



**EVALUATION OF THE COST ESTIMATING SYSTEM OF BUILDING
CONTRACTORS IN ADDIS ABABA**

BY

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Nomenclature

BOQ =Bill of Quantity

OH =Over Head

WBS =Work Break Down Structure

MDG=Millennium Development Goal

GOE=Government of Ethiopia

MUDHCo= Ministry of Urban Development, Housing and Construction

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ABSTRACT

In Ethiopia, construction has been booming in the last ten years due to the growth and transformation plan linked with the Millennium Development Goal (MDG) adopted by the Government of Ethiopia (GOE). However, achieving this goal as its plan remains a challenge. Out of the many inter-related problems, difficulties and shortcomings of the construction sector, the contracting companies' performance in completing the projects within the contractual time, quality and cost is one of the major issues in developing the sector to the highest level. Hence, improving the efficiency and effectiveness of local contractors with regard to cost estimating system is very vital since efficient and effective estimating and bidding process is a key to successful construction and to build sustainable development to the sector.

The objective of this research is to evaluate cost estimating practice of local building contractors, identify shortcomings, deficiencies and limitations of the cost estimating system used by local contractors, explore factors that influence the accuracy of estimating the building project cost in Addis Ababa and suggest some ways to improve the existing practice in order to minimize the delay in time and maintaining the desired quality of the construction work.

A survey questionnaire is used to explore the local practice in cost estimating. Basically, the shortage of qualified personnel and lack of available guidelines or established standards on cost estimating systems are considered the main obstacles for successful cost estimating.

One of the main recommendations of this research is to encourage local contracting companies to have better awareness and attitude to use proper cost estimating systems in more modernized (computerized) ways to become more successful not only in winning the bids with the desired profit but also completing the work within the estimated time and the required quality.

Key Words: Cost, Cost estimates, accuracy, building projects, local contractors.

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CHAPTER ONE

INTRODUCTION

1.1 .Background

Construction is a major capital expenditure which clients do not commence until they are certain that there is a benefit. This benefit may be for society in the case of public projects, with justification based on a cost-benefit analysis or purely based on financial considerations in the case of private projects (Potts, 2008).

Traditionally, there have been three types of contractors' tendering (selection) procedures, namely *Open tendering (Open competition)*, *Selective (Short listing) tendering and Negotiation tendering*.

1. *Open tendering or Open competition* is an arrangement where an advertisement in local newspapers or trade journals invites contractors to apply for tender documents. Usually, public work is awarded in this manner and all who meet the minimum technical and financial qualifications are allowed to compete (Potts, 2008, Brook, 2004).

2. *Selective (short listing) tendering* allows the number of organizations to be restricted by using a selection process in advance of tender invitation. The selection process produces a short list of the most suitable organizations from those that expressed an interest in carrying out the project and it must be objective, fair, accountable and transparent with the criteria for selection established before inviting expressions of interest (Potts, 2008).

3. *Negotiation tendering*: When a contract is negotiated, a contractor is often selected on the basis of past performance, recommendation, familiarity with the work, or from previous experience with the client or his advisers. *Negotiation tendering* is available in two forms:

- a. Combined competitive- negotiated – is a common practice for relatively large jobs select and negotiate with a single contractor a price for the work. It enables clients to negotiate the terms with selected bidders and may include a formal tender stage prior to negotiation.

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b. Purely negotiated (without competition) – is when a given contractor is the only party asked to perform the work. Where a price is required prior to initiating work, this price is negotiated between a given contractor and the client. For example, it can be used in special circumstances such as emergency storm-damage repair (Potts, 2008; Brook, 2004, James, 2003).

Most of the time, in a highly competitive business, a contractor must be the qualified bidder while maintaining an acceptable profit margin. This profit margin must provide the contractor an acceptable rate of return and compensation for the risk associated with the project. Thus, profit is an obvious and principal motive for bidding on a construction contract. A contractor who has decided to bid on a project must then prepare a detailed cost estimate for the execution of the project. The *qualification* of a contractor is the determination that he possesses both the technical and financial ability to perform the work required by the contract (Dagostino & Peterson, 2011, Nunnally, 2007).

Detailed cost estimating by its very nature requires attention to detail and consistency in methods of preparation. Those who prepare cost estimates benefit if they are able to focus on detail while at the same time keeping an eye on the larger picture of how construction items interface, that is, the ability to relate construction details and specifications to actual construction processes, especially for processes and sequences not typically drawn and detailed in construction documents, such as excavation, form work, false work, and a variety of general conditions (Michael, 2003).

In most cases, local contractors are using the Ethiopian building construction authority performance standards and material breakdowns as a sole basis for estimating building project construction costs. Moreover, there are many instances whereby contractors use previously prepared unit prices by other contractors whom they believed are well organized contractors in estimating project construction costs without considering the most important factor which is the time value of money (Tadesse, 2006). The value of money is dependent on the time at which it is received because a sum of money on hand today is worth more than the same sum of money to be received in the future or the money on hand today can be invested to earn interest to gain more than the same money in the future.

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Hence, studying the present value of money or the discounted value that will be received in the future is very decisive (Elbeltagi, E. ,2009).

From the above, it can be seen that the problem is caused by lack of efficient estimation system (contractors policies, procedures, practices, methods, techniques, approaches and other analysis) to generate accurate and reliable cost estimates in expectation of receiving contract award.

Moreover, establishing clear responsibility for preparation, review and approval of cost estimate is vital. This research project thus identifies the deficiencies in estimation tools, evaluates the current local contractors cost estimation practice and suggests some ways to improve the existing cost estimating system.

1.2.Statement of the problem

In many developing countries including Ethiopia, the majority of contractors lack expertise in achieving reasonable accurate cost estimates and have poor cost estimating procedures. Hence, this led to a notable increase in bankruptcy cases and the delay or complete stop of some projects. The local construction cost estimation practice clearly indicates that the local knowledge and experience of construction cost estimation of the local contractors is very poor and on top of all other managerial, economic, political and social factors, this poor construction cost estimation practice has contributed its own negative impact on the national economy as well as in the development of the local construction industry. Hence, most local contractors are delivering poor quality, delayed projects and suffering from bankruptcy (Tadesse, 2006; Ofori, 2012; Salama et al., 2005).

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1.3. Objectives of the research

In view of the above mentioned problems, the following research objectives are adopted:

- Identify the major shortcomings, deficiencies and limitations of the cost estimating system used by local contractors.
- Explore some factors that influence the accuracy of cost estimates of building project cost in Addis Ababa.
- Evaluate the cost estimating current practice in promoting the competence of local building contractors.
- Provide the local contracting companies with a structured approach or ways to minimize the problems such as time delay, delivering poor quality and suffering from bankruptcy.

1.4. Significance of the research

Lack of an efficient cost management system or inefficiency of the prevailing practice is one of the major factors which undermine contractors' overall capacity and consequently hamper them from fulfilling predetermined performance criteria which are stipulated in terms of budgeted cost, completion time, quality and stakeholders' satisfaction (Abraham, 2008). The problem of ineffective and poor cost estimating technique in the process of formulating predictive cost of building projects due to the use of inadequate information and improper system mainly results in cost overrun as well as delays in the finishing time of the project.

As stated above, most of the construction projects in Addis Ababa encounter considerable delays, cost overruns and quality related issues. Accordingly, giving proper attention to the cost estimating practice and tools that requires efficient estimation system will be essential to finish a project successfully with its desirable quality. Hence, cost estimation is an important factor to be realized as it has the main role on the achieving the major goals of construction projects.

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1.5. Research scope and limitation

This research will be limited to the evaluation of cost estimating systems of building construction contractors in Addis Ababa. Although there are different classes of contractors, the research is limited to Grade 1, Grade 2 and Grade 3 contractors. Thus, the researcher believes these contractors are well organized for carrying out a research in evaluating cost estimating practice on them. Therefore, this research only focuses on evaluating cost estimating system in relation to delay, cost overrun and quality with the aim of identifying the shortcomings and provides some remedies or improvements to the current practice.

CHAPTER TWO

LITERATURE REVIEW

2.1. General

While construction has traditionally been a very conservative industry, the increasing rate of technological development and growing international competition in the industry are serving to accelerate the development of new construction methods, equipment, materials, and management techniques (Nunnally, 2007).

The construction industry comprises thousands of companies, which commonly refers contractors whose primary objective is to build projects for the benefit of society as a whole and to obtain a commensurate rate of return (profit) on the time and effort (risk) invested in building these projects. While the diversity and composition of contractors are practically unlimited, they all share the same goal: to make profit on the work they perform. To accomplish this goal, they must recover all their costs of performing the work from the compensation they receive for the contract. Therefore, all costs which a prudent and experienced contractor would expect to incur should be included in the cost estimate. Each estimate should be developed as accurately as possible, in as much detail as can be assumed, and be based upon the best information available (Department of Energy, 2011; Cilensek, 1991).

Building construction estimating is the determination of probable construction costs of any given project. Many items influence and contribute to the cost of a project; each item must be analyzed, quantified and priced. Because the estimate is prepared before the actual construction, much study and thought must be put into the construction documents. The estimator who can visualize the project and accurately determine its cost will become one of the most important persons in any construction company (Dagostino & Peterson, 2011).

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2.2. Definitions of cost estimates

a. Cost

“In project control and accounting, cost is the amount measured in money, cash expended or liability incurred, in consideration of goods and/ or services received. From a total cost management perspective, cost may include any investment of resources in strategic assets including time, monetary, human, and physical resources” (AACE International Recommended Practice, 2014).

b. Estimating

“Estimating is a complex process involving collection of available and pertinent information relating to the scope of a project, expected resource consumption and future changes in resource costs, synthesizing this information through a mental process of visualization of the constructing process for the project. This visualization is mentally translated into an approximation of the final cost.”(James, 2003).

c. Cost estimating

“Cost estimating is the predictive process used to quantify cost and price of the resources required by the scope of an investment option, activity or project and it is a process used to predict uncertain future costs with a goal of minimizing the uncertainty of the estimate given the level and quality of scope definition.”(AACE International Recommended Practice, 2014). Cost estimating involves developing an approximated estimate of the costs of the resources needed to complete project activities in which the estimator considers the causes of variation of final estimate for purposes of better managing the project (Project Management Institute, 2000).

d. Construction cost

“The sum of all costs, direct and indirect, inherent in converting a design plan for material and equipment into a project ready for start-up, but not necessarily in production operation; the sum of field labor, supervision, administration, tools, field office expense, materials, equipment, taxes and subcontracts.”(AACE International Recommended Practice, 2014).

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Construction costs include the cost of materials, labor, and equipment. Overhead costs related to the job site contribute to management of the project, while additional markups are applied relative to the “home office” cost of doing business (Michael, 2003).

2.3. Basics for preparation of cost estimates

In the normal sequence of events toward the preparation of any estimate, it is of utmost importance to understand basic fundamental principles and responsibilities (James, 2003).

2.3.1. Planning

The cost engineer must thoroughly understand the project scope of work and aspects of the project being estimated. The cost engineer must also review drawings, specifications, and construction sequences and durations to determine total construction costs. A site visit is strongly recommended to enable the cost engineer to relate the physical characteristics of the project to the available design parameters and details. The construction sequence must be developed as soon as possible and should be used to provide a checklist of construction requirements throughout the cost estimating process (James, 2003).

Since the preparation of an estimate is a corroborative effort, it is essential that all persons have input into when certain items are required and that they understand the interrelationships between the responsible parties. Therefore, one of the first things that needs to be done when preparing the estimate is to bring together all the estimate team members to develop the overall estimate schedule (Dagostino & Peterson, 2011).

2.3.2. Construction Method Statement

Method statements are written descriptions of how items of work will be carried out. They usually deal with the use of labor and plant in terms of types, gang sizes and expected outputs (Brook, 2004). The method statement is a key document in the preparation of the tender and should consider the site-visit report, the geotechnical report, the sequence and methods for the main operations of work, subcontracted work, bulk quantities, schedule of labor and construction equipment and any temporary works required.

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According to Abraham (2008), after having a clear picture of the project through site visits and the contract document the next crucial step in the process of cost estimation is the preparation of construction method statement.

2.3.3. Work break down structure

A WBS is a deliverable-oriented grouping of project components that organizes and defines the total scope of the project. It is often used to develop or confirm a common understanding of project scope. Each descending level represents an increasingly detailed description of the project deliverables (Project Management Institute, 2000). A WBS is normally presented in chart form, as illustrated in Figure 2.1.

A work task, sometimes called a work activity is a specific item of work that can be clearly identified in such a way that its resource requirement, commencement, content and completion time can readily be recognized. The work break down structure (WBS) shows the hierarchy of a project (Abraham, 2008).

The work break down structure (WBS) is a uniform, consistent, and logical method for dividing the project into small, manageable components for purposes of planning, estimating, and monitoring (Rad, 2002).

