education Level	Frequency	Percent (%)	Cumulative percent
Advance/normal diploma	26	26.5	26.5
Bachelor's Degree	48	49	75.5
Post-graduate Degree	21	21.4	96.9
Other	3	3.1	100
Total	98	100	

Source: Primary Data

The preceding information explains the level of qualified professionals deployed in the construction industry and which in turn points out the fact that their perceptions can be relied up on.

4.3.5 Experience in the Construction Industry

Table 10 Experience of Respondents in construction industry

Work Experience	Frequency	Percent (%)	Cumulative percent
Less than 3 years	2	2	2
3-5 years	13	13.3	15.3
5-10 years	24	24.5	39.8
10-15 years	36	36.7	76.5
Over 15 years	23	23.5	100
Total	98	100	

Source: Primary Data

As the table indicates 2 & 13.3 percent of respondents have less than 3 years & 3-5 years of experience respectively in the construction industry. 24.5% of respondents are with an experience of 5-10 years within the industry. Majority of respondents, i.e. more than 60% of respondents, have a good deal of experience in the construction industry with work experience of more than 10 years. It can be observed from the data that respondents have been involved in different kinds of construction projects that have long durations. These experiences have equipped them with a wealth of knowledge that helped them to answer the survey questions satisfactorily and provided valuable additional comments which have improved the quality of data collected in this research.

4.3.6 Experience in the current enterprise & Cost Estimation Training

Despite the fact that respondents have a good deal of experience in the construction industry, all of them have spent less than 5 years in their present enterprise. This finding backs the fact that the population under the study is of emerging firms.

Likewise, 82.7% of respondents have replied that they have a formal cost estimation training indicating that they understand the subject matter in which they are dealing with.

4.4 General Characteristics of Firms under the study

Table 11 General Characteristics of Firms

Variables	Classification of Variables	Frequency	Percent	Cumulative Percent
Category	Water well Drilling	2	2	2
(Type of Contractor)	Water Works	7	7.1	9.2
	Sanitary Works	1	1	10.2
	Electro-Mechanical	9	9.2	19.4
	El. Equipment Installation	1	1	20.4
	Electrical	5	5.1	25.5
	General	18	18.4	43.9
	Building	53	54.1	98
	Road	2	2	100
Class	Grade 1	17	17.3	17.3
	Grade 2	7	7.1	24.5
	Grade 3	40	40.8	65.3
	Grade 4	21	21.4	86.7
	Grade 5	13	13.3	100
Legal form of	Sole Proprietor- ship	61	62.2	62.2

organization	Private Limited Company	37	37.8	100
Years in Operation	Less than five years	84	85.7	85.7
	5-10 years	2	2	87.8
	11-15 years	6	6.1	93.9
	15-20 years	3	3.1	96.9
	Over 20 years	3	3.1	100
Number of Employees (Permanent employees)	Less than 25	46	46.9	46.9
	25-75	13	13.3	60.2
	76-150	11	11.2	71.4
	151-250	23	23.5	94.9
	Over 250	5	5.1	100
Involvement in Public Sector proj.	Yes	74	75.5	75.5
	No	24	24.5	100
Involvement in Private sector proj.	Yes	69	70.4	70.4
	No	29	29.6	100
Type of Projects				
Residential	Yes	64	65.3	65.3
	No	34	34.7	100
Industrial & Comm. Construction	Yes	57	58.2	58.2
	No	41	41.8	100
Infra. (Road, Bridge, Airport, etc.)	Yes	32	32.7	32.7
	No	66	67.3	100

Electro-mech. & Electric related	Yes	29	29.6	29.6
	No	69	70.4	100
Water & Sanitary work	Yes	15	15.3	15.3
	No	83	84.7	100
Well drilling & Rehabilitation	Yes	7	7.1	7.1
	No	91	92.9	100

Source: Primary Data

With regard to the enterprises involved in the survey, 2% of them were water well drilling contractors, 7.1% water works contractors, 1% sanitary contractors, 9.2% Electro-mechanical contractors, 1% electrical equipment installation contractors, 18.4% general contractors, 54.1 building contractors, and 2% were road contractors. Their class distribution is Grade 1 (17.3%), Grade 2 (7.1%), Grade 3 (40.8%), Grade 4 (21.4%) and Grade 5 (13.3%).

According to the survey there are only two types of legal form of the organizations, i.e. sole proprietorship and private limited company. 62.2% of the subject enterprises are sole proprietorship and the remaining 71.4% are private limited companies.

85.7 percent of enterprises under the study have been in operation for not more than 5 years. The remaining 14.3% have been in operation for more than 5 years. This seems to contradict with the target population of the study, emerging construction firms. Nevertheless these firms which were in operation for more than five years have been in another business and joined/emerge the construction industry at same time interval that the target population emerged as a side business.

In terms of the permanent employees they employ, 46.9 % of the enterprises have less than 25 permanent employees. Only 5.1% of these enterprises have more than 250 permanent

staffs. Outstanding enterprises have permanent staffs between 25 – 250 employees. Among firms under the study, about 46% involved both in private and public sectors. Remaining enterprises involve only in either of them. Although Building contractors are registered to be engaged in the construction of buildings, the survey showed that some proportion of these firms have been involved in infrastructure, Electro-mechanical & electric related, water and sanitary works, well drilling & rehabilitation projects. A similar situation is observed among general contractors in relation to type of projects in which they have been engaged.

4.5 Tendering

4.5.1 Project Procurement Method

Table 12 Importance level of Procurement Method

S/N	Method	Mean	Importance Index	Rank
1	Open or Public Tenders	3.62	72.45	1
2	Selected or Approved Tenders	2.13	42.65	2
3	Pre-Qualified Tenders	1.62	32.45	4
4	Direct Negotiation	2.03	40.61	3
5	Two Stage Tendering	1.11	22.24	5

Source: Primary Data

The research indicated that, the surveyed contractors procured most of the projects they have undertaken so far, through open or public tendering method. As the table shows, this method ranked first with mean value of 3.63 and importance index of 72.45%. Obtaining projects via selected or approved tendering method is the second mostly used method with a mean value of 2.13 and importance index of 42.66%. Direct negotiation ranked third with

2.03 mean value and 40.61% Importance index. According to the analysis, experiencing pre-qualified tendering method is placed to fourth stage with mean value of 1.62 and importance index of 32.45%. Among the tendering methods two stage tendering is the least practiced method with mean value of 1.11 and importance index of 22.24%. It is worth concluding that the method in which majority of studied construction firms obtain projects is predominantly open/ public tendering.

4.5.2 Proportion of Projects Obtained through Competitive Bidding

The research indicated that contractors' approach to the acquisition on award of contracts is predominantly competitive. 87% of the surveyed contractors procured most of projects they have undertaken so far, through tendering while remaining contractors mainly by negotiation.

Table 13 Percent of works obtained through competitive bidding

Range	Frequency	Percent (%)	Cumulative percent
Under 25%	7	7.1	7.1
25% - 50%	5	5.1	12.2
50% - 75%	53	54.1	66.3
75% - 100%	33	33.7	100
Total	98	100	

Source: Primary Data

4.5.3 Number of Tender Submitted Annually

Table 14 Number of Tender Submitted Annually

Range	Frequency	Percent (%)	Cumulative percent
Below 15	60	61.2	61.2
16 – 30	32	32.7	93.9
31 – 50	3	3.1	96.9
Above 50	3	3.1	100
Total	98	100	

Source: Primary Data

The study indicated that the average number of tender offers made annually by majority of the contractors is below 15, i.e. 61.2%. As shown in Table 14, the average number of tender offers submitted annually by 32.7% of the surveyed contractors is between 16 and 30. According to the survey, it can be anticipated that these enterprises submit one or two tender offers per month.

4.5.4 Rate of Success of tender offer

Table 15 Rate of Success of tender offer

Range	Frequency	Percent (%)	Cumulative percent
Under 25%	71	72.4	72.4
25% - 50%	21	21.4	93.9
50% - 75%	5	5.1	99
75% - 100%	1	1	100
Total	98	100	

Source: Primary Data

In the literature review of this paper, it is stated that construction firms are project based firms which needs securing construction projects for their survival and growth. Hence these firms need to obtain projects with adequate volume and number and ensuring that these projects are generating sufficient amount of profit in such a way that survival and growth of the firm can be secured.

In this regard, an assessment was made to reveal the rate of success of tender offer made by these enterprises. The survey results indicated that the tender offer success rate for majority of the contractors is low. As shown in Table 15, the success rate for 72.4% of contractors, is below 25%, and 21.4% of firms have a success rate of 25% - 50%. Only 6.1% of samples have a success rate which is more than 50%.

4.5.5 Cost estimation and Rate of success in tendering

Table 16 Relation between Cost estimation and Rate of success in tendering

Response	Frequency	Percent (%)	Cumulative percent
Yes	79	80.6	80.6
No	13	13.3	93.9
Not sure	6	6.1	100
Total	98	100	

Source: Primary Data

The above table reveals that 80.6% of respondents perceived that cost estimation is one of the major causes that aggravate their deprived success in tendering. Few respondents, i.e. 13.3%, responded that cost estimation is not one of major causes that can affect the rate of success of their enterprise in tendering.