According to Rad (2002), work break down structure (WBS) provides a roadmap for planning, monitoring, and managing all facets of the project such as the following:

- Definition of work
- Cost estimates
- Budgeting
- Time estimates
- Resource allocation
- Expenditures
- Changes to the project plan
- Productivity

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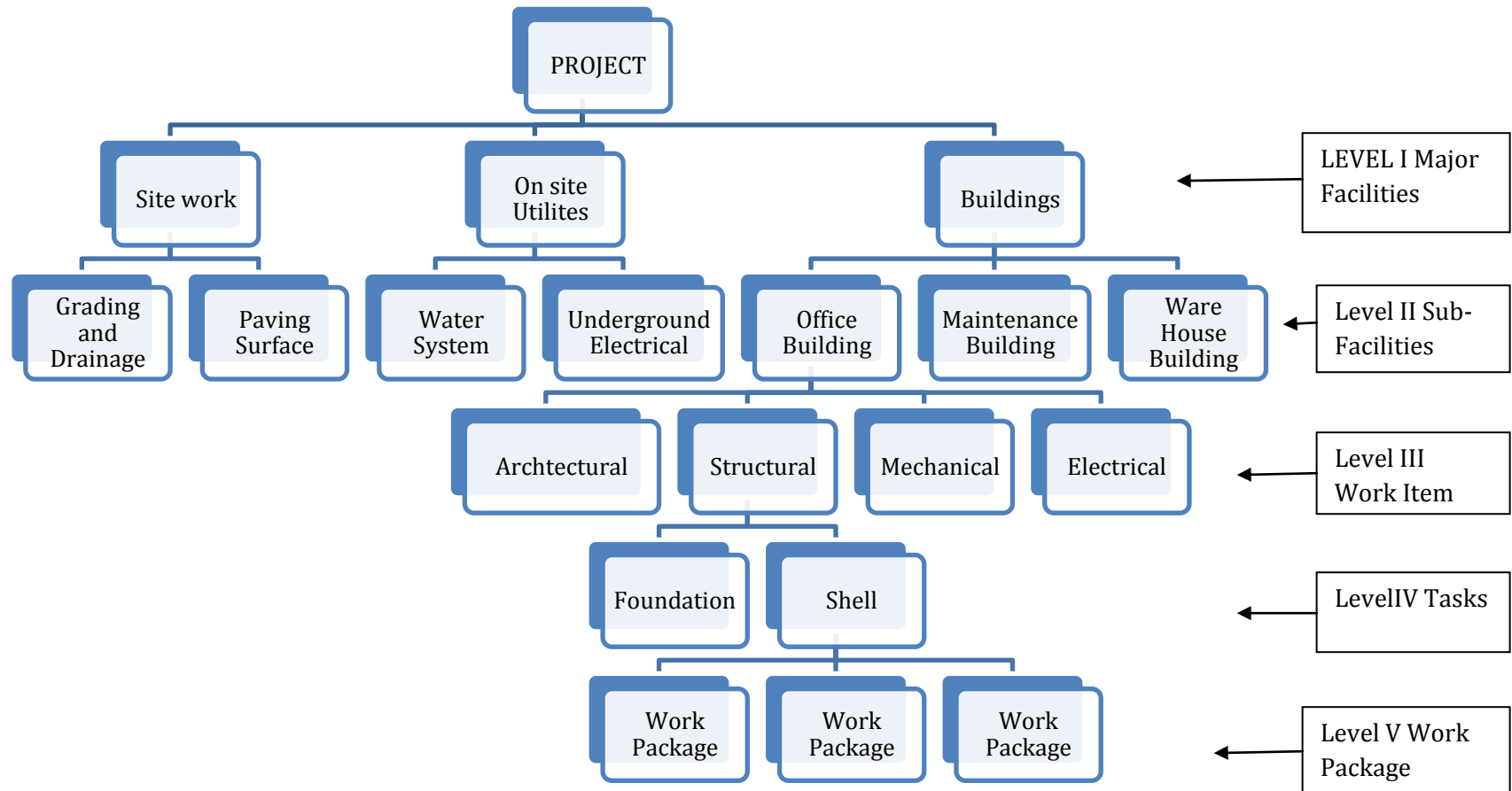


Figure 2-1 Illustrative Work Breakdown Structure (WBS).

Source: (Oberlender, 1993)

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2.3.4. Types of unit cost

A unit cost for each task is developed to increase the accuracy of the estimating procedure and should provide a reference comparison to historic experience (Department of Energy 2011). Some of them will be discussed as follows;

2.3.4.1. Direct cost

Direct Costs are those costs, which can be attributed to a single task of construction work. These costs are usually associated with a construction labor crew performing task using specific equipment and materials for the task. Subcontracted costs should be considered as direct costs to the prime contractor in estimates. They are the labor, material, and equipment costs of project construction. Direct costs are the contractor's costs for the physical construction of permanent facilities. The primary components of these costs are material, labor, equipment, and subcontractors hired by the contractor to perform work that he chooses not to accomplish himself (Department of Energy, 2011; Cilensek, 1991).

1. Labor cost

A building is a complex product, made up of many different systems, such as the structural system, exterior enclosure system, plumbing and sewage systems. In this way, a building construction project is divided into numerous work packages. These work packages can then be assigned to and completed by an individual worker or a crew. A crew is a team of workers, which can be of the same trade or a composite of many different trades. Due to the diverse nature of the different tasks associated with all the building systems, many types of craftsmen from many different trades are required in a building construction project (Calin et al., 2003). Estimating labor requires determining the number of labor hours to do a specific task and then applying a wage rate. A labor hour is defined as one worker working for one hour. Determining the labor hours requires knowing the quantity of work to be placed and the productivity rate for the specific crew that will perform the work (Dagostino & Peterson, 2011).

a1. Labor productivity rate

Labor productivity rates in the construction industry are characterized by their tendency to vary from individual to individual, day to day, and project to project and it has been historically one of the most inaccurate aspects of estimating (Calin et al., 2003).

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Therefore, to improve the accuracy of the overall cost estimate of a building project, an estimator must have a thorough knowledge of labor productivity and be able to determine the appropriate productivity rate for the estimated project. Therefore, it is clear that construction labor is a vital component of a construction project (Calin et al. 2003).

The productivity rate is often expressed as a number of labor hours per unit of work, although it may also be expressed as the quantity of work performed by a crew during a standard eight-hour day (Dagostino & Peterson, 2011).

$$\text{Productivity rate} = \frac{\text{Labor hours}}{\text{Quantity of work}} \quad \text{Eq. 2.1}$$

a2. Productivity sources

Productivity rates can come from a number of sources, but the most reliable source is historical data. The advantage of historical data is that it reflects how a particular company's personnel perform the tasks. The productivity rate that is used, if derived from historical data, is for the average or standard conditions for the projects used in calculating the historical production rate. On many occasions, the project that is being bid deviates from these standard conditions. The number of labor hours needs to be modified to take into consideration how the project that is being bid deviates from the standard condition (Dagostino & Peterson, 2011).

It is important to note the presentation of productivity in labor hours. By keeping the productivity record in labor hours, the record is essentially normalized and is not subjected to the variability in project locations and prevailing wage rates. In this way, unit labor costs for the contractor's own operating region can be easily developed by multiplying local wage rates including burden and fringe benefits by the productivity rate (Calin et al. 2003).

Example 2.1

A contractor determines that the unit productivity for painting a wall is 0.55 hour per m². If the local wage rate is 30 Birr per hour, the unit labor cost becomes 16.50 Birr per m². If the wage rate is 20 Birr per hour, the unit labor cost becomes 11 Birr per m².

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In addition, productivity performance between projects can also be easily compared if contractors keep cost accounting records in man-hours.

a3. Estimating work duration

Calin et al.(2003) has suggested determining the total work duration for a task involves knowledge of the quantity of work required for the task and the productivity rate for the specific crew that will be performing the work. A straight forward approach to the estimation of activity durations is to keep historical records of particular activities and rely on the average durations from this experience in making new duration estimates. Since the scope of activities is unlikely to be identical between different projects, unit production rates are typically employed for this purpose. The duration of an activity may be estimated as given in Eq. 2.2.

$$\text{Work duration} = \text{Quantity of work} / \text{Number of crews} \times \text{Productivity rate} \quad \text{Eq.2.2}$$

Example 2.2

To find the duration of an interior and exterior painting activities with quantities of 440 m² and 378 m² respectively, using crews productivity rate of 11 m²/hour and 14 m²/hour for the interior and exterior painting activities respectively,

For 1 crew, interior painting duration = 440 m² / (1crew x 11m²/hour) = 40 hours, and exterior painting duration = 378m² / (1crew x 14 m²/hour)= 27 hours, therefore, total work hours = 40+27=**67 hours**

For 2 crews, interior painting duration = 440 m² / (2crew x 11m²/hour) = 20 hours and exterior painting duration = 378 m² / (2crew x 14 m²/hour)= 13.5hours, therefore, total work hours = 20 + 13.5= **33.5 hours** which is half of 67 hours.

Hence, we can conclude that as we double the crews, the work duration will decrease by half and in equation 2.3 (*Total cost of labor = Total work hour × Wage rate*), the total cost of labor will remain the same since the wage rate will be doubled and the total work hour is decreased by half with the doubled crew.

Typically, the quantity of work is determined from engineering drawings of a specific project. The number of crews working is decided by the planner. In many cases, the

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number or amount of resources applied to particular activities may be modified in light of the resulting project plan and schedule. Some estimate of the expected work productivity must be provided. Historical records in a firm can also provide data for estimation of productivities. Defining the duration of a given work means that the planner has already defined the number of resources that will be employed in a particular work. If the contractor knows the duration and resources for a given work, it is simple to estimate the activity direct cost.

a4. Basic principles for estimating labor costs

Labor costs in construction are determined by two factors: *monetary* and *productivity*. The monetary factor is related to hourly wage rates, wage premiums, insurance and taxes. Estimating the components of the monetary factor is more difficult in construction than in other industries. This is due to the variety of work involved in construction, as well as the many types of trades involved. The problem is further complicated by the presence of the unions with their craft structures and collective bargaining processes (Calin et al. 2003). The formula for computing the total cost of labor is quite simple. It requires the knowledge of the total work hours or labor hours needed to perform all the tasks and then applying the corresponding wage rates.

The formula for calculating the total cost of labor is shown in Eq. (2.3).

$$\text{Total cost of labor} = \text{Total work hour} \times \text{Wage rate} \quad \text{Eq.2.3}$$

Example 2.3

Assuming that a crew for a work item includes 3 bricklayers and 2 laborer (helpers), the crew works for 3 days with 8-hr/day to complete the work package, the wage rate for each bricklayer is 28.55Birr and for each helper is 22.40Birr.

Hence, the total cost of the crew = 3 bricklayers × 3days × 8 hr/day × 28.55Birr + 2 helpers × 3days × 8hr/day × 22.4Birr = 3131 Birr

Crew for a Work	H ours	Straight time rate (Birr/hr)	Total Cost (Birr)
bricklayers	3 bricklayers × 3days × 8 hr/day = 72hr	28.55	2,055.60
helpers	2 helpers × 3days × 8 hr/day = 48hr	22.4	1,075.20
			3,130.80 Birr

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Example 2.4

If the daily production rate for a crew that works in an activity is 175 units/day and the total crew cost per day is 1800 Birr. The material needed for daily work is 4.5 units at 100/unit Birr.

- Calculate the time and cost it takes the crew to finish 1400 units
- Calculate the total unit cost. Consider an eight hour work day.

Solution

a. Duration (units of time) = Quantity / Production per unit of time x number of crews
= 1,400 units / 175 units/day × 1 crew = 8 days

Cost (labor cost) = Duration (units of time) x crew cost per unit of time
= 8 days × 1,800 Birr / day = 14,400 Birr

Total direct cost = 14,400 Birr + 4.5 units of material × 100 Birr/ unit × 8 days
= 18,000 Birr

b. Unit cost = total cost / quantity
= 18,000 Birr / 1400 units = 12.86 Birr / unit

Sometimes the productivity of a specific crew expressed in man-hours/unit not units/day.

Although most items associated with the monetary factor remain relatively constant over a short period of time, such as during the construction phase, productivity, on the other hand, can fluctuate wildly. To accurately estimate productivity, an estimator not only needs a good historical record, but a lot of experience (Calin et al. 2003).

b. Material cost

Material costs are obtained by getting quotations from suppliers, generally in a unit price of birr per unit of measure of a specified material. Generally, the more the amount of purchase, the lower the unit price is. This is called quantity discount. Freight costs must also be considered and added to the direct cost of the materials. This cost can be a big portion of the total cost of materials when the job site is isolated and far away from the nearest supplier. However, generally the freight cost per unit quantity of material can be reduced as the order quantity is increased (Calin et al. 2003).

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b1. Other Considerations for material cost

In making material procurement decisions, the following interrelated factors need to be considered: quantity discount, interest rate, escalation, and holding cost.

Quantity discounts provide incentives to the buyer to purchase more at one time, due to a lower unit purchase cost as well as shipping costs. However, this usually entails paying more up front due to the higher volume of purchase. This can also lead to higher material handling and storage costs due to a greater or excess volume of material.

Interest rate is the rate of return on capital. When the interest rate is low, the return on capital is low; therefore the cost of capital is low. During periods of low interest rates, it is more feasible to use capital for advanced purchasing since the cost of capital is low.

Escalation refers to the continual rise in the price of goods, in this case the cost of materials. To guard against escalation, sometimes materials need to be procured early and stocked for later use at the expense of other costs.

Holding cost is associated with the storage of excess materials onsite. This can be in the forms of rental cost for a lay down area, of storage facilities (e.g., renting or constructing fencing, shed, warehouse, storage container, etc.), handling cost, theft or misplacement, providing security, insurance, and financial loss in terms of interest on funds invested in inventory.

b2. Material pricing sources

The pricing of materials is generally much easier than the pricing of labor and equipment costs. Generally material pricing sources are:

- Published sources,
- Company cost records, catalogues and quotations.

b3. Trends in material prices

Apart from the knowledge of prevailing prices of materials, it is also important to be aware of trends in the cost of materials. This is especially important for big projects where construction duration is long or for those projects where there is a long lead time

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between bidding and actual construction. In these situations, the knowledge of prevailing prices may not be enough since the contractor will have to estimate the future cost of materials when they will actually be needed. Material price trends are developed by collecting and compiling price data of materials at similar time intervals from many time periods (Calin et al. 2003).

c. Equipment cost

In a construction project, equipment costs are typically divided into portions. The first and bigger portion covers the cost of equipment and is often referred to as equipment cost. The cost of equipment is one of the major cost categories in a construction project.

It represents the cost of acquiring the equipment and the cost of operating that equipment during the construction processes. The second and smaller portion covers the cost of hand tools. This represents a smaller portion of the project cost and is often calculated as a percentage of payroll costs. It is added to the indirect cost under the jobsite overhead. The understanding and knowledge of the components of equipment costs are necessary for a good cost estimate. It is also important to note that for any decision made in the acquisition of equipment, all costs should be considered and accounted (Calin et al. 2003).

The costs for equipment cannot come from thin air; the estimator must rely heavily on equipment expense data for future bids. Especially in heavy construction, the cost accounting is important since the contractor has great deal of money invested, and the equipment costs become a large percentage of the costs of the project. It is important that equipment costs be constantly analyzed and kept under control. It is necessary for the estimator to decide what equipment is required for each phase of the work and for what length of time it will have to be used. Equipment that is required throughout the project is included under equipment expenses, because it cannot be charged to any particular item of work (Dagostino & Peterson, 2011).