4.5.6 Components of Tender Document

Table 17 Importance level of Components of Tender Document identified in this study

S/N	Components of Tender Document	Mean	Importance Index	Rank
1	Instruction to Bidders	3.15	63.06	10
2	the form of the tender	3.21	64.29	9
3	Information about final submission Date, Time and place	3.92	78.37	5
4	Bid Submission forms and bid security forms	3.28	65.51	8
5	Legal documents & qualification demonstration requirements	3.37	67.35	6
6	Bid Validity Period	2.89	57.76	12
7	Price Adjustments that may apply during implementation	2.78	55.51	13
8	the terms and conditions of the contract	3.07	61.43	11
9	bill of quantities	4.81	96.12	1
10	the specifications	4.56	91.22	2
11	designs/drawings and/or plans	4.14	82.86	4
12	the quality requirements	3.29	65.71	7
13	the evaluation criteria	4.39	87.76	3

Source: Primary Data

“Indicate the level of importance of under listed components of tender document in your cost estimation process.” is one of a question on the questionnaire so as to assess the practice of cost estimators in weighing importance level of parts of the document. After analyzing the data, it is found out that bill of quantity is perceived to be the most important

component of a tender document in view of cost estimators. It ranked first with a mean value of 4.81 and importance index of 96.12%. The second rank goes to specifications with 4.56 mean value and 91.22 of importance index. The evaluation criteria have been ranked third, with a mean value of 4.39 and an importance index of 87.76%. Mean value 4.14 and an importance factor of 82.86% belong to designs/ drawings and/ or plans ranking fourth. According to the table, Information about final submission date, time and place with mean value of 3.92 & importance index of 78.37%, Legal documents & qualification demonstration requirements with mean value of 3.37 & importance index of 67.35%, the quality requirements with mean value of 3.29 & importance index of 65.71%, Bid Submission forms and bid security forms with mean value of 3.28 & importance index of 65.51%, the form of the tender with 3.21 mean value & 64.29% of importance index, Instruction to Bidders with 3.15 mean value & 63.06% of importance index, the terms and conditions of the contract with mean value of 3.07 & 61.43% of importance index and Bid Validity Period with 2.89 mean value & 57.76% of importance index ranked, 5^{th} to 12^{th} sequentially. Respondents indicate that Price Adjustments that may apply during implementation is the least important component of a tender document through estimator's perspective. It ranked last with mean value of 2.78 and an importance index of 55.51%.

In the local construction industry of Ethiopia, it is obvious and widely known that the provision of price adjustment clause that may apply during implementation allows a contractor to be at least partially protected against material or fuel price increases that may occur between the contract award and the execution of the work. This is done by having an owner accepting the risk for escalating prices by offering a PAC that pays the contractor for any increases above an agreed-upon threshold (trigger value).Prices of goods and labor are highly variable due to fluctuations in the currency market. Also, some price adjustment clauses contain provisions for the contractor to provide a rebate to the owner in the event of decreasing commodity prices. In light of this, it can be easily visualized the high importance of considering the direct and indirect impact of this clause in cost estimates, Russel et.al, (2013), PEC, (2009). Though the provision or non-provision of the clause decreases or increases the bid price, the analysis showed that it is poorly understood/ considered among cost estimators of the survey sample. This implies that local construction

cost estimators are not prudent enough to compute the cost of contracts on present price, keeping provisions of price adjustment for probable fluctuations.

4.5.7 Tender Evaluation Criteria

The under table presents emerging contractor's rating of the importance of tender Evaluation Criteria, during cost estimation.

Table 18 Importance index of Tender Evaluation Criteria identified in this survey

S/N	Tender Evaluation Criteria	Mean	Importance Index	Rank
1	proposed technical offer	3.29	65.71	2
2	prices and costs	4.62	92.45	1
3	delivery times and terms	2.54	50.82	3
4	Availability and quality.	2.45	48.98	4

Source: Primary Data

As per the perception of respondents the above table indicated that criteria for prices and costs ranked first with 4.62 mean value & 92.45% of importance index. The second rank, with mean value of 3.29 & importance index of 92.45%, goes to the criteria for proposed technical offer. Criteria for delivery times and terms and availability and quality ranked third and fourth with mean values of 2.54, 2.45 and importance index of 50.82% & 48.98% consecutively.

From the above ranking it can be realized that prices and costs are great concerns of cost estimators among other tender evaluation criteria which is right and fair. Construction cost is highly affected by delivery times and terms as well as availability and quality. Nevertheless, these criteria ranked least implying that cost estimators of emerging local

construction firms are not prudent enough to delivery times and terms besides Availability and quality.

4.6 Proposal Management & Estimating team

4.6.1 Responsibility of Proposal Management &Cost Estimating

Table 19 presents the emerging contractors' distribution according to frequencies of responsibility for managing proposal and estimating among the role players (business owner, project manager and independent expert) involved when the emerging contractors prepare tender documents.

Table 19 Responsibility for proposal management and estimation

Response	Frequency	Percent (%)	Cumulative percent
Business Owner	74	75.5	75.5
Project Manager	21	21.4	96.9
Independent Expert	3	3.1	100
Total	98	100	

Source: Primary Data

Among emerging contractor sector which is under the study area, proposal management and estimation were dominated by business owners (75.5%), then project managers (21.4%) and, lastly, independent experts (3.1%).

Interest arises to test whether the responsibility in proposal management & estimation and the category of the contractor are independent. And Chi-Square is conducted to uncover any significant association between the responsible person for estimation and category of the firm. The underneath table shows the result.

The null hypothesis is H_o: Responsibility for tender proposal Management & Estimation and category of the contractor in the emerging contractor sector are independent.

All the tests were conducted at the 5% level of significance to determine whether the estimation method used by emerging contractors were due to an existing pattern or occurred randomly.

From the analysis, as presented in following tables, calculated Pearson Chi-Square is 26.272 with 16 d.f. (P-value= 0.0503). As the critical value of chi-square at 16 d.f. (26.296) is greater than calculated value, then we do not reject Ho. i.e. the result indicates that there is no statistically significant relationship among the responsible person and category of the contractor.

Table 20 Relation between Estimator and Enterprise Category

Crosstab

			Enterprise Category									
			Water Well Drilling Contractor	Water Works Contractor	Sanitary Works Contractor	Electro-Mechanical Contractor	Electrical Equipment Installation Contractor	Electrical Contractor	General Contractor	Building Contractor	Road Contractor	Total
Responsible person for tender proposal management and Estimation in firms	Business Owner	Count	2	6	1	3	0	5	12	44	1	74
		% within Enterprise Category	100.0%	85.7%	100.0%	33.3%	0.0%	100.0%	66.7%	83.0%	50.0%	75.5%
	Project Manager (Internal Staff)	Count	0	1	0	4	1	0	5	9	1	21
		% within Enterprise Category	0.0%	14.3%	0.0%	44.4%	100.0%	0.0%	27.8%	17.0%	50.0%	21.4%
	Independent Expert	Count	0	0	0	2	0	0	1	0	0	3
		% within Enterprise Category	0.0%	0.0%	0.0%	22.2%	0.0%	0.0%	5.6%	0.0%	0.0%	3.1%
Total		Count	2	7	1	9	1	5	18	53	2	98
		% within Enterprise Category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.272[a]	16	0.0503
Likelihood Ratio	22.967	16	.115
Linear-by-Linear Association	1.411	1	.235
N of Valid Cases	98		

a. 22 cells (81.5%) have expected count less than 5. The minimum expected count is .03.

Source: Primary Data

4.6.2 Professional background of Estimator

Table 21 displays the observed frequencies of the professional backgrounds of the various emerging contractor sector role players' in proposal management and estimation.

Table 21 Professional background of estimator

Response	Frequency	Percent (%)	Cumulative %
Civil Engineer	24	24.5	24.5
Building Engineer	31	31.6	56.1
Mechanical Engineer	4	4.1	60.2
Electrical Engineer	12	12.2	72.4
Sanitary Engineer	3	3.1	75.5
Construction Tech. & Management professional	22	22.4	98
Other Profession	2	2	100
Total	98	100	

Source: Primary Data

Among the study construction enterprises, building engineers dominated the contractors i.e. 31.6% of responses, followed by civil engineers (24.5%), Construction technology & management professionals (22.4%), Electrical engineers (12.2%), mechanical engineers (4.1%), sanitary engineers (3.1%), and, lastly, a mix of other types of professionals i.e. 2%.

Here also Interest arises to test whether the responsibility in proposal management & estimation, and the professional background of the estimator are independent. And Chi-Square is conducted to uncover any significant association between the responsible person

for estimation and his or her professional background. The underneath table shows the result.

The null hypothesis is H_o: Responsibility for tender proposal Management & Estimation and professional background of the estimator in the emerging contractor sector are independent.

The test is conducted at the 5% level of significance to determine whether the estimators professional background in the local emerging contractors sector were due to an existing pattern or occurred randomly.

From the analysis, as presented in following tables, calculated Pearson Chi-Square is 20.514 with 12 d.f. (P-value= 0.058). As the tabulated value of chi-square at 12 d.f. (21.026) is greater than calculated value, then we do not reject Ho. I.e. the result indicates that there is no statistically significant relationship among the responsible person and his or her professional background.

Table 22 Relation between Estimator & His/ Her professional background

Crosstab

			Professional background of the estimator							
			Civil Engineer	Building Engineer	Mechanical Engineer	Electrical Engineer	Sanitary Engineer	Construction Technology & Management Professional	Other Profession	Total
Responsible person for tender proposal management and Estimation	Business Owner	Count	19	24	0	9	3	18	1	74
		% within the professional background of the estimator	79.2%	77.4%	0.0%	75.0%	100.0%	81.8%	50.0%	75.5%
	Project Manager (Internal Staff)	Count	5	7	3	2	0	3	1	21
		% within the professional background of the estimator	20.8%	22.6%	75.0%	16.7%	0.0%	13.6%	50.0%	21.4%
	Independent Expert	Count	0	0	1	1	0	1	0	3
		% within the professional background of the estimator	0.0%	0.0%	25.0%	8.3%	0.0%	4.5%	0.0%	3.1%
Total		Count	24	31	4	12	3	22	2	98
		% within the professional background of the estimator	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.514[a]	12	.058
Likelihood Ratio	19.562	12	.076
Linear-by-Linear Association	.059	1	.809
N of Valid Cases	98		

a. 15 cells (71.4%) have expected count less than 5. The minimum expected count is .06.

Source: Primary Data

4.7 Cost Estimation

4.7.1 Estimating Methods

The under table presents emerging contractors' rating of their practice in using construction cost estimating methods.