Renting versus purchasing equipment

The purchase of equipment represents a capital investment by the construction contractor. The contractor must recover sufficient money to pay the ownership and operating costs of the equipment during its useful life, and at the same time make a profit

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on the investment. Any estimate must include the cost of equipment used on the project. Construction equipment could be purchased or rented. The choice between purchase and rental usually depends on the amount of time the equipment will be used in the contractor's operations. If extensive use of the equipment is required, the equipment is always purchased. If the equipment is to be used for a limited amount of time, it is typically rented (Elbelagi, 2009).

A contractor does not necessarily have to own any construction equipment in order to carry on business. There can be distinct advantages increasing profit margin in renting equipment such as:

- No need of maintaining a large inventory of specialized equipment or no maintenance cost in this case.
- Continuous access to the newest and most efficient items of available equipment.
- No need for equipment warehouse and storage facilities.
- Reduced need to employ maintenance staff.
- Equipment cost accounting is simpler when the equipment is rented.

According to Elbelagi (2009), contractors may purchase equipment when factors pertaining to ownership economically become more favorable than renting. These factors may include governmental tax incentives (investment credit and tax depreciation), full control of equipment resources, and a availability of equipment when needed. However, renting requires little initial capital and the contracting company loses the tax depreciation shield of machine ownership but gains a tax deduction because rental payments are treated as an expense. A rational analysis of these alternatives for obtaining equipment is complex and must include cost under the expected conditions, as well as equipment availability and productivity. Purchasing equipment will result in the lowest hourly equipment cost if the equipment is properly maintained and fully utilized. However, equipment owning costs continue whether equipment is being utilized or sitting idle. But, renting is usually less expensive for equipment with low utilization than purchasing. The question of whether it is better to purchase or rent a piece of construction equipment is difficult to answer (Nunnally, 2007).

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c1. Ownership Costs

Estimating equipment cost involves identifying the ownership cost and operating costs. Costs associated with owning equipment are called the ownership costs. Elbelagi (2009) stated that Ownership costs include: initial cost, financing (investment) costs, depreciation costs and taxes, insurance costs and described as follow;

Initial cost

The initial cost is the total cost required to purchase a piece of equipment. This initial cost is the basis for determining other costs related to ownership as well as operating costs. Generally, initial cost is made up of: price at the factory or used equipment price, extra options and accessories, sales tax, freight and assembly or setup charges. The initial cost is very straightforward, whereas the other costs require more analysis and computation.

Investment cost

The purchase of construction equipment requires a significant investment of money. This money either be borrowed from a lender, or it will be taken from reserve fund of the contractor. Either the lender will charge an interest rate for the borrowed money or the contractor will lose any interest money that could be gained if the contractor invest that amount of money used to purchase a piece of equipment.

Depreciation cost

The cost charged to operations of an asset during a particular year is called depreciation. Depreciation can be classified as Economic Depreciation (Purchase price- market value) and accounting depreciation. However, from an engineering economics point of view, our primary concern is with accounting depreciation in which a fraction of the cost of the asset is chargeable as an expense during the accounting periods or it is the systematic allocation of an asset's value over its depreciable life.

In order to calculate accounting depreciation, one has to know its cost, its salvage value, service or depreciable and what method to use.

There are basically two methods for calculating accounting depreciation:

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1. **Book depreciation** is the method of depreciation used for financial reports and pricing decisions like balance sheet or income statement;
2. **Tax depreciation** is used for the purposes and usually permits higher depreciation in earlier years than book depreciation methods (Gashaw, 2014). It is governed by tax legislation and used for calculating taxable income and for engineering economics (PARK, 2004).

c2. Operating costs

Operating cost accrue only when the unit of equipment is used, whereas ownership costs accrue whether or not the equipment is used. Operating cost include maintenance and repairs, fuel, oil and other lubricants, filters, tires, high wear items etc. The amounts consumed by a piece of equipment vary with the type and size of equipment, the conditions under which it is operated (Calin et al., 2003). The costs of operating the construction equipment should be calculated on the basis of the working hour.

Maintenance and repair costs

The cost for maintenance and repairs include the expenditures for replacement parts and the labor required to keep the equipment in good working condition. Historical cost records of maintaining and servicing equipment are the most reliable guide in estimating maintenance and repair cost. The manufacturers of construction equipment provide information showing recommended costs for maintenance and repairs for the equipment they manufacture. The annual cost of maintenance and repairs is often expressed as a percentage of purchase prices or as a percentage of the straight-line depreciation costs.

Fuel consumption

When operating under standard conditions, a gasoline engine will consume approximately 0.23 liter of fuel for each horsepower-hour developed. A diesel engine will consume approximately 0.15 liter of fuel for each horsepower-hour developed (Elbelagi, 2009).

Lubricating oil consumption (Lube oils and grease)

The quantity of lubricating oil consumed by an engine varies with the size of the engine, the capacity, the equipment condition and the number of hours between oil changes.

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Cost of rubber tires, high-wear items (crawlers), filters etc

Many types of construction equipment use rubber tires, high-wear items and filter whose life usually will not be the same as the equipment on which they are used. For example, a unit of equipment may have an expected useful life of six years, but the tires on the equipment may last only for two years. Therefore, a new set of tires must be placed on the equipment every two years, which would require three sets of tires during the six years. In addition to this, the cost of replacing high-wear items such as dozer, grader, scraper blade cutting edges, end bits, as well as ripper tips, shanks, and shank protectors should be calculated as a separate item of operating expense. Filters must also be replaced and the filter housing wiped clean at specified intervals. Thus, the cost of depreciation and repairs for tires, high-wear items (crawlers), filters etc should be estimated separately from the equipment.

c3. Rental costs

In considering the rental of equipment, the estimator must investigate the available rental agencies for the type and condition of equipment available, the costs, and the services the rental firm provides. The estimator must be certain that all terms of rental are understood, especially those concerning the repair of the equipment. Contractors tend to buy equipment even when it is more reasonable to rent. Many rental firms have newer equipment than a contractor might purchase. They also may have a better maintenance program. Estimators should check the rental firms carefully, especially when doing work in a given locale for the first time. The price of the rental is important, but the emphasis should be on the equipment's condition and service. Rental rates are usually quoted by the month, week, or day. These costs must be broken down into costs per hour or per unit of work so that they may be accurately included in the estimate and checked during construction (Dagostino & Peterson, 2011).

d. Formwork

Two major categories of formwork are job built and prefabricated. Job-built forms are often designed, built, and used with the particular requirements of a single project in mind. They are most often constructed using plywood sheathing and lumber framing. They may also incorporate proprietary hardware in their assembly. Job-built forms are

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often the economical choice when complicated forming is required that would be difficult or more expensive if using commercial form systems (James, 2003).

Based on material content, concrete forms can be classified into three groups, namely, wood, metal, and miscellaneous forms which could be a combination of those or other materials. Among these forms, wood forms are normally the least expensive and may be used up to four times depending upon their use or maintenance. The waste factor for wood forms may take a significant role. Hardware composed of the necessary metal parts is required to tie and hold the wood forms. Hardware includes nails, snap ties, tapered tie bolts, tie screws, deck hangers, and so on. Metal forms, on the other hand, are usually much more expensive, but may last for many uses and can be repaired. In general, lower formwork cost will result from repetitive use of forms (Calin et al., 2003, Nunnally, 2007).

2.3.4.2. Indirect cost

. Indirect costs are also referred to as distributed costs. Indirect costs are not a component of the actual construction work but are incurred by the contractor in support of the work. Overhead costs are those costs which cannot be attributed to a single task of construction work. These costs include overhead, profit, and bond. Overhead costs are customarily divided into two categories; namely General or Home office overhead cost and Job or Field overhead costs (Department of Energy, 2011; Ron, 1991).

A).General (Home office) overhead costs

General overhead consists of those costs that cannot be specifically identified to the completion of a construction project. General overhead may also be referred to as indirect costs. General overhead includes all main office and supervisory costs that cannot be billed to a specific construction project. General overhead costs are controlled on a companywide basis. The responsibility for controlling these costs falls on the owner of the construction company or the company's general manager (Peterson, 2005).

The home office overhead costs include items that cannot be readily charged to any one project, but represent the cost of operating the construction company. These expenses are those incurred by the contractor in the overall management of business, associated with all costs at the home office. Since they are not incurred for any one specific project, they

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must be apportioned to all the projects. Many expenses such as interest and entertainment are not allowable. These expenses must be shared proportionally among the projects undertaken; usually the home office cost items are estimated based on a fiscal year budget and reduced to a percentage of the anticipated annual revenue (Department of Energy, 2011; Dagostino & Peterson, 2011).

B). Job (Field) office overhead costs

The job overhead costs include all overhead expenses that will be incurred as a result of executing a specific project. Most of these items are a function of the project duration; therefore, having a good estimate of the project duration is critical in developing a good job overhead estimate (Dagostino & Peterson, 2011).

These costs are indirect and cannot be tied to specific construction activities even though they are included with the total project costs. The individual components will vary with the size and complexities of the project.

C). Profit

Profit is defined as a return on investment that provides the contractor with an incentive to perform the work as efficiently as possible (Department Of Energy, 2011). The last item to be included in the bid and representing contractor's return on investment is the profit. The magnitude of desired profit must be decided by the owner for each individual bid, depending on local market conditions, competition, and the contractors' need for new work (Calin et al., 2003).

For profit calculation to be accurate, the budget must be a realistic estimate of the cost to complete the project. Budgets that are fat, have large contingencies, are missing items, or have underestimated costs distort the profit analysis. It is important that budgets are carefully and accurately prepared. The profit margin is the percentage of the revenues that becomes profit and may be measured before or after income taxes. It is also known as the return on revenues or return on sales (Peterson, 2005).

D).Contingency

It is an amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain, will likely result additional costs and estimated using statistical analysis or judgment based on past asset or project experience.

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(AACE International Recommended Practice, 2014). Contingency is not potential profit. It includes risk and uncertainty but explicitly excludes changes in the project scope (change orders). The contingency should absolutely not be treated as an allowance. Allowances are costs that are foreseen to be spent, and need to be included in the detail estimate in the proper construction category of work and not as a total for the project (Dagostino & Peterson, 2011).

Contingency is just a percentage of cost as a reserve for both parties (contractors and clients). It is intended to cover additional costs due to events such as incomplete design, construction disturbances (accidents or breakdowns), regulatory risk, technological change, omissions and abnormal construction and start-up problems (Wesley, 1989 p B.9.1). Contingencies relate to a known and defined project scope and a re-notation of prediction of future project scope or schedule changes (Department of Energy, 2011).

2.3.4. Pricingsource

Various pricing sources should be obtained and be available to the cost engineer. In pricing from any source, experience and ability to relate data in hand to a specific circumstance is important (Department of Energy, 2011)

a. Historical data

The amount of applicable data for unit pricing of materials and work-hour estimating of labor and the time available to update this data for current and specific conditions affects accuracy (Graf, 1984).

Data are the foundation of every cost estimate. How good the data are affects the estimate's overall credibility. Depending on the data quality, an estimate can range anywhere from a mere guess to a highly defensible cost position? Credible cost estimates are rooted in historical data. Rather than starting from scratch, estimators usually develop estimates for new programs by relying on data from programs that already exist and adjusting for any differences. Thus, collecting valid and useful historical data is a key step in developing a sound cost estimate. The challenge in doing this is obtaining the most applicable historical data to ensure that the new estimate is as accurate as possible. One way of ensuring that the data are applicable is to perform checks of reasonableness to see if the results are similar. Different data sets converging toward one value provides

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a high degree of confidence in the data (The U.S. Government Accountability Office, 2009).

Historical costs from past similar work are excellent pricing sources when adequate details have been saved and adjustment to project specifics can be defined. Portions of other estimates having similar work can be retrieved and reprised to the current project rates (Department of Energy, 2011).

b. Current information

Every cost estimate must be based on the most complete, thorough, and current information concerning the process, product, project or service being estimated. The information takes many forms. Some of these are pro-forma invoices, drawing, specification, cost records, handbooks', professional and reference books, personal knowledge of the shop or office operation. Formulation of a credible and usable cost estimate involves the selection of the appropriate information from among these vast stores of knowledge.

2.4. Types of construction cost estimates

Construction cost estimates may be viewed from different perspectives because of different institutional requirements. In spite of the many types of cost estimates used at different stages of a project, cost estimates can best be classified into three major categories according to their functions. A construction cost estimate serves one of the three basic functions: design, bid and control (Hendrickson, 2000).

2.4.1. Design estimates.

According to Hendrickson (2000), for the owner or its designated design professionals, the types of cost estimates encountered run parallel with the design as follows:

- . Screening estimates (or order of magnitude estimates)
 - Preliminary estimates (or conceptual estimates)
 - Detailed estimates (or definitive estimates)
 - Engineer's estimates based on plans and specifications

In the design stages of a project, various design estimates reflect the progress of the design. At the very early stage, the *screening estimate* or *order of magnitude* estimate is usually made before the facility is designed, and must therefore rely on the cost data of

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similar facilities built in the past. A *preliminary estimate* or *conceptual estimate* is based on the conceptual design of the facility at the state when the basic technologies for the design are known. The *detailed estimate* or *definitive estimate* is made when the scope of work is clearly defined and the detailed design is in progress so that the essential features of the facility are identifiable. The *engineer's estimate* is based on the completed plans and specifications when they are ready for the owner to solicit bids from construction contractors. Some of the types of cost estimates parallel with the planning and design stages are:

A).Parametric estimating

Parametric estimating is the process of establishing an order of magnitude project value by modifying a field of predefined standard work units through the use of parametric sets. A parametric set is defined as a grouping of numerical factors which, by their application, alter a standard work unit in relation to a specific area of sensitivity. Examples of such areas are geographical location, labor intensity, project timing, etc. Often upper management requires order of magnitude cost estimates quickly in order to make basic business judgments on the feasibility and profitability of various capital investments. Such judgments will define as profitable project that will fulfill a particular corporate need at the least investment and operating costs. Parametric estimating is not intended for the creation of detailed estimates, it is a manual mode tool useful primarily when time is at a premium and detailed design is not yet available (Norman, 1998).

Parametric estimating provides several advantages as an estimating technique such as;

- **Efficiency:** is not only allowing estimates to be prepared in much less time than required by more detailed techniques, but require less engineering and level of project definition to support the estimate.
- **Objective:** Parametric models require quantitative inputs that are linked to algorithms providing quantitative outputs. All costs are traceable.
- **Consistency:** If two estimators input the same values for parameters, they will get the same resulting cost.
- **Flexibility:** Parametric models provide costs for a range of input values, extrapolating to derive costs for projects of a different size or nature than you

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may have history for. The models can be easily adjusted to provide cost sensitivity analysis for proposed design changes (Larry, 2008).

B).Analogous estimating

Analogous estimating refers to the estimating process where there is significant similarity between the proposed project and those projects contained in the historical database (Rad, 2002). Analogous estimating can be used in serial tendering that allow a number of similar projects to be placed with a particular contractor and thereby provide the incentive of a continuous flow of work. It is most reliable when a) previous projects are similar in fact and not just in appearance, and b) the individuals or groups preparing the estimates have the needed expertise (Project Management Institute, 2000).

Analogous technique is used for early estimates that are called order of magnitude and used to estimate project costs by comparing the proposed project with similar projects for which historical information is available. It is important when developing the analogous estimate that the project manager uses the values of as many of the following deliverable indices as available: type, functions, requirements, design characteristics, capacity, size, location, cost constraints, and quality expectations (Rad, 2002).

The analogous method has several advantages:

- It can be used before detailed program requirements are known.
- If the analogy is strong, the estimate will be defensible.
- An analogy can be developed quickly and at minimum cost.
- The tie to historical data is simple enough to be readily understood.

Analogies also have some disadvantages:

- An analogy relies on a single data point.
- It is often difficult to find the detailed cost, technical, and program data required for analogies.
- There is a tendency to be too subjective about the technical parameter adjustment factors (The U.S. Government Accountability Office, 2009).

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C). Range estimating

Another approach to increasing the reliability of the early estimates, known as range estimating, is to provide not just one estimate for the cost of an element but rather define the range of possible values for the cost of a specific element (Rad, 2002). As its name implies, range estimating uses a simple but effective measure of uncertainty. The range is specified by three parameters: the probability that the element's actual value will be equal to or less than its target, a lowest estimate, and a highest estimate (Curran, 1989).

In a range cost estimate, the unit prices are assumed to be random variables rather than known parameters. As a result, a distribution of total cost is obtained in lieu of a single estimate. This distribution is then used to provide an estimate with a known level of confidence. In addition, the exposure and risk associated with the estimate are quantified. These features are very helpful to the cost engineer both in preparing useful estimates as well as in managing resources during project execution. Range cost estimates have been prepared using a probabilistic technique called Monte Carlo simulation. In this technique, the random unit costs are sampled in accordance with their distribution functions. An associated total cost is calculated for these sampled values as in deterministic estimating. This sampling and calculation is repeated a large number of times to produce a sample of total costs. Range cost estimating can be performed directly through a normal approximation whose parameters are computed from those of the unit costs (Mlakarand Bryant, 1990).

D). Square foot estimating

Square-foot estimates are prepared by multiplying the square footage of a building by a cost per square foot and then adjusting the price to compensate for differences in the building heights, length of the building perimeter, and other building components. Square-foot estimates are helpful to check whether the project, as designed, is within the owner's budget (Dagostino & Peterson, 2011).

This method also saves a considerable amount of time estimating jobs that are in these early phases of detail. This, in turn, allows the estimator to spend more time on the jobs that have the detail available to do a detailed estimate. It also keeps the estimator from creating detail that is incorrect. Very few of these methods can be used for estimating a project early in design phases (Roney, 1992).

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2.4.2. Bid estimates

The contractor's bid estimates often reflect the desire of the contractor to secure the job as well as the estimating tools at its disposal. Some contractors have well established cost estimating procedures while others do not. Since only the lowest bidder will be the winner of the contract in most bidding contests, any effort devoted to cost estimating is a loss to the contractor who is not a successful bidder. Consequently, the contractor may put in the least amount of possible effort for making a cost estimate if he/she believes that its chance of success is not high (Hendrickson, 2000).

2.4.3. Control estimates

Both the owner and the contractor must adopt some base line for cost control during the construction. For the owner, a budget estimate must be adopted early enough for planning long term financing of the facility. Consequently, the detailed estimate is often used as the budget estimate since it is sufficient definitive to reflect the project scope and is available long before the engineer's estimate.

For the contractor, the bid estimate is usually regarded as the budget estimate, which will be used for control purposes as well as for planning construction financing. The budgeted cost should also be updated periodically (Hendrickson, 2000).

2.5. Factors that influence building project cost estimation

Construction is a unique industry which is inherently risky because most projects must be priced before they are constructed, whereas in other industries the selling price is based on known manufacturing costs. A serious industry problem in most developing countries is inaccurate estimating (Enshassiet al., 2007). Many factors influence a building construction project estimate. Several key factors are described below.

A. Project size

Project sizes can affect the unit cost of constructing. Generally, the unit price for smaller quantities of a given material will be more than that for larger quantities. Suppliers usually offer discounts for larger quantity orders (Department of Transport, 2013). Mobilization and overhead, such as site and head office overhead are all spread out over a large quantity, thus reducing their effort on each unit. The most common factors affecting overhead costs are payroll taxes and insurance premiums, economic

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conditions, type of business, and the management philosophy of the business (rapid growth versus controlled grow).

The smaller the project in terms of scope or the number of square feet, the more it will cost per square foot. Contractors have a set of basic “start-up costs.” Thus for a very large and expensive project, the start up costs will be a small percentage of the total construction cost. For a small project, since start-up costs remain stable, they will constitute a large percentage of the total construction budget (budisuanda, 2011).

B. Types of project

The cost of construction depends on the time the contractors will need to execute the work, the degree of specialization of the work to be done, and the cost of the materials. Different types of project have different levels of complexity and detail. A school cafeteria wouldn't require the same amount of time, nor the same level of complexity, as a four star restaurant (budisuanda, 2011).

C. Bidder Competition

A lack of competition often leads to higher bid prices. Generally, projects that are tendered during a period of time with a large number of contractors are bid competitively with lesser price (Department of Transport, 2013).

D. Types of client

If there are some difficulties with the client during the design process, these difficulties will affect the construction process. A demanding client who may anger on construction crews and an indecisive client who may wish to make changes up to the last minute or later will obviously raise costs. The client's problematic behavior is difficult to explain, let alone bill (budisuanda, 2011).

E. Contract period

The part of the year during which the Project is to be awarded for contract and the time estimated for completion may have a significant influence in price selection. Factors such as shortened working hours during the summer, major holidays, during Ramadan in some Arab countries and suspension or delay due to abnormal weather conditions will have an effect on bid price. Accelerated or compressed construction schedules can

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potentially increase costs. These factors should be considered when establishing the price or construction schedule for each project (Department of Transport, 2013).

F. Geographical location of the area

Geographic considerations can have a considerable effect on the selection of unit bid prices. The project location, whether in a densely populated area (urban) or sparsely populated (rural) area, should be considered in establishing bid prices (Department of Transport, 2013).

Groundwater conditions can vary greatly and need to be investigated to determine the extent of dewatering required for foundations and other structures such as storm water retention ponds. Varying geotechnical conditions are covered under soil conditions (SAEO, 2008).

G. Practical experience of the estimator (Lack of site knowledge and construction)

Construction contract price forecasting practice is, with very few exceptions, heavily dependent on the skill of the forecaster. This skill is associated with the other factors affecting the quality of forecasts - the nature of the target, information, technique, and feedback - and the personal attributes of the forecaster himself combining to provide the general term of 'expertise'. These influences, together with some observations regarding the acquisition and application of forecasting expertise constitute the remainder of this review (Skitmore et al., 1990).

H. Project information

The project information factor grouping comprises the quality of information and information flow, availability and supply of resources (Akintoye, 2000).

The level of information available to the estimator increases as the design progresses. The effect of increasing information can therefore be comparing the accuracy of estimates made in the early stages of design (conceptual estimates) with those made when the design is substantially complete (detailed estimates)(Skitmore, 1988).

Construction price forecasting involves the acquisition of two classes of information relating to the contract market. Firstly, information which identifies the specific market under consideration, and secondly information of the general price levels associated with

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that market. The information concerning general price levels for a particular construction contract market is held by forecasters in various forms and extracted from various sources (Skitmore et al., 1990).

I. Project duration

The cost estimator has to tie up the earning and purchasing power of money to time and consider the inflation rate. According to Rad (2002), once the cost and duration of a proposed project have been predicted using historical data, the resulting values need to be adjusted and normalized in the **light of time**. The term time refers to the year in which the existing project is completed. Comparison between the delivery dates would provide the basis to adjust the estimate based on the **inflation rate or the time value of money**.

Applying inflation is an important step in cost estimating. If a mistake is made on the inflation amount, cost overruns will likely happen. Applying inflation for the project duration correctly is necessary if the cost estimate is to be credible (The U.S. Government Accountability Office, March 2009).

According to Department of Energy (2011), estimates are accurate when they are not overly conservative or too optimistic and adjusted properly for inflation based on an assessment of most likely costs.

Factor grouping for project duration includes the anticipated frequency and extent of variations to the client's building requirements. The extent of variations has a potential impact on the completion time for a project. Apart from these factors having an impact on the resources required for the project, they affect the pricing of preliminaries (including site overheads) and general overheads (Akintoye, 2000). Building construction is a seasonal enterprise. There are periods of the year when contractors are busy and can barely keep up and then there are periods of the year when they are likely to be looking for work (budisuanda, 2011).

J. Market condition

Estimators should take into account market conditions whilst developing a cost estimate. If the economy is experiencing a downturn and there is more competition for projects, Contractors will bid competitively with less profit. Conversely, if the market is booming and more projects are advertised, Contractors will bid projects with higher mark-ups

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(Department of Transport, 2013). This factor is closely linked to other items likely to affect the competitiveness level of contractors and the estimating performance of cost engineers (Pearl, 1994). According to Akintoye (2000), the cost estimator in the estimating process must take into account the trends in market conditions and the implications on the costs of the resources for the project.

2.6. The estimating process

All projects benefit from following a thoughtful and deliberate process in developing project cost estimates. The task of cost estimating, by its very nature, requires the application of prudent judgment to the completion of the task (SAEO, 2008).

The process of preparing detailed cost estimates starts with establishing clear definitions of the scope of the estimating tasks and the physical nature of the project being estimated. The next step is to follow an organized and consistent work plan for preparing and reviewing the estimate. The final step is to present the estimate and, if necessary, reconcile it with estimates prepared by others (Michael, 2003). However, in most literatures the estimating process is quite common. According to James (2003), to produce a detailed construction cost estimate, it is necessary to follow a rigorous process made up of several key steps. These key steps are explained below.

1. Familiarization with project characteristics

The estimator must be familiar with the project and evaluate the project from three primary avenues: scope, constructability, and risk. Having evaluated these three areas in a general way, the estimator will decide whether the effort to estimate and bid the work has a potential profit or other corporate goal potential (long-term business objective or client relations). The contractor must be convinced that the firm's competitive advantage will provide the needed margin to secure the work away from competitors.

a. Scope: Just because a project is available for bidding does not mean that the contractor should invest the time and expense required for the preparation of an estimate. These scope issues include the following:

1. Technological requirements of the project
2. Stated milestone deadlines for the project

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3. Required material and equipment availability
4. Staffing requirements
5. Stated contract terms and associated risk transfer
6. Nature of the competition and likelihood of an acceptable rate-of-return

b. Constructability: knowledgeable contractor, having made a preliminary review of the project documents, can assess the constructability of the project. Constructability evaluations include examination of construction quality requirements, allowable tolerances, and the overall complexity of the project. The construction industry has general norms of quality requirements and tolerances for the various types of projects.

c. Risk: The contractor must also evaluate the risks that might be encountered on the project. In general, a construction firm faces business risks, project risks, and operational risks, which must be offset in some way. Contract terms that transfer unmanageable risk or categories of risk that are not easily estimated discourage participation in bidding.

2. Examine the project design

The estimator must be able to read, interpret, and understand the technical specifications, the referenced standards and any project drawings, and documents. The estimator must closely examine material specifications so that an appropriate price for the quality and characteristics specified can be obtained.

The estimator must keep a watchful eye for errors and omissions in the specifications and drawings. Discrepancies are often identified between drawings, specifications, or between drawings and specifications. The discrepancies must be resolved either by acceptance of a risk or through communication with the designer. The best choice of solution depends on the specifics of the discrepancy and the process or the method for award of contract.

3. Structuring the estimate

The estimator either reviews a plan or develops a plan for completing the project. This plan must be visualized during the estimating process; it provides the logical flow of the project from raw materials to a completed facility. Together with the technical

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specifications, the plan provides a structure for the preparation of the detailed estimate. Most estimators develop the estimate around the structure of the technical specifications. This increases the likelihood that items of work are covered without duplication in the estimate.

4. Preparation of cost estimate

This activity covers the development of estimated costs for all components of a project, excluding future escalation. These components may be estimated using different techniques depending on the level of scope definition and the size and complexity of the project. The number and detail of components estimated may vary depending on the project development phase (SAEO), 2008).

Potts (2008) states that during this stage the estimator will assemble information on the net cost of the works including calculating the following: the current rates for labor, materials and construction equipment, the unit or activity rates, the preliminaries or general items and finally the summaries.

a. Current rates for labor, materials and construction equipment

The rates for labor will be the 'all-in' rates, that is, the contractor's total cost per hour of employing the different categories of labor. These hourly rates are calculated based on the basic rates as the national working rule agreement with the defined allowances for special skills together with bonus payments, holiday pay, employers' insurance etc.

Prices for bulk materials must be scrutinized in order to ensure that they meet the specification and testing/sampling requirements; delivery must also meet the demands of the programme.