Table 23 Importance level of Estimating Methods

S/N	Estimating Methods	Mean	Importance Index	Rank
1	Parametric methods	1.41	28.16	3
2	Historical bid-based methods	3.65	73.06	2
3	Cost-based estimate methods	4.12	82.45	1
4	Risk-based estimate methods	1.02	20.41	4

Source: Primary Data

The survey indicated that cost-based estimate methods is highly exploited by emerging construction local firms ranking first with 4.12 mean value & 82.45% of importance index. Historical bid-based method is the second highest rand with 3.65 mean value & 73.06% of importance index. The third rank goes to parametric method with mean value of 1.41 & 28.16% of importance index. Risk-based estimate method ranked last with mean value of 1.02 & 20.41% of importance index.

Risk-based estimate method is a method of Risk identification and uncertainty analysis techniques to forecast project costs (Shane, 2015). Cost estimation global best practitioners exploit this method significantly. It is the best estimating method that can ensure a high quality estimate that utilizes risk identification and uncertainty analysis techniques. Meanwhile the survey indicated that this method is used very least among other methods

within the study area. Hence it can be deduced that ability of using best estimating method of tender cost estimation of local emerging contractors is under question.

4.7.2 Causes of inaccurate/ poor estimate

Respondents have been asked to identify their perception of factors that cause inaccurate/ poor estimates in their firm. The underneath table displays severity indices and ranking of variables of the cause as computed using equation (1).

Table 24 Sever causes of Poor Cost Estimate identified in this research.

S/N	Causes for Poor Cost Estimate	Response	Frequency	Severity Index (SI)	Rank
1	technical problems on how to estimate project costs	Yes	32	37%	6
		No	57		
		Not sure	9		
2	insufficient project information at the early stages of the project	Yes	91	94%	2
		No	5		
		Not sure	2		
3	Unrealistic timescales	Yes	75	82%	3
		No	12		
		Not sure	11		
4	Inexperienced and poorly trained staff	Yes	24	27%	7
		No	70		
		Not sure	4		

5	Poorly adhered to processes	Yes	8	9%	9
		No	88		
		Not sure	2		
6	Poorly defined, documented and tracked assumptions,	Yes	92	96%	1
		No	1		
		Not sure	5		
7	Inadequate, out-of-date or improperly recorded data,	Yes	38	44%	5
		No	49		
		Not sure	11		
8	Inappropriate Forecasting methodologies	Yes	11	23%	8
		No	64		
		Not sure	23		
9	No supported rationale or basis for the forecast.	Yes	45	57%	4
		No	31		
		Not sure	22		

Source: Primary Data

With respect to the various respondents' opinion, the analysis of severity of variables indicates that, the most sever causes of inaccurate/ poor cost estimates, with index range of $75 < Is \leq 100$ and as per their rank are:

1. Poorly defined, documented and tracked assumptions (SI = 96%)
2. Insufficient project information at the early stages of the project (SI= 94%)
3. Unrealistic timescales (SI = 82%)

Cause for poor estimates with moderately severe with index range 50 < Is ≤ 75 is “no supported rationale or basis for the forecast”. It ranked fourth with SI value of 57%.

Slightly severe causes of poor estimates (Index range 25 < Is ≤ 50), as indicated by the analysis are:

5. Inadequate, out-of-date or improperly recorded data (SI = 44%)
6. Technical problems on how to estimate project costs (SI= 37%)
7. Inexperienced and poorly trained staff (SI=27%)

Causes with Index range 0 < Is ≤ 25, which are categorized as non-severe are:

8. Inappropriate Forecasting methodologies (SI = 23%)
9. Poorly adhered to processes (SI = 9%)

Based on the results of the analysis as seen in tables 1 and 2, the following conclusions were drawn: Poorly defined, documented and tracked assumptions, insufficient project information at the early stages of the project and unrealistic timescales are the most sever causes of inaccurate/ poor cost estimate within the emerging construction sector of local firms. Having no supported rationale or basis for the forecast is a moderate cause for poor estimates. While Inadequate, out-of-date or improperly recorded data, technical problems on how to estimate project costs and inexperienced and poorly trained staff, have a slight effect on poor cost estimates. Meanwhile the result showed that, inappropriate Forecasting methodologies and poorly adhered to processes are causes of poor estimates which are non-sever within the emerging local construction firms.

4.7.3 Effects of inaccurate/ poor estimate

As well as the cause, respondents have been asked to identify their perception of effects of inaccurate/ poor estimates in their firm. The underneath table displays severity indices and ranking of variables of the effect as computed using equation (1).

Table 25 Sever Effects of Poor Cost Estimate identified in this research

S/N	Effects of Poor Cost Estimates	Response	Frequency	Severity Index (Is)	Rank
1	Cost Overrun	Yes	84	88%	1
		No	10		
		Not sure	4		
2	Project Failure	Yes	27	28%	4
		No	71		
		Not sure	0		
3	Company Failure	Yes	15	15%	5
		No	83		
		Not sure	0		
4	Bankruptcy	Yes	61	66%	3
		No	30		
		Not sure	7		
5	Failure to win Tender and luck projects/ acquiring new jobs	Yes	83	85%	2
		No	14		
		Not sure	1		

Source: Primary Data

With respect to the various respondents' opinion, the analysis of severity of variable indicates that, the most sever effects of inaccurate/ poor cost estimates, with index range of $75 < Is \leq 100$ are:

1. Cost Overrun (SI = 88%)
2. Failure to win Tender and luck projects/ acquiring new jobs (SI = 85%)

As per the analysis bankruptcy is an effect which is moderately sever with 66% of severity index. Project failure falls to a category of slightly sever among effects. While company failure is a non-sever effect of poor cost estimates in accordance with the above analysis and perception of the different respondents.

4.8 Best practice of Cost Estimation

Respondents have been asked to indicate their performance in developing cost estimates with a 5 scale Likert scale, so as to assess at what level the local construction industry is attaining, the key cost estimation requirements i.e., accuracy, comprehensiveness, well documentation and credibility (Please refer tables in Appendix II for frequency distribution of all responses of the twelve tasks). As stated in the methodology part of this paper, this research survey used the twelve cost estimating tasks (including their sub tasks), as a tool to draw conclusions about the local practice, in such a way that adoption of the global best practice of cost estimation can be evaluated.

4.8.1 Well Documentation

Documents are required to be in a level of detail that can show the estimates quality during the period of investigation in an easy and traceable manner. A strict discipline in documenting creates ease of decision making for managers. Besides it enhances the credibility of the estimate (GAO, 2009).

Respondents have been asked to indicate the frequency of documentation related cost estimating tasks that their firm practices while preparing a tender offer. The underneath table displays the summary of mean score value of tasks as data analyzed by SPSS software.

Table 26 Mean score of well documentation

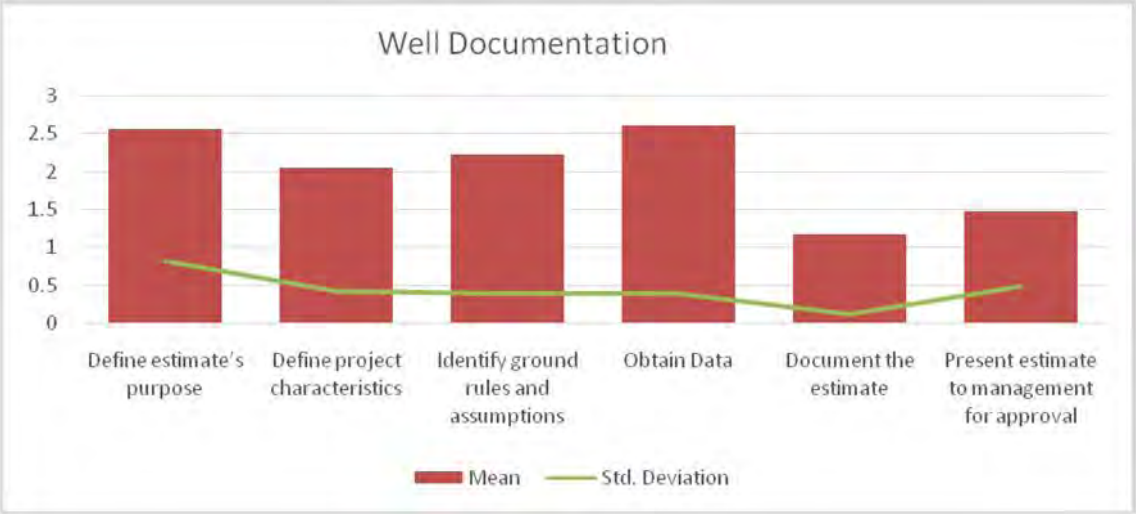
		QQ1_ Define estimate's purpose	QQ3_Define project characteristics	QQ5_Identify ground rules and assumptions	QQ6_Obtain Data	QQ10_Document the estimate	QQ11_Present estimate to management for approval	QQQ1_WELL DOCUMENTED
N	Valid	98	98	98	98	98	98	
	Missing	0	0	0	0	0	0	
Mean		2.5459	2.0394	2.2114	2.6054	1.1663	1.463	2.0052
Std. Deviation		0.81255	0.42328	0.38879	0.38766	0.12431	0.48369	0.20797

Source: Primary Data

The task of obtaining data has the highest mean score among tasks that are mapped with the well documentation characteristics, with a mean score of 2.6054 and standard deviation of .38766. Defining estimates purpose score the second highest within this category, with a mean score of 2.5459 and standard deviation of .81255. The third highest mean is scored by a task of identifying ground rules and assumptions with a mean score of 2.2114 and standard deviation of .38879. Define project characteristics and present estimates to management for approval score mean values of 2.0393 and 1.463, with standard deviation of .42328 and .48369 respectively. Document the estimate score the least among this category of tasks. It scored a mean value of 1.1663 and a standard deviation of .12431. Accordingly this characteristic, well documentation has a grand mean score of 2.0052 with a standard deviation of .20797.