The construction equipment rates should cover for transport to site, erection/dismantling, operators, maintenance and fuel. Major static items of construction equipment such as tower cranes are normally priced separately in the general items or method-related charges section whilst other items are often included in the individual rates.

b. Unit rates for each item in the BOQ/activity schedule

According to Potts (2003), the three main estimating techniques used by contractors when pricing major construction works are detailed below.

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Unit-rate estimating

Unit-rate estimating, which is the standard procedure in the sector, involves pricing individual rates in the BOQ which has been prepared in accordance with a method of measurement.

The unit rates are calculated using one of the following methods:

- Historical rates based on productivity data from similar projects and customizing ;
- Historical rates based on data in standard price books and customizing;
- *Built-up* rates from an analysis of labor, materials and construction equipment for each item and cost at current rates.

There are several possible disadvantages of using the unit-rate method for estimating major works such as; a).lack of precision especially in the interpretation of what the unit rate exactly provides b).the system does not demand an examination of the programme or the method statement c). It does not encourage an analysis of the real costs and major costs risks in undertaking the work and d). Level of detail in pricing each item can give a false sense of confidence in the resulting estimate (Ports, 2008, Department of Transport, 2013).

Generally, it is not recommended that the data from standard price books are used in the estimating of major civil engineering works, either at tender or when variations are required. The reason for this is due to the possible differences in ground conditions, method statements, temporary works, availability of construction equipment, location of the project and the time of year in which the work is executed etc. Each project should be considered on its own merits and the cost estimate based on first principles using the operational method.

Operational estimating

Operational estimating, which is the recommended method for estimating civil engineering works, requires the estimator to build up the cost of the operation based on first principles, that is, the total cost of the construction equipment, labor and permanent/temporary materials. This method of estimating links well with the planning process as it embraces the total anticipated time that the construction equipment and labor gang are involved in the operation including all idle time.

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If a BOQ approach is used, the total cost of the operation is then divided by the quantity in the BOQ to arrive at an appropriate rate. For example, if a total of 2,550 m³ of concrete placing were contained in different bill items of varying quantity and if the total cost of the plant element of the operation was 13,110.00 Birr, then the rate would be $(13,110.0 \text{ Birr} / 2550 \text{ m}^3) = 5.14 \text{ Birr/m}^3$ and this would be set against each item together with the labor costs. A significant advantage of this approach is that it provides a complete integration between the estimate and the programme which in turn enables a project cash flow to be produced. The process involves the following:

- Compiling a method statement, showing sequence, timing, resources required;
- Refining the method statement to show an *earliest completion* programme with no limit on resources;
- Adjusting the programme by *smoothing* or *leveling* the resources in order to produce the most economic programme to meet the time constraints;
- *Applying current unit costs*: fixed, quantity proportional and time related.

Operational estimating is a method that is based essentially on an analysis of the work content of a project on the basis of how costs are incurred. It is claimed that each identifiable site operation can be performed by a gang of men and materials without interruption from other operations. For example, the costs of reinforced concrete suspended floor are an amalgamation of the formwork, reinforcement and concrete items. An in situ concrete staircase that is to be cast at the same time can also be part of this same operation. Instead of attempting to separate the costs and allocating these to the individual measured items, the cost of the entire operation only is calculated.

Man-hours estimating

Man-hours estimating are most suitable for work which has significant labor content and/or for which extensive reliable productivity data exists for the different trades/specialism involved. Typical applications include the following:

- Design work and drawing production, both engineering and architectural;
- Installation of process plants and offshore modules.

This method of estimating is frequently used by the major mechanical and electrical contractors. It should be used in conjunction with a construction programme/schedule in order to highlight any restrictions, for example a availability of heavy-lifting equipment, which may affect labor hours expended in fabrication yards or on site.

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5. Assessment of project over head

According to James (2003), each project requires certain items of cost that can not be identified with a single item of work. These items are referred to as project overhead and are normally described in the general conditions of the contract. The items that are part of the project overhead include but are not limited to the following:

- Bonds
- Permits
- Mobilization
- Professional services (such as scheduling)
- Safety equipment
- Small tools
- Supervision
- Temporary facilities
- Travel and lodging

6. Assessment of general overhead

Each business has certain expenses that are not variable with the amount of work they have under contract. These expenses must be spread across the projects. The typical method for spreading general overhead is to assign it proportionally according to the size of the project in relation to the expected total volume of work for the year. General overhead costs typically include the following:

- Salaries (home office)
- Employee benefits
- Professional fees
- Insurance
- Office lease or rent
- Office stationery and supplies
- Maintenance
- Job procurement and marketing
- Home office travels (James ,2003).

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7. Assessment of risk and profit allowance

The profit assigned to a project should recognize the nature of risk that the company is facing in the project and an appropriate return on the investment being made in the project. The reality is that the profit is limited by the competition. A larger number of bidders requires that a smaller profit be assigned to have a chance at having the low bid. This process of assigning profit is usually performed at the last minute by the senior management for the company submitting the bid (James, 2003).

Risks are, by definition, uncertainties that have the potential to affect a project's expected outcomes. In the context of cost estimating, the cost impact of project risks (favorable or unfavorable) must be included to derive a total project cost (SAEO, 2008).

8. Review and approval

Estimates are key products of the project management process and are fundamental documents upon which key management decisions are based. Given their importance, all estimates should receive an independent review and then be reconciled and revised as needed to respond to independent reviewer comments. Once independent review comments have been satisfactorily incorporated, estimates should be presented to management staff for approval (SAEO, 2008).

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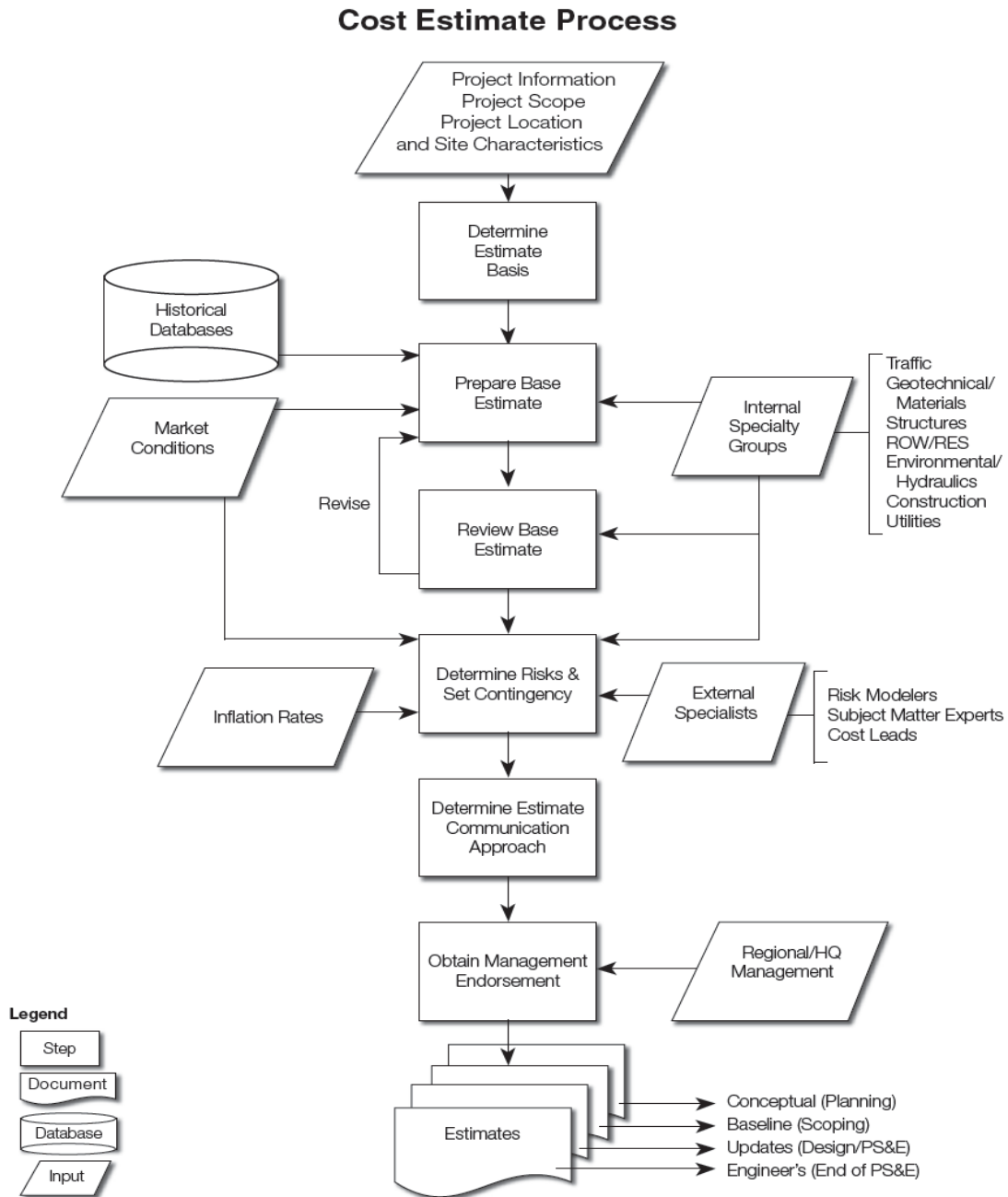


Figure 2.2: Illustrative cost estimating process.

Source: (SAEO), 2008)

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2.7. Experiences in other developing countries

2.7.1. Thailand's experience

The Engineering Institute of Thailand (1999) recommends that design firms and construction companies use the CSI standard format (Construction Specification Institute's) for project cost estimates. However, there is one additional division in the CSI system used in Thailand, which is Item 17 Painting Work while the CSI standard format used in the United States has 16 divisions.

In the book "Guideline for Quantity Takeoff for Structural and Architectural Works" by the Engineering Institute of Thailand (2002), there are nine standard categories of cost estimates which differ from those discussed in the book "The Guideline for Information Management for Construction Evaluation and Management." Basically, most standard divisions identified by the Engineering Institute of Thailand are similar to the CSI standard format. However, estimating techniques are different for the units of materials and measurement of labor cost.

Roachanakanan(2005) states in his dissertation that for all practical purposes, the procedures for cost estimating used in Thailand are similar to those in the United States. The data needed for cost estimating include:

- Labor Productivity
- Labor Rate: cost per hour/day/week
- Labor Unit Price
- Material Unit
- Material Conversion
- Material Unit Price
- Waste Percentage
- Equipment Productivity
- Equipment Rate

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2.7.2. South African experience

According to Seeletse and Ladzani (2012),

- Cost drivers such as labor, materials, plant and equipment are highly recognized in the tender compilation.
- It seems to have high awareness of risk factors but seems to lack the capability to manage risk.
- Since leading nations use complex methods which the emerging construction sector in South Africa did not use, 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.
- Since estimation approach was found to be dependent on the type of contractor, this implies that different contractors approached estimation differently. It was similarly shown that different contractors approached estimation and proposal management differently according to province. Professional backgrounds of different contractors also influence the way in which the contractors managed proposals and conducted their cost estimation

2.7.3. Ghanaian experience

Laryea and Hughes (2009) states that

- The risk allowances included by the contractors were based mainly on a fixed percentage of the estimated cost of a bill item. Some also included arbitrary lump sum allowances as they calculated quantities and unit rates. The amount of contingency allocation is guided by concerns about competitors and winning the job rather than the level of project risk. However, this does not necessarily mean that the contractors assume more risk than usual.
- Main risk pricing mechanisms used by contractors in Ghana is that including the risk as a percentage in the profit margin and the 5% risk allowance included in bid price. Here, the main factors affecting pricing levels appeared to be: (1) the actual direct costs; (2) level of competition; (3) delivery time of the project; (4) promptness of payment; and (5) clarity of tender documents. The risk assessment practices were based mainly on the experience and subjective judgment of the QS

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and the managing director who were believed to make about 95 % of the decisions on pricing levels.

- The profit and loss statement showed that overhead was 15% of the yearly expenditure.
- The ratios of other costs showed labor (14%), plant (9%), materials (45%) and overheads (15%). This implied that overhead is 15% of the yearly expenditure. The main factors that influenced pricing levels appeared to be the actual direct costs; level of competition; delivery time of the project; promptness of payment; and clarity of tender documents.
- The risk management processes of contractors in Ghana practice formal risk management; although it is clear that they take account of risks when pricing their work. No analytical risk models or rigorous analysis are applied to determine contingencies. Indeed, none of the contractors indicated any knowledge or application of any mathematical approach for analyzing project risks. Instead, all the contractors relied on the Q's skill and experience to price risk based on a fixed percentage of the estimated costs or an estimated number of days for which risk events are most likely to occur during the contract.
- The building up of prices for labor and materials showed that some allowances were included for risks identified by the contractors. The contractors assessed factors such as the client's ability to pay, project location, the parties involved, and contractors' own ability to perform before deciding to bid. An examination of the project characteristics plays a key role in shaping the allocated profit margin. From the way that they build up prices, risk is captured. Hence, they do not perform any one-off formal risk assessment event. Where contractors are not sure, they subjectively include an arbitrary allowance of 5-10% to cover any "unforeseen events".

2.8. Cost estimating related researches in Ethiopia

Among the several researches conducted on cost estimating related issues here in Ethiopia, Abraham (2008) has conducted his research on cost management of local contractors investigating the current cost management practice of national contractors. He concluded that;

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- No local contractor uses other estimating methods except the standard estimating method in which the costs of construction (labor, material, plant, subcontractors) are established and an allowance for overheads and profit is added. The procedure emphasizes that the estimate is prepared in a logical manner based on information on historical costs and anticipated production outputs during construction on site. However, the application of statistical and/or probabilistic estimating techniques such as the range estimating technique can improve the quality and accuracy of the estimates prepared by the standard method.
- The application of the standard or detailed estimating method for pricing contracts is very popular among the contractors. The preparation of such detailed estimate requires collecting, retrieving and manipulating massive amount of data on resources' cost, consumption and productivity standards and other qualitative items
- The development of estimates for material, labor and equipment costs requires information regarding their cost and productivity standards. Lack of accurate and reliable data on resources' price and labor and equipment productivity standards are identified by the surveyed contractors.
- Results of the survey indicated that the ratio of OH costs to total project direct costs, on the average, is about 25%. Despite their significant proportion, large portion of the surveyed contractors do not estimate these costs systematically or in a detailed manner.
- Majority of the surveyed contractors do not incorporate allowances for risk in their tender price, mainly due to difficulties in identifying, forecasting and quantifying potential risks. Only 38% of the contractors introduce allowance for risks in their final tender price.