The analysis shows that the performance of well documentation characteristics is in low range, i.e., b/n 1.81–2.61 mean. It is found out that the task of documenting the estimate is lowest performed task with a score between 1.00 – 1.80 mean. On the other hand, remaining tasks scored b/n 1.81 – 2.61 which are interpreted to be low. Hence it worth concluding that, the performance of emerging local construction firms towards well documentation of estimates is low.

Figure 3 Bar graph on response for well documentation



Source: Primary Data

4.8.2 Comprehensiveness

Costs shall be estimated to a level of detail that can ensure every pertinent cost element is not lost, every possible cost have been considered, its completeness and consistency (GSA, 2007; GAO, 2009). In addition to this, the level of detain shall assure that the estimate is free from double-counted cost elements. Meanwhile all assumptions and exclusions that are functions of the foundation of the estimate shall be checked in parallel, for their reasonableness and weather they are clearly identified and explained.

Respondents have been asked to indicate the frequency of comprehensiveness related cost estimating tasks that their firm practices while preparing a tender offer. The underneath table displays the summary of mean score value of tasks as data analyzed by SPSS software.

Table 27 Mean score of well comprehensiveness

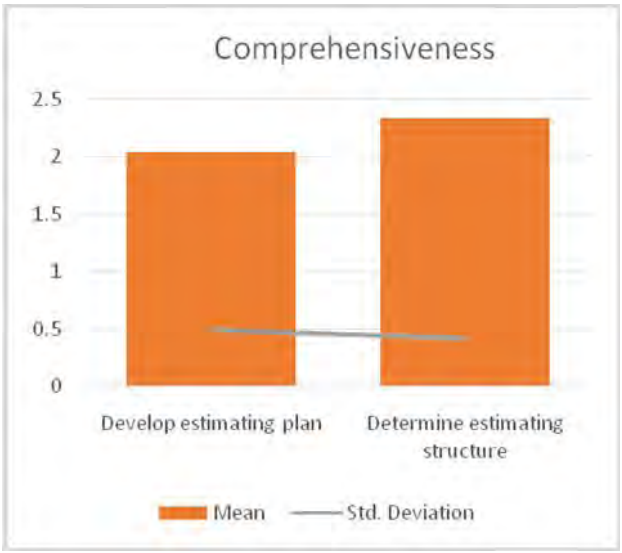
		QQ2_Develop estimating plan	QQ4_Determine estimating structure	QQQ2_COMPREHENSIVE
N	Valid	98	98	
	Missing	0	0	
Mean		2.0332	2.3342	2.1837
Std. Deviation		0.48779	0.42162	0.31917

Source: Primary Data

The task of determining estimating structure has the highest mean score among the two tasks that are mapped with the well comprehensiveness characteristics, with a mean score of 2.3342 and standard deviation of .42162. “Developing estimating plan”, score the least among this category of tasks. It scored a mean value of 2.0332 and a standard deviation of .48779. Accordingly this characteristic, comprehensiveness, has a grand mean score of 2.1837 with a standard deviation of .31917.

The analysis shows that the performance of comprehensiveness, i.e., one of the key requirements of quality cost estimates, is in low range, i.e., b/n 1.81–2.61 mean. Accordingly it is found out that both tasks that are mapped for this requirement, (determining estimating structure and developing estimating plan), score b/n 1.81 – 2.61 which is interpreted to be low. Yet again it is worth to conclude that emerging local construction firm’s performance towards comprehensiveness of estimates is low.

Figure 4 bar graph on response for Comprehensiveness



Source: Primary Data

4.8.3 Accuracy

Accurate estimates are estimates that are: projected by means of most likely costs, properly adjusted for inflation, easy to adapt changes due to change in underlying assumptions/ or schedule, free from errors (if possible) (GAO, 2009).

Respondents have been asked to indicate the frequency of accuracy related cost estimating tasks that their firm practices while preparing a tender offer. The underneath table displays the summary of mean score value of tasks as data analyzed by SPSS software.

Table 28 Mean score of accuracy

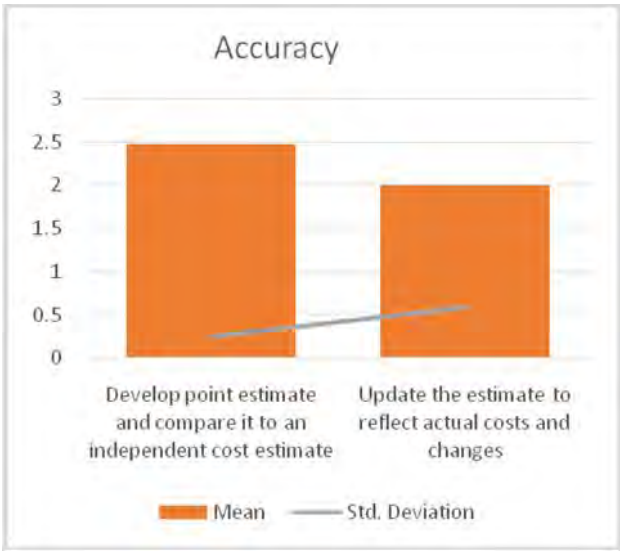
		QQ7_Develop point estimate and compare it to an independent cost estimate	QQ12_Update the estimate to reflect actual costs and changes	QQQ3_ACCURATE
N	Valid	98	98	
	Missing	0	0	
Mean		2.4707	2	2.2353
Std. Deviation		0.25434	0.58425	0.32163

Source: Primary Data

The task of “Develop point estimate and compare it to an independent cost estimate” has the highest mean score among the two tasks that are mapped with accuracy characteristics, with a mean score of 2.4707 and standard deviation of .25434. Update the estimate to reflect actual costs and changes score the least among this category of tasks. It scored a mean value of 2.00 and a standard deviation of .58425. Accordingly this characteristic, accuracy, has a grand mean score of 2.2353 with a standard deviation of .32163.

The analysis shows that the performance of accuracy, i.e., one of the key requirements of quality cost estimates, is in low range, i.e., b/n 1.81–2.61 mean. Accordingly it is found out that both tasks that are mapped for this requirement, (develop point estimate & compare it to an independent cost estimate and update the estimate to reflect actual costs & changes), score b/n 1.81 – 2.61 which is interpreted to be low. Here also it is worth to conclude that emerging local construction firm’s performance towards accuracy of cost estimates is low.

Figure 5 Bar graph on response for Accuracy



Source: Primary Data

4.8.4 Credibility

Data and assumptions are prone to uncertainty and bias. An estimate to be credible it shall clearly show the level of risk and uncertainties within its underlying assumptions and data (GSA, 2007). Sensitivity, risk and uncertainty analysis are tools that helps to define the degree of risk accompanying the estimate. Moreover credibility of project cost estimates can best be determined thru Independent verification and validation. This ensures that entire procedures of the estimate are exhaustively reviewed, in such a way that it meets business objectives. Independency allows this party to take an objective view while identifying high-risk areas early in the project so as one can mitigate risks and prepare contingencies along with the estimate, (O.Lewis, 1992; GAO, 2009; Zelkowitz and IoanaRus, 2002).

Respondents have been asked to indicate the frequency of Credibility related cost estimating tasks that their firm practices while preparing a tender offer. The underneath table displays the summary of mean score value of tasks as data analyzed by SPSS software.

Table 29 Mean score of Credibility

		QQ7_Develop point estimate and compare it to an independent cost estimate	QQ8_Conduct sensitivity analysis	QQ9_Conduct risk and uncertainty analysis	QQQ4_CREDIBLE
N	Valid	98	98	98	
	Missing	0	0	0	
Mean		2.4707	1.0714	1.1871	1.5764
Std. Deviation		0.25434	0.28818	0.25657	0.18572

Source: Primary Data

The task of “develop point estimate and compare it to an independent cost estimate” has the highest mean score among tasks that are mapped with credibility characteristics, with a mean score of 2.4707 and standard deviation of .25434. Conduct risk and uncertainty analysis score the second highest within this category, with a mean score of 1.1871 and

standard deviation of .25657. Conducting sensitivity analysis scores the minimum among this category of tasks. It scored a mean value of 1.0714 and a standard deviation of .28818. Accordingly this characteristic, credibility, has a grand mean score of 1.5764 with a standard deviation of .18572.

The analysis illustrates that the performance of credibility characteristics is in the lowest range, i.e., b/n 1.00–1.80 mean. It is found out that relatively better performed task is "develop point estimate and compare it to an independent cost estimate". Although it is relatively better it scored b/n 1.81 – 2.61, which is understood to be low. On the other hand, remaining tasks (conducting sensitivity analysis & conducting risk and uncertainty analysis) scored b/n 1.00 – 1.80 mean, which are interpreted to be the lowest. Hence it is worth to conclude that emerging local construction firms' performance towards credibility of estimates is the lowest.

Figure 6 Bar graph on response for Credibility

Source: Primary Data

Chapter 5 - CONCLUSION AND RECOMMENDATION

5.1 Introduction

The research set out with the object of assessing cost estimation practices of emerging contractors of Ethiopia, particularly Addis Ababa based Local Contractors, with the specific objectives of:

- Analyzing project cost estimation practices, methods and processes utilized by emerging local contractors of Ethiopia
- Identify deficiencies requiring remedial actions
- Recommend solutions that can enhance the performance of emerging construction firms while estimating tender prices.

In an effort to achieve these objectives a modest examination into the literature has been made. The complex nature of construction cost estimation was established and the value and significance of adopting best practices of cost estimation for construction organizations has been reviewed in the effort to achieve their objectives.

An empirical survey was conducted by the researcher in an effort to examine the experience of the local construction firms with respect to the management of tender cost estimation. Both primary and secondary data collected through the research survey was analyzed to understand the cost estimation practice in construction enterprises of Addis Ababa, results of which were presented in the previous chapter. This section will present the conclusions and recommendation of the study.

5.2 Conclusion

The following conclusions are drawn based on the assessment made on estimation practice of local firms and information gathered through questionnaires from respondents.

This study discloses that surveyed contractors, irrespective of category and class, obtained most of the projects they have undertaken so far, through open or public tendering method. Likewise the research indicated that contractors' approach to the acquisition on award of contracts is predominantly competitive. 87% of the surveyed contractors procured most of the projects they have undertaken so far, through tendering while the remaining contractors mainly by negotiation.

The study indicated that the average number of tender offers made annually by majority of the contractors is below 15. According to the survey, it can be anticipated that these enterprises submit one or two tender offers per month. Furthermore, the survey results indicated that the tender offer success rate for majority of the contractors is low i.e. below 25%. Consequently 80.6% of respondents perceived that cost estimation is one of the major causes that aggravate their deprived success in tendering.

Despite the fact that provision/ or non-provision of price adjustment clause in tender documents decreases/ or increases the bid price, the analysis showed that it is poorly understood/ considered among cost estimators of the survey sample. This implies that local construction cost estimators are not prudent enough to compute the cost of contracts on present price, keeping provisions of price adjustment for probable fluctuations. Conversely the study reveals that prices and costs are great concerns of cost estimators than delivery times and terms as well as availability and quality within tender evaluation criteria.

Through analyses, empirical evidence shows that, in Addis Ababa based local emerging contractor sector, Business owners prefer to take responsibility for proposal management and estimation by their own, whereas few firms usually outsource the responsibility to independent experts. In this sector, building engineers dominated the contractors, followed by civil engineers, construction management technology professionals, electrical engineers and, lastly, a mix of other types of contractors. Moreover it is found out that category of firms and professional background of the estimator, are independent of the person who is responsible for managing proposals and estimation.

The survey indicated that cost-based estimate method is highly exploited by emerging construction local firms, irrespective of category and class. Whereas the more complex technique, i.e. risk-based estimate method, which consider risks and variability in cost estimates, have not been adopted by contractors. Hence it can be deduced that it is difficult to emerging firms to manage a competent as well as a high quality cost estimates thru predominantly simpler estimate methods.

The study shows that the root causes of inaccurate/ poor cost estimates continue to be poorly defined, documented and tracked assumptions, insufficient project information at the early stages of the project, unrealistic timescales and no supported rationale or basis for the forecast in their particular order. Besides it shows that the most sever effects of inaccurate/ poor cost estimates are found out to be cost Overrun and failure to win Tender/ acquiring new jobs.

With regard to leading practices related to quality cost estimates, the study found out that the performance of emerging contractors towards well documentation, comprehensiveness and accuracy is low. Rigorously the performance of credibility is found out to be the lowest. Hence it is worth to conclude that the performance of Addis Ababa based local emerging construction firms, in light of global best practice cost estimation, is low.

5.3 Recommendation

It is evident that this sector does not meet global best practice standards. There is no doubt that this is caused by the lack of skills and resources necessary to meet global best practice. Hence based on the findings of the research, the following recommendations are forwarded. The implementation of the recommendations is believed to take the emerging construction firms a step forward in respect of quality cost estimation.

Government should include quality cost estimation trainings within its capacity building programs for construction firms and professionals in the industry. This shall in-turn promotes the competence of the emerging construction sector as well.

Professional and interdisciplinary trade associations need to be actively engaged in raising the awareness of their members on quality cost estimates by undertaking related trainings, workshops, seminars, forums and developing standards which encourage best cost estimation practice, to manage the problems that arise from lack of skill, awareness, and knowledge where effects of poor estimates could substantially be reduced or avoided through adopting best practices of cost estimation.

Public bodies should play a vital role on the industry, by promoting collaborative research and development with higher institutions about quality cost estimation and enlighten firms and professionals reduce the effects of inaccurate/ poor cost estimates, in the construction industry.

Universities and colleges need to update their cost estimation related courses in their undergraduate programs; in such a way that quality cost estimation will be included in the course outline so as to be able to reach a large number of construction professionals.

Owners of construction enterprises, their board and the top management of the construction enterprises have to be able to discharge their leadership role in implementing the practice of quality cost estimation in their enterprises for the success and growth of the firm as well as the construction industry.

Firms

- Shall make internal policy or guidelines for developing high quality cost estimates including what steps must be followed, how much time is needed, and how estimates will be updated.
- Shall use independent cost estimating experts (within or outside the firm), that can test whether the cost estimate is accurate and realistic.

Estimators

- Shall be prudent enough to compute the cost of contracts on present price, keeping provisions of price adjustment for probable fluctuations.
- Shall practice/ adopt risk-based estimate method in order to ensure a high quality estimate that utilizes risk identification and uncertainty analysis techniques.
- Shall implement a system of integrated cost estimating practice via utilization of the twelve cost estimating tasks to achieving the requirements of quality cost estimates, i.e., accuracy, Comprehensiveness, well-documentation and credibility as per the global best practice.

5.4 Areas for Further Study

Due to time limitation and resource it was not possible to cover emerging construction firms in the study that acquire competence certificate from regional government offices. Likewise in order to increase the research generalizability power, the researcher recommends other researchers to broaden the scope of the research outside Addis Ababa and include all local emerging construction firms of Ethiopia.

Moreover it is believed that the construction sector of Ethiopia severely lacks management resources. Thus the following areas of study are suggested for further future studies as part of the extension of this research work:

- ✓ Assessment on the practices of cost management and the use of Earned Value Management System (EVM) in emerging construction firms.
- ✓ Challenges faced by emerging construction firms.
- ✓ Assessment of emerging construction firms in alternate project delivery mechanism.

While interacting with emerging contractors for the purpose of data survey of this study, majority of respondents reflect that corrupt ethical practices at tendering stage like ganging up, sabotage etc. are the most challenging and burning issues in the sector. On the other hand, despite the fact that there's no right or wrong way to structure a company's leadership, the researcher perceived that majority of these firms are owner centered and luck organizational setups. Hence with respect to these, following areas of studies are also suggested for further future study:

- ✓ Assessment of ethical practices at tendering stage: The case of construction projects of Ethiopia.
- ✓ Assessment of organizational setups: The case of Ethiopian local construction contractors.

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Appendix – I

SURVEY QUESTIONNAIRE

Addis Ababa University
College of Economics and Management
Management Department
Executive MBA Program

11th, December, 2016

Questionnaire on cost estimation Practice of local contractors

Company Sent to: _____

Dear CEO,

The aim of this questionnaire is to study current practices of cost estimation in the construction industry, particularly by emerging contractors. It is an important element in my post graduate research. Cost estimation practice of an organization is the concern of the top management. Thus, it is very important that the questionnaire be completed by Your Excellency, the Chief Executive Officer, or if not possible, by a most senior executive officer. Each statement/question has a number of choices provided in the respective columns. Possible answers to the questions are provided in the columns in bold. You are expected to answer by ticking at the appropriate box corresponding your answer from those provided against each statement/question.

This survey is purely for research purposes, and the information you provide will be treated strictly confidential and no reference will be made to enterprise or persons. However, the outcome of the research can be made available to you if you so desire.

For any enquiry, fell free to contact me via email: samimen1@gmail.com or telephone +251 911 516497. I thank you in advance for taking the time to complete the questionnaire. I would also be extremely grateful if the completed questionnaire could be returned to me the soonest possible.

Yours sincerely,

Samuel Mengistu

General Definitions

Types of Tendering

Open or Public Tenders - In this type of bid the client advertises the tender offer in the local newspaper giving detail and key information of the proposed works and inviting interested contractor with an equal opportunity to submit the tender

Selected or Approved Tenders - In this method, a pre-selected list of possible contractors is prepared that are known by their track record to be suitable for a contract of the size, nature and complexity required.

Pre-Qualified Tenders - In this method The Client invites expressions of interest (EOI) by way of public advertisement for Pre-Qualification for a specific project or specific types of projects. After collecting EOI the client seeks detailed bids from the shortlisted bidders. This process may in turn lead to a tender process or directly to a negotiation with one or several preferred contractors.

Direct Negotiation - Negotiating with a single supplier may be appropriate for highly specialist contracts, or for extending the scope of an existing contract. It is very much dependent upon the type of construction and the requirement by the client for factors such as speed, quality, repetition, cost & desire to retain the services.

Two Stage Tendering - Two stage selective tendering combined elements of competition and negotiation into a formula where the employer could utilize the contractor's expertise at an early stage of the project cycle. In the first stage, a limited appointment is agreed allowing the contractor to begin work and in the second stage a fixed price is negotiated for the contract. In this process, the Contractor starts his role on preliminary design and concept, at a very beginning of the project.

Cost Estimating Methods

Parametric methods - Parametric models are used where there is no Bill of quantities or when estimates are required within very short period of time. It helps to get an idea of how much the project will cost based on a few physical attributes (such as length, area, weight, volume, and power). E.g. estimating a building using a total floor area of a building multiplied by per square meter price.

Historical bid-based methods - The use of historical data from recently bid contracts is the most common method used during and after design stage where bill of quantity of items can be prepared. Under this approach, specifications will be summarized with items developed for major elements of work so that quantities and historical unit prices can be applied to these items.

Cost-based estimate methods - This method uses Bill of quantity for estimation. However unlike historical bid based method, rates are fixed based on determined breakdowns of contractors cost for labor, material, equipment etc. More over indirect costs such as overhead and profit will be added to infer the final cost.