Fetene (2008) investigated the causes and effect of cost overrun in public building construction projects in Ethiopia. From the result of the research project he identified 39 causes of cost overrun. The causes of cost overrun were identified based on the responses of the respondents. The most frequent causes of cost overrun are also identified by the research based on the ranking of the rate of occurrences of the variables

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of cost overrun and cost underestimation or inaccuracy is one of the major factors that causes cost overrun in Ethiopia.

2.9. Construction cost estimation guideline in Ethiopia

Tadesse(2006) prepared a construction cost estimation guideline on how to establish the unit costs of construction activities and develop the overall project construction cost. In the preparation of this construction cost estimation guideline, he establishes unit costs for the following major construction cost components with relevant examples.

- ◆ Direct labor costs
- ◆ Direct material costs
- ◆ Direct equipment costs
- ◆ Site overhead costs
- ◆ Head office overhead costs
- ◆ Risk allowance
- ◆ Profit margins
- ◆ Income tax

The guideline is applicable in the construction industry mainly in the preparation of construction cost estimates for different building, industrial and engineering construction projects; to serve mainly as a reference material in the preparation of construction cost estimates for different local construction projects in Ethiopia and with the believe of the following particular stakeholders, but not limited to, will benefit from his research work.

- ◆ Local contractors
- ◆ Local consultants
- ◆ Governmental offices
- ◆ Higher instructions
- ◆ Public and private sectors
- ◆ Engineers and architects
- ◆ As well as other interested stakeholders.

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2.10. Summary

This chapter has provided a background for research on the cost estimating process. The literature review shows that estimating has been recognized as a crucial stage of a construction project. The success or failure of a project relies on the accuracy of the estimates — from conceptual to detail.

Every professional may have a different interpretation of estimating. Estimating cannot be a precise technical and analytical process; but to an extent, it is a subjective process. Estimators consider factors relevant to the successful completion of a project. Hence, estimating is a process of calculated guessing by looking at the anticipated future costs of a project or product before it actually commences. Estimates are an approximation and so include a fair deal of uncertainty.

The literature review repeatedly mentions that feedback systems are an essential part of reviewing, assessing, and improving the data available so that the new estimates do not have inaccuracies carried forward from previous projects. This is ideally a process of learning from mistakes and seems to be neglected by estimators and their companies when it comes to improving the accuracy of the estimating practice.

From this literature review, one can draw conclusions that there are definite factors that affect the cost estimating of building projects. However, it becomes evident that the practice and improvement of the estimating practice is a must; otherwise, the inconsistencies will continue to be transmitted to new estimates.

This research will evaluate cost estimating practice of local construction companies and will attempt to fill the gap of the drawbacks of the existing practices. The methodology to achieve this is described in the next chapter.

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CHAPTER THREE

METHODOLOGY

3.1 Introduction

Research methodology involves the systematic procedures by which the researcher starts from the initial identification of the problem to its final conclusions. The role of the methodology is to carry on the research work in a scientific and valid manner (Kumar, 2006). Moreover; Kothari(1990) defines methodology as a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically.

Accordingly, this chapter discusses the methodology used in this research. The adopted methodology to accomplish this study uses the following techniques: questionnaire for gathering data, analysis of data to come up with conclusion and the required recommendation.

This chapter discusses the research strategy, questionnaire design, research population and sample, and method of data analysis.

3.2 Research strategy

In conducting this research, several steps were taken. First, problem identification has been done through preliminary literature review and researchers experience in construction projects.

Furthermore, based on the identified problem, an extensive review of literatures on the subject was undertaken. Next, an investigation on the existing building projects cost estimating practice of local contractors was carried out with the view of discovering whether it matches to what has been discussed in the literature or not.

Accordingly, questionnaire survey was selected as the research instrument and designed to get the factual information about the local practice of contractors in cost estimating by gathering their opinions. After the development of questionnaire, a pilot study was conducted before collecting the final data of the whole sample and this process generated

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some questions about explanation of certain terms and requested to modify some wording of the questionnaire. At the end of this process, the final form of the questionnaire was constructed or structured and distributed to the selected contracting companies by making some minor changes, modifications and additions. Finally, the results obtained from the questionnaire were analyzed to identify the major shortcomings and limitations of the cost estimating practices which were used to propose the improvement directions.

3.3 Research population and sample

a) Population study

The studied population is local contracting companies in Addis Ababa which are classified as first, second and third classes. This is applied only to companies which have valid registration for 2006 E.C. or 2014 G.C, as per the Ministry of Urban Development, Housing and Construction (MUDHCO). Accordingly the total population was 131 contracting companies, where 74 of them are first class, 17 of them are second class and 40 of them are third class construction firms.

b) Sample design

The sample size needed was computed using the statistical equation (Eq.3.1 and 3.2).

The formula used in sample size calculation is:

$$Ss = \frac{Z^2 * (p) * (1-p)}{C^2} \dots \dots \dots \text{Eq.3.1}$$

Where:

- Ss= Sample size needed
- Z= z value corresponding to the level of confidence or the standard normal distribution
- P= percentage picking a choice expressed as decimal
- C= confidence interval

Correction for finite population

$$\text{New ss} = \frac{Ss}{1 + \frac{Ss-1}{Pop}} \dots \dots \dots \text{Eq.3.2}$$

Where Pop=population

The z value corresponding to a level of confidence of 95% is 1.96 and the confidence interval (maximum error) was set to 0.05. For a given level of accuracy, p=0.5 for

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percentage picking a choice expressed as decimal using the worst case percentage (50%). This helps in creating the most conservative (largest) estimate of sample size.

Source: (www.surveysystem.com/sample-size-formula.htm)

According to Eq.3.1, the required sample size will be:

$S_s = (1.96^2) * (0.5) (0.5) / (0.05^2) = 384$ and the corrected new ss value will be

By using Eq 3.2 the new ss= $(384) / (1 + (383/131)) = 98$

Therefore the total sample size determined was 98 from total 131 contracting companies (55 out of 74, 13 out of 17 and 30 out of 40) representative samples selected from first, second and third classes respectively. The samples were selected by the researcher using simple random sampling method from different contractors working in Addis Ababa from each level of the three classes of contractors with minimum bias to get possible equal chances or reliable representative samples as much as possible. But, the respondents were 69 contractors which are 34, 10 and 25 from first, second, and third classes respectively.

3.4 Questionnaire design

This research focuses on the common local practice for cost estimating, the obstacles which are facing the contractors in estimation works and the use of different tools for cost estimating in Addis Ababa. The questionnaire consists of eight sections in general to achieve the objectives of the study. The first section is addressed to the company profile, the second part deals with the estimating in general, the third is addressed to the estimating of the bid items, the fourth treats the indirect costs, the fifth is related to the database, the sixth is addressed to the risk factors and contingencies, the seventh considers factors affecting cost estimates and the last (eighth) one covers cost estimating process.

The questionnaire was developed with closed ended questions. It was reliable in that it used the same questions to all respondents and was answered in similar ways. The questions were adopted from previously done studies related to the cost estimating and the researcher's experience.

The original questionnaire is in (Annex 1). The questionnaire was provided with a covering letter which explains the purpose of the study, the way of responding, the aim

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of the research and the security of the information to be confidential in order to encourage a high response by the contractors.

A draft questionnaire was first discussed with other experienced colleagues who gave the researcher some useful advice. Many of these advice have been taken into consideration during the preparation of the questionnaire. Of course, the final revision of the questionnaire was discussed with the advisor and was amended according to his advice.

3.6. Method of analysis

In this study, the frequency distribution which shows the frequency of observation of each response to each variable under investigation is used to describe aspects of a group of data. It is often useful to distribute the data into categories and to determine the number of individuals or cases belonging to each category (Naoum, 1998). The researcher uses this method because of large amounts of raw data. To elaborate more the results were presented and analyzed in the form of tabulation, bar charts, and pie charts.

CHAPTER FOUR

RESULTS, ANALYSIS AND DISCUSSION

4.1. Introduction

This chapter introduces the survey results which are analyzed by using frequency distribution and presents the results of the analysis on the main issues related to the literature review of the recent studies in cost estimating.

4.2. Survey results and discussions

This section shows the results, analysis and discussions obtained from the surveyed companies. The survey results are discussed in more details in this section to explore and evaluate the existing local practice in cost estimate.

4.2.1. The response rate of the questionnaire

Table 4.1 presents the response rate of the questionnaire. The result shows that the response rate for the third class companies are much more than the response rate of other categories (see Figure 4.1).

Table 4.1 Frequency distribution of sample respondents

Class	Questionnaire issued	Responses	% of Response
Class I	55	34	62%
Class II	13	10	77%
Class III	30	25	83%
Total	98	69	70%

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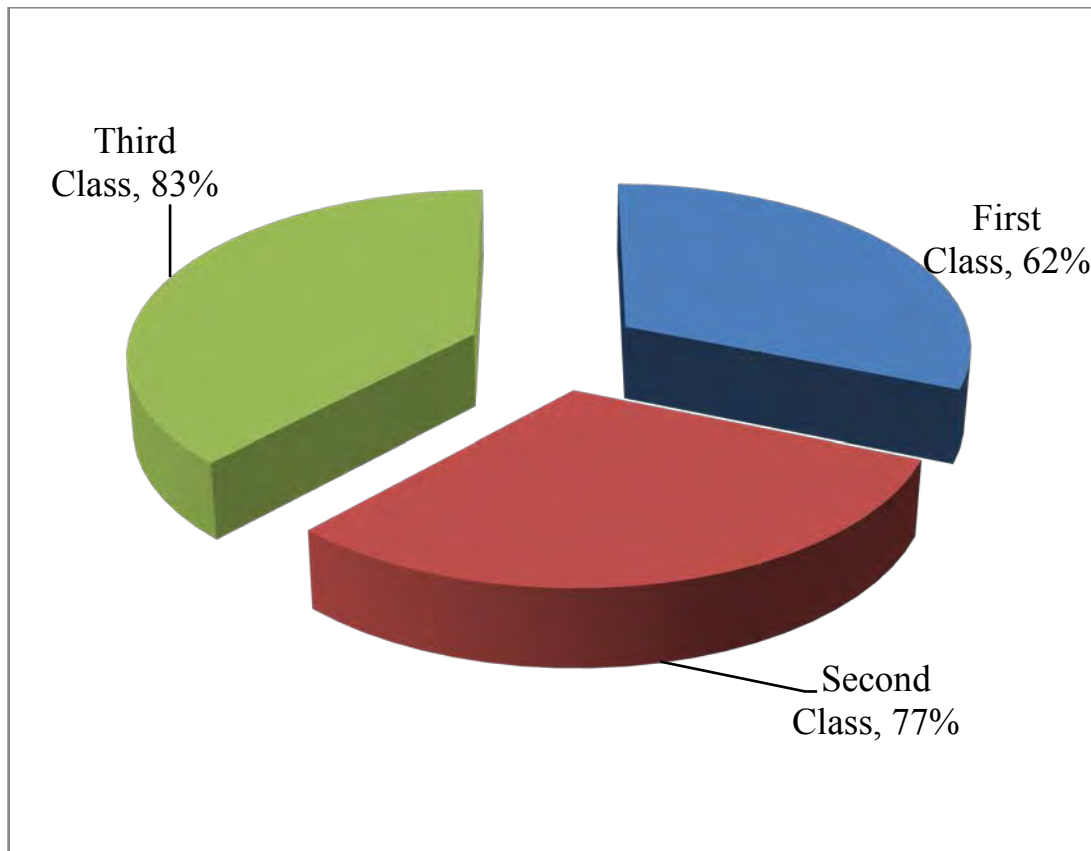


Figure 4.1 the general classification of respondent contractor

4.2.2 Study population characteristics

A. Year of establishment

Table 4.2 indicates that most companies are relatively newly established having less than 10 years of experience.

Table 4.2 Year of establishment of contracting companies

Variable		Contractors	
		No.	%
Year of Establishment	Before 1990	12	17
	1990-2000	34	49
	2000-2006	23	34
<i>The total number of respondents</i>		69	100

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B. Classification of contractors

Table 4.3 illustrates that each of the responding contractors, namely building contractors (BC) and general contractors (GC) classified as first class, second class and third class are shown in percentage as follows.

Table 4.3 Classification

Variable		Contractors	
		No.	%
Building Contractors	First Class	14	32
	Second Class	8	18
	Third Class	22	50
	Total	44	100
General Contractors	First Class A	20	80
	Second Class	2	8
	Third Class	3	12
	Total	25	100

C. Number of employees

Table 4.4 and Figure 4.2 indicate the number of employees in percent.

Table 4.4 Percentage distribution of contractors by number of employees

Variable		Contractors	
		No.	%
Number of employees	Equal or less than 10	28	41
	From 11 to 50.	13	19
	From 51 to 100.	12	17
	From 101 to 200	11	16
	More than 200	5	7

The total number of respondents=69 contractors

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These results reveal how small the organization sizes of contracting companies in Addis Ababa are. This means that more than half of contractors execute their projects mainly using subcontractors. One may expect that none of the contractors execute his works completely with his own crew. (See figure 4.2)

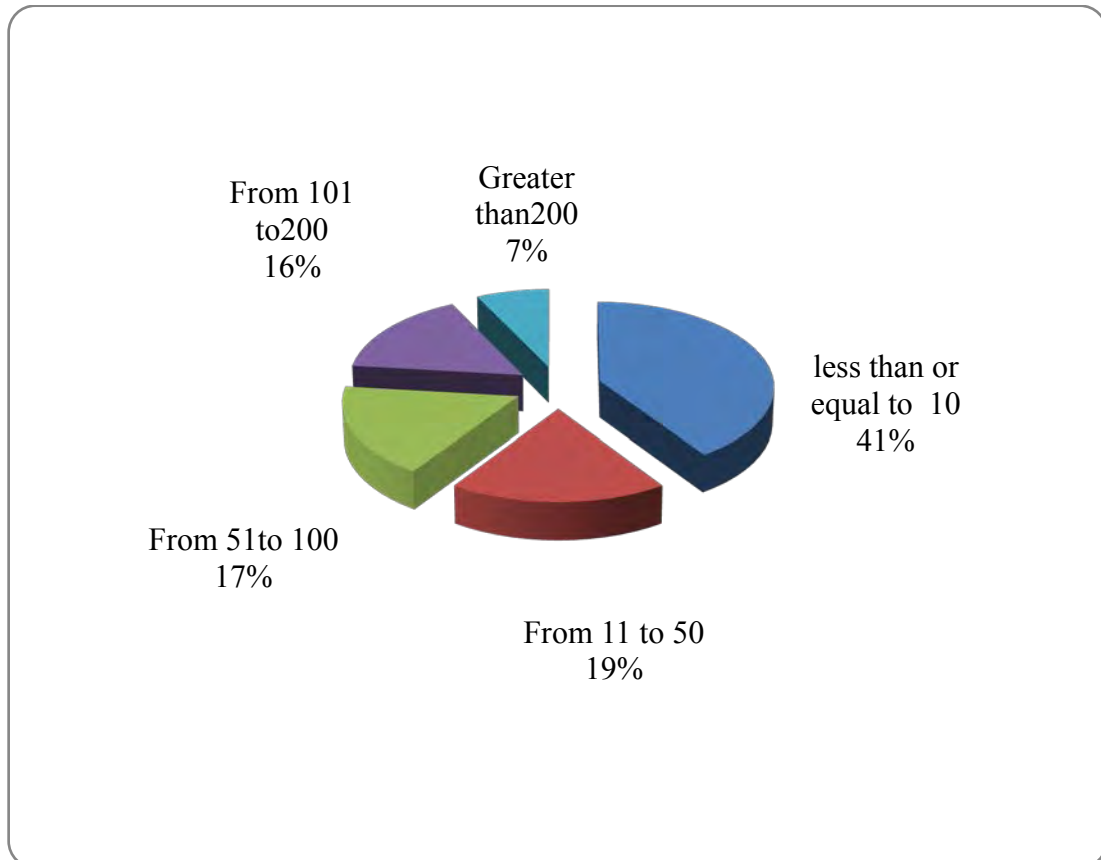


Figure 4.2: Distribution of respondents by number of employee

D. No. of executed projects and their value during the last five years

Table 4.5 shows the executed projects during the last five years (2010-2014 G.C). Here, most of the executed projects are of small in number and value (price).

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Table 4.5 Distribution of number and value of executed project

Number and Value of Projects		Contractors	
		No.	%
Number of executed projects during the last 5 years (2010-2014 G.C)	1-10	44	64
	11-20	14	20
	21-30	2	3
	31-40	7	10
	>40	2	3
Value of executed projects during the last 5 years (2010-2014 G.C) in millions Birr	<11	19	28
	11-30	9	13
	31-50	4	6
	51-70	23	33
	>70	14	20

E. Years of experience of the person in-charge of estimating

Table 4.6 presents the work experience of participants. It indicates that the highest percentage of respondents are highly experienced in construction field and that enables them to determine the critical factors which affect the cost of projects.

Table 4.6 Percentage distribution of contractors according to their experience

Variable		Contractors	
		No.	%
Year of Experience	From 1-3 Years	3	4
	From 4 to 6 years.	15	22
	From 7 to 10 years.	31	45
	More than 10 years	20	29
	Total	69	100

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F. Job title of the contractors (in charge of estimating)

Table 4.7, shows that the highest number of job title is the office engineers who have the whole vision about all of project cost details and the lowest number is the project manager title. It is good to be like that but the number of site engineers who participate has to be increased for better performance and accuracy of the estimate.

Table 4.7 Percent distribution of contractors according to their job title

Variable		Contractors	
		No.	%
Job titles	Company owner	16	23
	Project Manager	4	6
	Site engineer	6	9
	Office engineer	30	43
	Other	13	19
	Total	69	100

4.2.3. Local cost estimating practice

A). Performance of the local cost estimating practice

Table 4.8 indicates 48 % of the respondents agree that the performance of the local cost estimating practice is good and their perception may arise from the direct engagement in executing the works very well. However, from the researcher's point of view, they should evaluate this not only from their interest in getting the work they execute and in the profit they gain, but also in delivering the works with the desired quality and within the scheduled time.

Surprisingly, 46% of the respondents report that the performance of the local cost estimating practices is bad and their basic reason for this is lack of competent and experienced professionals as well as lack of published price information of labor, material, equipment etc. The other reason given by some of the respondents for the poor performance of such practices is contractors' inappropriate and malpractice in the construction industry such as fraud and corruption. Also, insufficient information

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provided by design teams such as lack of accurate, meaningful and comprehensive schedule of works, drawings, specifications and Bill of Quantity (BOQ) for tender is mentioned as the major reason for the poor performance.

Few respondents (6%) label the practice very bad. Hence, the contractors need proper information technology system for recording data and for the cost estimation process. In addition to this, they have to be genuine, transparent and committed for attaining the desired performance of local cost estimating practice.

Table 4.8 Percent distribution of contractors according to their performance

Variable		Contractors	
		No.	%
Performance of the local cost estimating practice	Very Good	0	0
	Good	33	48
	Bad	32	46
	Very bad	4	6
	Total	69	100

B). Competence of local contracting companies in cost estimating practice

Proper cost estimation system is vital to achieve the three major goals of project delivery such as optimizing cost, attaining the desired quality and minimizing delays. Majority of the contractors (67%) feel their companies are competent to achieve the desired goals of cost, time and quality parameters using proper cost estimating system. However, the researcher has reservations on this suggestion because there is still lack of awareness in using modern estimating techniques. In addition to this, there is financial as well as professional incompetency of the contracting companies.

On the other hand, 29% of the respondents consider their companies as incompetent, where 20% of them emphasized that shortage of skilled professionals and lack of guidelines (established standards) are the main reasons for the incompetence of their company in achieving the above mentioned major goals. The remaining 9% of the respondents consider lack of diligence by estimators due to insufficient time as the main

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reason behind the problem of their companies' competency. One respondent suggested that being too eager to get the work without considering the consequences of the risk and without having sufficient knowledge of the project is the major drawback that causes incompetency of his company. Only few respondents (4%) consider their companies as very incompetent.

Table 4.9 Percent distribution of contracting companies according to their competence

Variable		Contractors	
		No.	%
Competence of local contracting companies in cost estimating practice	Very competent	0	0
	Competent	46	67
	In Competent	20	29
	Very Incompetent	3	4
	<i>Total</i>	69	100

4.2.4. Detail cost estimating

A). Tools used for detail cost estimation of building work item (direct cost)

As shown on table 4.8, the majority of the respondents report that detailed analysis for all elements of building work items is the most important and mostly used tool in bid estimating practice. This trend may be referred to their desire to get more accurate estimate and minimize risk and errors. This comes in line with the research outcome of Abraham (2008) that reports 100% of the respondents use detailed analysis for cost estimating in Ethiopia. In other observation, the least used tool by the respondents in calculating the cost estimate is using the price for the same item rate from a previous project. This may be referred to the fluctuation in material prices and the instability of market situation in Addis Ababa which affects much the item prices.

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Table 4.10 Degree of necessity and usage of estimating the item tools

Tool		Necessity Degree			Usage Degree		
		N	SN	UN	U	O	R
Using the same item rate from Previous projects.	No.	22	34	13	42	20	7
	%	32	49	19	61	29	10
Using detailed analysis only for Big value items.	No.	38	19	12	50	19	0
	%	55	28	17	72	28	0
Using detailed analysis for all Components of single item	No.	54	15	0	48	19	2
	%	78	22	0	70	28	3
Calculating all secondary elements of materials for every item	No.	27	32	10	12	35	22
	%	39	46	14	17	51	32

(N = Necessary, S.N. = Somehow Necessary, UN=Unnecessary) (U = Usually, O = Occasionally, R=Rarely)

Table 4. 10above also indicates that 39% of the companies consider the calculation of secondary elements of materials for each item necessary. 51% of the respondents occasionally calculate the secondary elements of material for each item instead of calculating for all item elements which may be due to the limited time available for estimating. However, this problem may be alleviated by using computerized software that can minimize the time taken for cost estimation and also by hiring more experienced professionals in cost estimating of building projects.

B). Estimation of indirect costs (Site and General overhead costs)

Table 4. 11 shows the majority of respondents calculate the site overhead cost as a percentage of the project' total cost.

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Table 4.11 Percentage distribution of contractors in calculating site over head

Variable		Contractors	
		No.	%
Calculating site overhead	As % of direct costs	57	83
	As a lump sum	0	0
	In details as specified in bid documents.	12	17
	Other	0	0

The total number of respondents=69 contractors.

Table 4.12 illustrates that few respondents estimate the general overheads as required by tender documents, where the majority of them estimate the overheads as percentage of total project cost, and none of the respondents calculate the overhead as a lump sum. The researcher believes that in this case most contracting companies include the general overheads in the profit margin.

Table 4.12 Percentage distribution of contractors in calculating general head

Variable		Contractors	
		No.	%
Calculating general overhead	As a % of direct costs	60	87
	As a lump sum	0	0
	In details as specified in bid documents.	9	13
	Other	0	0

The total number of respondents=69 contract

Considering table 4.11 and table 4.12, as Abraham (2008) states that the site and general overhead costs unless estimated properly, can challenge contractors. He also reports that over-estimation of these costs may result in high tender prices which force contractors out of competition during bid and under-estimation on the other hand can hamper them from realizing sufficient profit. However, as to the point of view of the researcher, more contractors has to calculate site and general overhead in details as specified in bid document .

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C. Database

Table 4.13 illustrates that the most important and mostly used tool in estimating process is building materials database. However, they use labor and plant database more or less occasionally. This result may be referred to the fact that in Addis Ababa building material price fluctuates highly due to the country's fast growth in construction sector rather than labor and plant price. Moreover, regarding contractors' opinion, the importance of building material database is ranked first; labor database second; plant databases third and the fourth is subcontractors' database. Regarding the frequency of updating the database, the results show most contracting companies believe that updating the database when estimating new project is the most important tool and the majority of them usually use this tool (see table 4.13). It seems that contractors find it more practical to consider updating database at the beginning of estimating new project rather than any other time. However, it is necessary to update the database consistently within specified time to improve the efficiency and effectiveness of the cost estimation process in building projects.

Table 4.13 Degree of necessity and usage of the database

Tool		Necessity Degree			Usage Degree		
		N	SN	UN	U	O	R
Building materials database	No.	66	2	0	54	13	2
	%	96	4	0	78	49	3
Building labor database	No.	58	11	0	27	38	4
	%	84	16	0	39	55	6
Building plant database	No.	45	20	4	22	39	8
	%	65	29	6	32	57	12
Building subcontracting database	No.	32	28	9	12	20	37
	%	46	41	13	17	29	54
Updating the database due to a noticeable change in prices	No.	47	22	0	20	11	38
	%	68	32	0	29	16	55
Updating the database when estimating a new project	No.	55	13	1	52	14	3
	%	80	19	1	75	20	4
Updating the database directly due to any changes in prices	No.	50	15	4	24	15	30
	%	72	22	6	35	22	43

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(N = Necessary, S.N. = Somehow Necessary, Un=unnecessary)

U=Usually, O = Occasionally, R=Rarely)

D. Risk factor

Table 4.14 shows the majority of contracting companies calculate the risk factor in a balanced way, while some of them under-estimate it and few over-estimate the risk factor.

However, as to the researcher's observation, mainly due to difficulties in identifying, forecasting and quantifying potential risks, the contractors fail to introduce allowance for risks in their final tender price properly and this may be one of the major factors responsible for inaccuracy of cost estimates.

In addition to this, according to Abraham (2008), the effort by the contractors to gather information on possible risks and uncertainties is low and the common method employed by these contractors for incorporating risk allowance is adjusting or increasing the mark-up or profit margin.

Table 4.14 Percentage distribution of contractors in calculating risk factor

Variable		Contractors	
		No.	%
Calculating risk factor	more than it should be	4	6
	In balanced way	50	72
	less than it should be	15	22
	No estimation for Risk	0	0

The total number of respondents=69 contractors.

In line with this, according to Khalafallah (2002), the researcher also categorized the risk factors that cause the contractor's potential losses in six groups namely:

- 1) Construction risk
- 2) Financial and economical risk
- 3) Design risk
- 4) Natural risk
- 5) Management risk
- 6) Legal risk

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1. Construction risk factor

Table 4.15 and figure 4.3 illustrate that poor labor and equipment productivity has the highest percentage of all other factors indicating an acute shortage of skilled manpower in the construction sector. Thus, this factor should be taken seriously when estimating the contingencies during cost estimating. Furthermore, site safety should also be seriously considered to provide an estimate which can reduce anticipated decrease in contractor's profit and loss in skilled manpower.

Table 4.15 Average contribution (%) of potential loss to construction risk factor

Item	Factor	Average Percentage to the Group's Losses
A	Poor labor and equipment Productivity	35%
B	Poor Site Safety	25%
C	Difficulty to access the site (very far, settlements)	20%
D	Quality Problems	20%

The following figure will give more figurative explanation of the result.