Risk-based estimate methods - Risk-based cost estimation is a method which considers risk and uncertainties early and often in the project development process. It identifies critical cost areas and directly treats with uncertainty and risk management tools for an enhanced cost estimate

I. General Information about the respondent

1	Gender	Male ☐	Female ☐			
2	Age	25 - 35 Yrs ☐	36 – 40 yrs ☐	41 – 50 yrs ☐	51 - 55 yrs ☐	Over 55 yrs ☐
3	Position in the Enterprise					
4	Educational background (1= High school complete; 2= Bachelor's Degree; 3= Post-graduate Degree; 4= PHD Doctoral Degree; 5= Other, Please specify)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
5	Experience in the construction industry	Less than three years ☐	3-5 years ☐	5-10 years ☐	10-15 years ☐	Over 15 years ☐
6	Years you spent in your present enterprise	Less than three years ☐	3-5 years ☐	5-10 years ☐	10-15 years ☐	Over 15 years ☐
7	Do you have formal cost estimating training	Yes ☐	No ☐			

II. General Information about the enterprise

1	Category	Water Well Drilling Contractor ☐	Water Works Contractor ☐	Sanitary Works Contractor ☐	Electro-Mechanical Contractor ☐	Electrical Equipment Instalation Contractor ☐
		Electrical Contractor ☐	General Contractor ☐	Building Contractor ☐	Road Contractor ☐	
2	Class	Grade 1 ☐	Grade 2 ☐	Grade 3 ☐	Grade 4 ☐	Grade 5 ☐

3	Legal form of organization	Sole Proprietor-ship ☐	Partnership ☐	Private Limited Company ☐	Share Company ☐	Other ☐
4	Years in operation	Less than five years ☐	5-10 years ☐	11-15 years ☐	15-20 years ☐	Over 20 years ☐
5	Number of Employees (Permanent employees)	Less than 25 ☐	25-75 ☐	76-150 ☐	151-250 ☐	Over 250 ☐
6	Sector of project involvement	Yes	No			
	- Public sector projects	☐	☐			
	- Private sector projects	☐	☐			
7	Type of construction projects	Yes	No			
	- Residential	☐	☐			
	- Industrial and Commercial Construction	☐	☐			
	- Infrastructures (Road, Bridge, Airport, etc)	☐	☐			
	- Electro-mech & Electric related	☐	☐			
	- Water & Sanitary work	☐	☐			
	- Well drilling & Rehabilation	☐	☐			

III. Tendering

1	Through which project procurement method, does your company obtain works, most of the time?	Never	Ocasionally	Frequently	Very Frequently	Always
	- Open or Public Tenders	☐	☐	☐	☐	☐
	- Selected or Approved Tenders	☐	☐	☐	☐	☐
	- Pre-Qualified Tenders	☐	☐	☐	☐	☐
	- Direct Negotiation	☐	☐	☐	☐	☐
	- Two Stage Tendering	☐	☐	☐	☐	☐
2	Please give a fair indication of the proportion of projects procured through competitive bidding.	Under 25% ☐	25% - 50% ☐	50% - 75% ☐	75% - 100% ☐	
3	On average, how many tender offers does your company submit annually?	Below 15 ☐	16 - 30 ☐	31 - 50 ☐	Above 50 ☐	

4	Give a fair measure of rate of success of the tender offers.	Under 25% ☐	25% - 50% ☐	50% - 75% ☐	75% - 100% ☐	
5	If your success rate of tendering is low, say below 25%, do your think that your cost estimate is one of the major reasons?	Yes ☐	No ☐	Not Sure ☐		
6	Indicate the level of importance of underlisted components of tender document in your cost estimation process.	Least Important	Slightly Important	Important	Very Important	Most Important
	- Instruction to Bidders	☐	☐	☐	☐	☐
	- the form of the tender	☐	☐	☐	☐	☐
	- Information about final submission Date, Time and place	☐	☐	☐	☐	☐
	- Bid Submission forms and bid security forms	☐	☐	☐	☐	☐
	- Legal documents & qualification demonstration requirements	☐	☐	☐	☐	☐
	- Bid Validity Period	☐	☐	☐	☐	☐
	- Price Adjustments that may apply during implementation	☐	☐	☐	☐	☐
	- the terms and conditions of the contract	☐	☐	☐	☐	☐
	- bill of quantities	☐	☐	☐	☐	☐
	- the specifications	☐	☐	☐	☐	☐
	- designs/drawings and/or plans	☐	☐	☐	☐	☐
	- the quality requirements	☐	☐	☐	☐	☐
	- the evaluation criteria	☐	☐	☐	☐	☐
7	Indicate the level of importance of underlisted tender evaluation criteria in your cost estimation	Least Important	Slightly Important	Important	Very Important	Most Important
	- proposed technical offer	☐	☐	☐	☐	☐
	- prices and costs	☐	☐	☐	☐	☐
	- delivery times and terms	☐	☐	☐	☐	☐
	- availability and quality.	☐	☐	☐	☐	☐

IV. Proposal management and estimating team

1 Who is responsible for tender proposal management and cost estimation in your firm?

Business Owner	Project Manager (Internal Staff)	Independnt Expert
☐	☐	☐

2 What is the professional background of the cost estimator

Civil Engineer	Building Engineer	Mechanical Engineer	Electrical Engineer	Sanitary Engineer
☐	☐	☐	☐	☐

Construction Technology & Management Professional	Other Profession	Non professional
☐	☐	☐

V. Cost Estimation

1 How often you use the following cost estimating Methods

	Never	Ocasionally	Frequently	Very Frequently	Always
- Parametric methods	☐	☐	☐	☐	☐
- Historical bid-based methods	☐	☐	☐	☐	☐
- Cost-based estimate methods	☐	☐	☐	☐	☐
- Risk-based estimate methods	☐	☐	☐	☐	☐

2 Factors that cause inaccurate/ Poor cost stimates in your Firm

	Yes	No	Not Sure
- technical problems on how to estimate project costs	☐	☐	☐
- insufficient project information at the early stages of the project	☐	☐	☐
- Unrealistic timescales	☐	☐	☐
- Inexperienced and poorly trained staff	☐	☐	☐
- Poorly adhered to processes	☐	☐	☐
- Poorly defined, documented and tracked assumptions,	☐	☐	☐
- Inadequate, out-of-date or improperly recorded data,	☐	☐	☐
- Inappropriate Forecasting methodologies and,	☐	☐	☐
- No supported rationale or basis for the forecast.	☐	☐	☐

3	Effects of inaccurate/ Poor cost stimates in your firm	Yes	No	Not Sure
	- Cost Overrun	☐	☐	☐
	- Project Failure	☐	☐	☐
	- Company Failure	☐	☐	☐
	- Bankruptcy	☐	☐	☐
	- Failure to win Tender and luck projects/ acquiring new jobs	☐	☐	☐

The following table contains tasks of Cost Estimation Process. Indicate the level of frequency that your organization performs by marking (√) under the rate scale.

#	Tasks	Never	Ocasionally	Frequently	Very Frequently	Always
1	**Define estimate's purpose**					
.	Determine estimate's purpose, required level of detail, and overall scope;					
.	Determine who will receive the estimate					
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					
3	**Define project characteristics**					
.	In a technical baseline description document, identify the project's purpose and its system and performance characteristics and all system configurations;					
.	Any technology implications;					
.	Its tender schedule and tendering strategy;					
.	Its relationship to other existing systems, including predecessor or similar legacy systems;					
.	Support (manpower, training, etc.) and security needs and risk items;					
.	System quantities for development, test, and production;					

#	Tasks	Never	Ocasionally	Frequently	Very Frequently	Always
.	Deployment and maintenance plans.					
4	**Determine estimating structure**					
.	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					
5	**Identify ground rules and assumptions**					
.	Clearly define what the estimate includes and excludes;					
.	Identify global and projects' specific assumptions, such as the estimate's base year, including time-phasing and life cycle;					
.	Identify time schedule information by phase and project acquisition strategy;					
.	Identify any schedule or budget constraints, inflation assumptions, and travel costs;					
.	Specify equipment the client is to furnish as well as the use of existing facilities or new modification or development;					
.	Identify major subcontractors;					
.	Determine technology refresh cycles, technology assumptions, and new technology to be developed;					
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;					

#	Tasks	Never	Ocasionally	Frequently	Very Frequently	Always
.	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					
7	**Develop point estimate and compare it to an independent cost estimate**					
.	Develop the cost model, estimating each WBS element, using the best methodology from the data collected, and including all estimating assumptions;					
.	Express costs in constant year monetary value;					
.	Time-phase the results by spreading costs in the years they are expected to occur, based on the program schedule;					
.	Sum the WBS elements to develop the overall point estimate;					
.	Validate the estimate by looking for errors like double counting and omitted costs;					
.	Compare estimate against the independent cost estimate 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					
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					

#	Tasks	Never	Ocasionally	Frequently	Very Frequently	Always
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					
10	**Document the estimate**					
.	Document all steps used to develop the estimate so that a cost analyst unfamiliar with the project 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 project, its schedule, and the technical baseline used to create the estimate;					
.	Present the project's time-phased life-cycle cost;					
.	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 (prefer more detail over less);					

#	Tasks	Never	Ocasionally	Frequently	Very Frequently	Always
.	Describe the results of the risk, uncertainty, and sensitivity analyses and whether any overhead costs were identified;					
.	Document how the estimate compares to the funding profile;					
.	Track how this estimate compares to any previous estimates					
11	**Present estimate to management for approval**					
.	Develop a briefing that presents the documented life-cycle cost estimate;					
.	Include an explanation of the technical and project baseline and any uncertainties;					
.	Compare the estimate to an independent cost estimate (ICE) and explain any differences;					
.	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 files available for more probing questions;					
.	Act on and document feedback from management;					
.	Request acceptance of the estimate					
12	**Update the estimate to reflect actual costs and changes**					
.	Update the estimate to reflect changes in technical or project assumptions or keep it current as the program passes through new phases or milestones;					
.	Perform a post mortem and document lessons learned for elements whose actual costs or schedules differ from the estimate;					
.	Document all changes to the project and how they affect the cost estimate					

Appendix – II

FREQUENCY TABLES FOR TASKS OF ESTIMATION PROCESS

Frequency Table

Q1.1_Purpose_ Determine estimate's purpose, required level of detail, and overall scope

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	37	37.8	37.8	37.8
	Occasionally	34	34.7	34.7	72.4
	Frequently	11	11.2	11.2	83.7
	Very Frequently	12	12.2	12.2	95.9
	Always	4	4.1	4.1	100.0
	Total	98	100.0	100.0	

Q1.2_Purpose_ Determine who will receive the estimate

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	9	9.2	9.2	9.2
	Occasionally	26	26.5	26.5	35.7
	Frequently	20	20.4	20.4	56.1
	Very Frequently	43	43.9	43.9	100.0
	Total	98	100.0	100.0	

Q2.1_Plan_ Determine the cost estimating team and develop its master schedule

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	22	22.4	22.4	22.4
	Occasionally	18	18.4	18.4	40.8
	Frequently	25	25.5	25.5	66.3
	Very Frequently	15	15.3	15.3	81.6
	Always	18	18.4	18.4	100.0
	Total	98	100.0	100.0	

Q2.2_ Plan_ Determine who will do the independent cost estimate;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	94	95.9	95.9	95.9
	Occasionally	3	3.1	3.1	99.0
	Very Frequently	1	1.0	1.0	100.0
	Total	98	100.0	100.0	

Q2.3_ Plan_ Outline the cost estimating approach;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	32	32.7	32.7	32.7
	Occasionally	46	46.9	46.9	79.6
	Frequently	13	13.3	13.3	92.9
	Very Frequently	4	4.1	4.1	96.9
	Always	3	3.1	3.1	100.0
	Total	98	100.0	100.0	

Q2.4_ Plan_ Develop the estimate timeline

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	17	17.3	17.3	17.3
	Occasionally	54	55.1	55.1	72.4
	Frequently	21	21.4	21.4	93.9
	Very Frequently	2	2.0	2.0	95.9
	Always	4	4.1	4.1	100.0
	Total	98	100.0	100.0	

Q3.1_Chxs_ In a technical baseline description document, identify the project's purpose and its system and performance characteristics and all system configurations;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	63	64.3	64.3	64.3
	Occasionally	11	11.2	11.2	75.5
	Frequently	7	7.1	7.1	82.7
	Very Frequently	14	14.3	14.3	96.9
	Always	3	3.1	3.1	100.0
	Total	98	100.0	100.0	

Q3.2_ Chxs_ Any technology implications;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	50	51.0	51.0	51.0
	Occasionally	28	28.6	28.6	79.6
	Frequently	17	17.3	17.3	96.9
	Very Frequently	1	1.0	1.0	98.0
	Always	2	2.0	2.0	100.0
	Total	98	100.0	100.0	

Q3.3_ Chxs_ Its tender schedule and tendering strategy;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	5	5.1	5.1	5.1
	Occasionally	18	18.4	18.4	23.5
	Frequently	13	13.3	13.3	36.7
	Very Frequently	34	34.7	34.7	71.4
	Always	28	28.6	28.6	100.0
	Total	98	100.0	100.0	

Q3.4_ Chxs_ Its relationship to other existing systems, including predecessor or similar legacy systems;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	58	59.2	59.2	59.2
	Occasionally	37	37.8	37.8	96.9
	Frequently	3	3.1	3.1	100.0
	Total	98	100.0	100.0	

Q3.5_ Chxs_ Support (manpower, training, etc.) and security needs and risk items;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	34	34.7	34.7	34.7
	Occasionally	45	45.9	45.9	80.6
	Frequently	9	9.2	9.2	89.8
	Very Frequently	10	10.2	10.2	100.0
	Total	98	100.0	100.0	

Q3.6_ Chxs_ System quantities for development, test, and production;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	45	45.9	45.9	45.9
	Occasionally	21	21.4	21.4	67.3
	Frequently	18	18.4	18.4	85.7
	Very Frequently	10	10.2	10.2	95.9
	Always	4	4.1	4.1	100.0
	Total	98	100.0	100.0	

Q3.7_ Chxs_ Deployment and maintenance plans.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	67	68.4	68.4	68.4
	Occasionally	9	9.2	9.2	77.6
	Frequently	12	12.2	12.2	89.8
	Very Frequently	9	9.2	9.2	99.0
	Always	1	1.0	1.0	100.0
	Total	98	100.0	100.0	

Q4.1_ Structure_ 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);

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	12	12.2	12.2	12.2
	Occasionally	14	14.3	14.3	26.5
	Frequently	46	46.9	46.9	73.5
	Very Frequently	23	23.5	23.5	96.9
	Always	3	3.1	3.1	100.0
	Total	98	100.0	100.0	

Q4.2_ Structure_ Choose the best estimating method for each WBS element;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	5	5.1	5.1	5.1
	Occasionally	12	12.2	12.2	17.3
	Frequently	43	43.9	43.9	61.2
	Very Frequently	20	20.4	20.4	81.6
	Always	18	18.4	18.4	100.0
	Total	98	100.0	100.0	

Q4.3_ Structure_ Identify potential cross-checks for likely cost and schedule drivers;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	42	42.9	42.9	42.9
	Occasionally	34	34.7	34.7	77.6
	Frequently	17	17.3	17.3	94.9
	Very Frequently	1	1.0	1.0	95.9
	Always	4	4.1	4.1	100.0
	Total	98	100.0	100.0	

Q4.4_ Structure_ Develop a cost estimating checklist

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	85	86.7	86.7	86.7
	Occasionally	7	7.1	7.1	93.9
	Frequently	6	6.1	6.1	100.0
	Total	98	100.0	100.0	

Q5.1_ Rules_ Clearly define what the estimate includes and excludes;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	3	3.1	3.1	3.1
	Occasionally	35	35.7	35.7	38.8
	Frequently	27	27.6	27.6	66.3
	Very Frequently	32	32.7	32.7	99.0
	Always	1	1.0	1.0	100.0
	Total	98	100.0	100.0	

Q5.2_ Rules_ Identify global and projects' specific assumptions, such as the estimate's base year, including time-phasing and life cycle;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	48	49.0	49.0	49.0
	Occasionally	29	29.6	29.6	78.6
	Frequently	19	19.4	19.4	98.0
	Always	2	2.0	2.0	100.0
	Total	98	100.0	100.0	

Q5.3_ Rules_ Identify time schedule information by phase and project acquisition strategy;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	65	66.3	66.3	66.3
	Occasionally	28	28.6	28.6	94.9
	Frequently	5	5.1	5.1	100.0
	Total	98	100.0	100.0	

Q5.4_ Rules_ Identify any schedule or budget constraints, inflation assumptions, and travel costs;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	8	8.2	8.2	8.2
	Occasionally	43	43.9	43.9	52.0
	Frequently	40	40.8	40.8	92.9
	Very Frequently	2	2.0	2.0	94.9
	Always	5	5.1	5.1	100.0
	Total	98	100.0	100.0	

Q5.5_ Rules_ Specify equipment the client is to furnish as well as the use of existing facilities or new modification or development;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	17	17.3	17.3	17.3
	Occasionally	16	16.3	16.3	33.7
	Frequently	49	50.0	50.0	83.7
	Very Frequently	10	10.2	10.2	93.9
	Always	6	6.1	6.1	100.0
	Total	98	100.0	100.0	

Q5.6_ Rules_ Identify major subcontractors;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	13	13.3	13.3	13.3
	Occasionally	32	32.7	32.7	45.9
	Frequently	25	25.5	25.5	71.4
	Very Frequently	19	19.4	19.4	90.8
	Always	9	9.2	9.2	100.0
	Total	98	100.0	100.0	

Q5.7_ Rules_ Determine technology refresh cycles, technology assumptions, and new technology to be developed;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	71	72.4	72.4	72.4
	Occasionally	17	17.3	17.3	89.8
	Frequently	10	10.2	10.2	100.0
	Total	98	100.0	100.0	

Q6.1_ Data_ Create a data collection plan with emphasis on collecting current and relevant technical, programmatic, cost, and risk data;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	8	8.2	8.2	8.2
	Occasionally	6	6.1	6.1	14.3
	Frequently	40	40.8	40.8	55.1
	Very Frequently	33	33.7	33.7	88.8
	Always	11	11.2	11.2	100.0
	Total	98	100.0	100.0	

Q6.2_ Data_ Investigate possible data sources;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	1.0	1.0	1.0
	Occasionally	10	10.2	10.2	11.2
	Frequently	31	31.6	31.6	42.9
	Very Frequently	36	36.7	36.7	79.6
	Always	20	20.4	20.4	100.0
	Total	98	100.0	100.0	

Q6.3_ Data_ Collect data and normalize them for cost accounting, inflation, learning, and quantity adjustments;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	18	18.4	18.4	18.4
	Occasionally	29	29.6	29.6	48.0
	Frequently	21	21.4	21.4	69.4
	Very Frequently	24	24.5	24.5	93.9
	Always	6	6.1	6.1	100.0
	Total	98	100.0	100.0	

Q6.4_ Data_ Analyse the data for cost drivers, trends, and outliers and compare results against rules of thumb and standard factors derived from historical data;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	60	61.2	61.2	61.2
	Occasionally	32	32.7	32.7	93.9
	Frequently	6	6.1	6.1	100.0
	Total	98	100.0	100.0	

Q6.5_ Data_ Interview data sources and document all pertinent information, including an assessment of data reliability and accuracy;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	51	52.0	52.0	52.0
	Occasionally	43	43.9	43.9	95.9
	Frequently	1	1.0	1.0	96.9
	Very Frequently	3	3.1	3.1	100.0
	Total	98	100.0	100.0	

Q6.6_ Data_ Store data for future estimates

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	4	4.1	4.1	4.1
	Occasionally	26	26.5	26.5	30.6
	Frequently	47	48.0	48.0	78.6
	Very Frequently	14	14.3	14.3	92.9
	Always	7	7.1	7.1	100.0
	Total	98	100.0	100.0	

Q7.1_ Point est._ Develop the cost model, estimating each WBS element, using the best methodology from the data collected, and including all estimating assumptions;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Occasionally	32	32.7	32.7	32.7
	Frequently	21	21.4	21.4	54.1
	Very Frequently	40	40.8	40.8	94.9
	Always	5	5.1	5.1	100.0
	Total	98	100.0	100.0	

Q7.2_ Point est._ Express costs in constant year monetary value;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	2	2.0	2.0	2.0
	Occasionally	11	11.2	11.2	13.3
	Frequently	53	54.1	54.1	67.3
	Very Frequently	24	24.5	24.5	91.8
	Always	8	8.2	8.2	100.0
	Total	98	100.0	100.0	

Q7.3_ Point est._ Time-phase the results by spreading costs in the years they are expected to occur, based on the project schedule;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	24	24.5	24.5	24.5
	Occasionally	21	21.4	21.4	45.9
	Frequently	45	45.9	45.9	91.8
	Very Frequently	5	5.1	5.1	96.9
	Always	3	3.1	3.1	100.0
	Total	98	100.0	100.0	

Q7.4_ Point est._ Sum the WBS elements to develop the overall point estimate;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Frequently	43	43.9	43.9	43.9
	Very Frequently	27	27.6	27.6	71.4
	Always	28	28.6	28.6	100.0
	Total	98	100.0	100.0	

Q7.5_ Point est._ Validate the estimate by looking for errors like double counting and omitted costs;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	5	5.1	5.1	5.1
	Occasionally	12	12.2	12.2	17.3
	Frequently	44	44.9	44.9	62.2
	Very Frequently	30	30.6	30.6	92.9
	Always	7	7.1	7.1	100.0
	Total	98	100.0	100.0	

Q7.6_ Point est._ Compare estimate against the independent cost estimate and examine where and why there are differences;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	91	92.9	92.9	92.9
	Occasionally	7	7.1	7.1	100.0
	Total	98	100.0	100.0	

Q7.7_ Point est._ Perform cross-checks on cost drivers to see if results are similar;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	68	69.4	69.4	69.4
	Occasionally	17	17.3	17.3	86.7
	Frequently	13	13.3	13.3	100.0
	Total	98	100.0	100.0	

Q7.8_ Point est._ Update the model as more data become available or as changes occur and compare results against previous estimates

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	67	68.4	68.4	68.4
	Occasionally	30	30.6	30.6	99.0
	Very Frequently	1	1.0	1.0	100.0
	Total	98	100.0	100.0	

Q8.1_ Sensitivity_ Test the sensitivity of cost elements to changes in estimating input values and key assumptions;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q8.2_ Sensitivity_ Identify effects on the overall estimate of changing the project schedule or quantities;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	92	93.9	93.9	93.9
	Frequently	2	2.0	2.0	95.9
	Very Frequently	4	4.1	4.1	100.0
	Total	98	100.0	100.0	

Q8.3_ Sensitivity_ Determine which assumptions are key cost drivers and which cost elements are affected most by changes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	94	95.9	95.9	95.9
	Occasionally	3	3.1	3.1	99.0
	Frequently	1	1.0	1.0	100.0
	Total	98	100.0	100.0	

Q9.1_ Risk_ Determine and discuss with technical experts the level of cost, schedule, and technical risk associated with each WBS element;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	89	90.8	90.8	90.8
	Occasionally	7	7.1	7.1	98.0
	Frequently	2	2.0	2.0	100.0
	Total	98	100.0	100.0	

Q9.2_ Risk_ Analyse each risk for its severity and probability;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	92	93.9	93.9	93.9
	Occasionally	1	1.0	1.0	94.9
	Frequently	5	5.1	5.1	100.0
	Total	98	100.0	100.0	

Q9.3_ Risk_ Develop minimum, most likely, and maximum ranges for each risk element;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	83	84.7	84.7	84.7
	Occasionally	11	11.2	11.2	95.9
	Frequently	4	4.1	4.1	100.0
	Total	98	100.0	100.0	

Q9.4_ Risk_ Determine type of risk distributions and reason for their use;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	90	91.8	91.8	91.8
	Occasionally	7	7.1	7.1	99.0
	Frequently	1	1.0	1.0	100.0
	Total	98	100.0	100.0	

Q9.5_ Risk_ Ensure that risks are correlated;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	97	99.0	99.0	99.0
	Occasionally	1	1.0	1.0	100.0
	Total	98	100.0	100.0	

Q9.6_ Risk_ Use an acceptable statistical analysis method (e.g., Monte Carlo simulation) to develop a confidence interval around the point estimate;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q9.7_ Risk_ Identify the confidence level of the point estimate;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q9.8_ Risk_ Identify the amount of contingency funding and add this to the point estimate to determine the risk-adjusted cost estimate;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	27	27.6	27.6	27.6
	Occasionally	39	39.8	39.8	67.3
	Frequently	24	24.5	24.5	91.8
	Very Frequently	5	5.1	5.1	96.9
	Always	3	3.1	3.1	100.0
	Total	98	100.0	100.0	

Q9.9_ Risk_ Recommend that the project or program office develop a risk management plan to track and mitigate risks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q10.1_ Document_ Document all steps used to develop the estimate so that a cost analyst unfamiliar with the project can recreate it quickly and produce the same result;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	24	24.5	24.5	24.5
	Occasionally	31	31.6	31.6	56.1
	Frequently	23	23.5	23.5	79.6
	Very Frequently	20	20.4	20.4	100.0
	Total	98	100.0	100.0	

Q10.2_ Document_ Document the purpose of the estimate, the team that prepared it, and who approved the estimate and on what date;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q10.3_ Document_ Describe the project, its schedule, and the technical baseline used to create the estimate;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q10.4_ Document_ Present the project's time-phased life-cycle cost;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q10.5_ Document_ Discuss all ground rules and assumptions;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	83	84.7	84.7	84.7
	Occasionally	14	14.3	14.3	99.0
	Very Frequently	1	1.0	1.0	100.0
	Total	98	100.0	100.0	

Q10.6_ Document_ Include auditable and traceable data sources for each cost element and document for all data sources how the data were normalized;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q10.7_ Document_ Describe in detail the estimating methodology and rationale used to derive each WBS element's cost (prefer more detail over less);

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	89	90.8	90.8	90.8
	Occasionally	9	9.2	9.2	100.0
	Total	98	100.0	100.0	

Q10.8_ Document_ Describe the results of the risk, uncertainty, and sensitivity analyses and whether any overhead costs were identified;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q10.9_ Document_ Document how the estimate compares to the funding profile;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q10.10_ Document_ Track how this estimate compares to any previous estimates

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q11.1_ Approval_ Develop a briefing that presents the documented life-cycle cost estimate;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	76	77.6	77.6	77.6
	Occasionally	4	4.1	4.1	81.6
	Frequently	11	11.2	11.2	92.9
	Very Frequently	4	4.1	4.1	96.9
	Always	3	3.1	3.1	100.0
	Total	98	100.0	100.0	

Q11.2_ Approval_ Include an explanation of the technical and project baseline and any uncertainties;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	91	92.9	92.9	92.9
	Frequently	5	5.1	5.1	98.0
	Very Frequently	2	2.0	2.0	100.0
	Total	98	100.0	100.0	

Q11.3_ Approval_ Compare the estimate to an independent cost estimate (ICE) and explain any differences;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	98	100.0	100.0	100.0

Q11.4_ Approval_ Focus in a logical manner on the largest cost elements and cost drivers;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	92	93.9	93.9	93.9
	Occasionally	6	6.1	6.1	100.0
	Total	98	100.0	100.0	

Q11.5_ Approval_ Make the content clear and complete so that those who are unfamiliar with it can easily comprehend the competence that underlies the estimate results;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	87	88.8	88.8	88.8
	Occasionally	9	9.2	9.2	98.0
	Frequently	2	2.0	2.0	100.0
	Total	98	100.0	100.0	

Q11.6_ Approval_ Make backup files available for more probing questions;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	86	87.8	87.8	87.8
	Occasionally	10	10.2	10.2	98.0
	Frequently	2	2.0	2.0	100.0
	Total	98	100.0	100.0	

Q11.7_ Approval_ Act on and document feedback from management;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	17	17.3	17.3	17.3
	Occasionally	28	28.6	28.6	45.9
	Frequently	21	21.4	21.4	67.3
	Very Frequently	19	19.4	19.4	86.7
	Always	13	13.3	13.3	100.0
	Total	98	100.0	100.0	

Q11.8_ Approval_ Request acceptance of the estimate

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	54	55.1	55.1	55.1
	Occasionally	7	7.1	7.1	62.2
	Frequently	34	34.7	34.7	96.9
	Very Frequently	2	2.0	2.0	99.0
	Always	1	1.0	1.0	100.0
	Total	98	100.0	100.0	

Q12.1_ Update_ Update the estimate to reflect changes in technical or project assumptions or keep it current as the program passes through new phases or milestones;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	7	7.1	7.1	7.1
	Occasionally	14	14.3	14.3	21.4
	Frequently	34	34.7	34.7	56.1
	Very Frequently	31	31.6	31.6	87.8
	Always	12	12.2	12.2	100.0
	Total	98	100.0	100.0	

Q12.2_ Update_ Perform a post mortem and document lessons learned for elements whose actual costs or schedules differ from the estimate;

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	62	63.3	63.3	63.3
	Occasionally	27	27.6	27.6	90.8
	Frequently	4	4.1	4.1	94.9
	Very Frequently	5	5.1	5.1	100.0
	Total	98	100.0	100.0	

Q12.3_ Update_ Document all changes to the project and how they affect the cost estimate

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	79	80.6	80.6	80.6
	Occasionally	18	18.4	18.4	99.0
	Very Frequently	1	1.0	1.0	100.0
	Total	98	100.0	100.0	