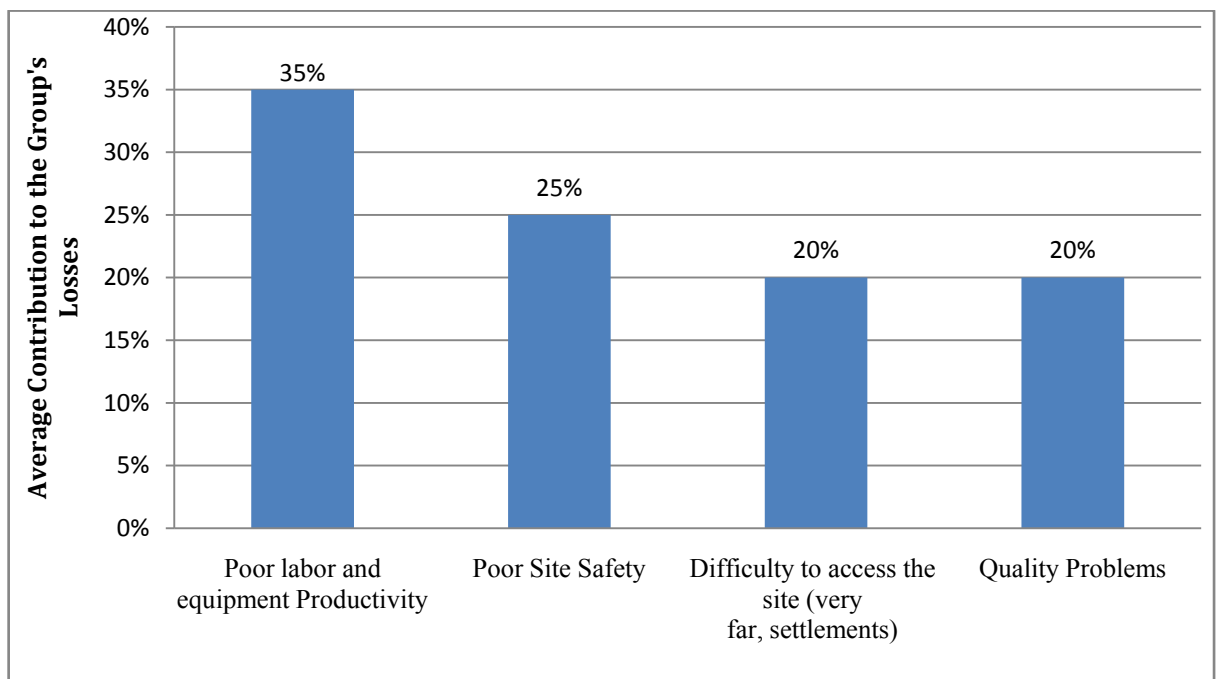


Figure 4.3: The average percentage contribution of each construction risk factor to its group's potential total losses

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2). Financial and economical risk

Table 4.16 and figure 4.4 indicates that inadequate cash flow and delayed payment in contract has the highest average percentage on potential loss of contractors' risk. This can result from exceeding the capacity of work suitable for the contractor's firm, unrealistic program (time schedule) and defaults in preparing and submitting the invoices (Khalafallah, 2002). This financial and economic risk which is associated with escalation of materials price is the major risk item considered by the contractors seriously to get accurate cost estimates.

Table 4.16 Average contribution (%) of potential loss to financial and economical risk factor

Item	Factor	Average Contribution to the Group's Losses
A	Inadequate Cash Flow	30%
B	Delayed payment in contracts	25%
C	Underestimation of Direct Costs	25%
D	Defaults by Subcontractors and Suppliers	20%

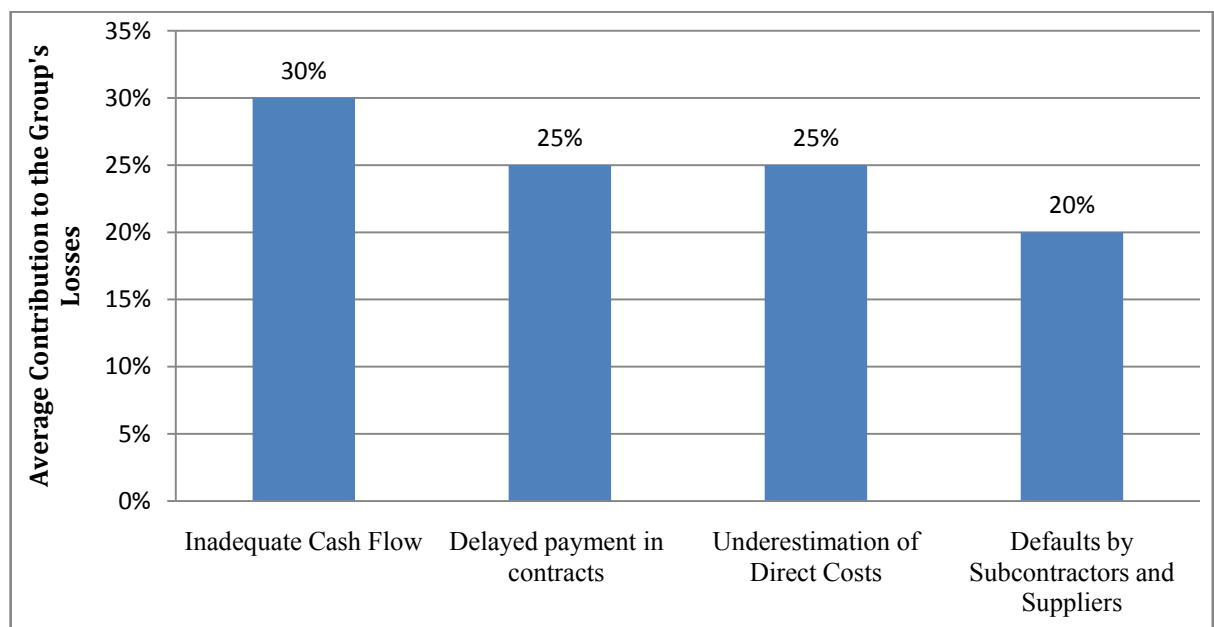


Figure 4.4: The average percentage contribution of financial and economical risk factor to its group's potential total losses

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3. Design risk factor

Table 4.17 and figure 4.5 illustrate that insufficient detailing such as unclear drawings and specifications, ambiguities, discrepancies and omissions in the contract documents as well as design errors in which the contractor participates as a designer on temporary works and storage areas have the highest percentage contribution considering design related risk factors. Hence, the designers' team should be aware of these risk factors so as to provide the detailed information of the contract strictly and accurately without negligence.

Table 4.17 Average contribution (%) of potential loss to design risk factor

Third: Design related risks		
Item	Factor	Average Contribution to the Group's Losses
A	Insufficient Detailing	24%
B	Design Errors	24%
C	Design Changes	19%
D	Not coordinated design (structural, mechanical, electrical, etc.)	17%
E	Inaccurate quantities	16%

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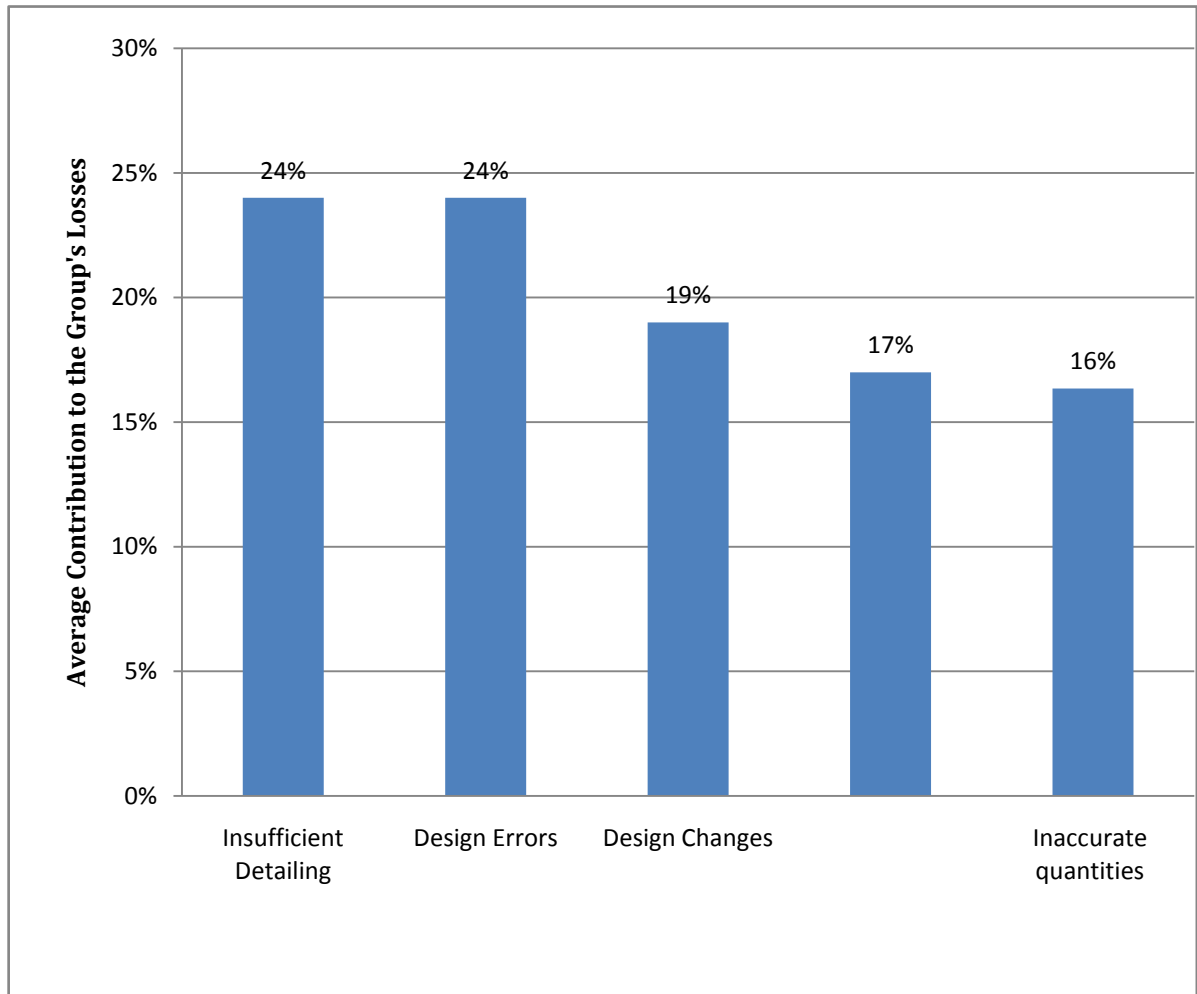


Figure 4.5: The average percentage contribution of each Design risk factor to its group's potential total losses

4. Natural risk factor

Table 4.18 and figure 4.6 show natural disasters like earthquake, collapse and slide of land have high risks which are the catastrophic events that might occur during the construction of a project. Contracts usually address these risks and minimize their effects with insurance or clauses. However, without a contract clause addressing natural risks, the contractor finds himself confronted by the complete risks and so considering contingency is the only methodology for him to manage these risks (Khalafallah, 2002).

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Table 4.18 Average contribution (%) of potential loss to natural risk factor

Fourth: Natural Risks		
Item	Factor	Average Contribution to the Group's Losses
A	Earthquake	28%
B	Collapse and Land Slide	23%
C	Fire	19%
D	Floods	16%
E	Rainy weather	14%

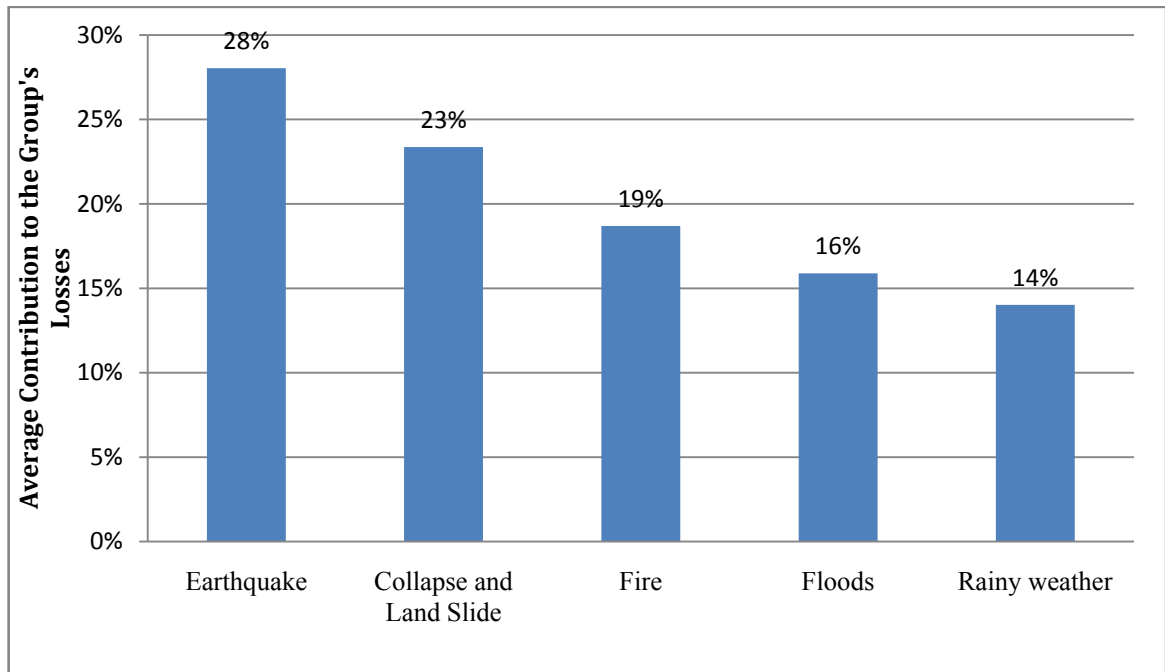


Figure 4.6: The average percentage contribution of each natural risk factor to its group's potential total losses

5. Management Risk Factors

As illustrated on table 4.19 and figure 4.7, poor communication between involved parties has the highest percentage when considering management risks as there is always a gap between the project manager and the laborers. As to the researcher point of view, this gap should be kept as small as possible so that the relationship between management and labor may be strengthened and they should work as a team to build a project with

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minimum cost. Ambiguous planning due to project complexity and lack of proper resource management system has also greater risk than the remaining factors. Therefore, contractors must be aware of all resources that they might need for any project and should utilize all resources effectively and efficiently. It is worth noting that proper scheduling is the key to utilize project resources otherwise the project cost will increase and may result in time delay and poor quality of the project delivery.

Table 4.19 Average contribution (%) of potential loss to management risk factor

Item	Factor	Average Contribution to the Group's Losses
A	Poor communication between involved parties	26%
B	Resource management	21%
C	Ambiguous planning due to project complexity	19%
D	Information unavailability (include uncertainty)	17%
E	Changes in management ways	17%
	Total	100%

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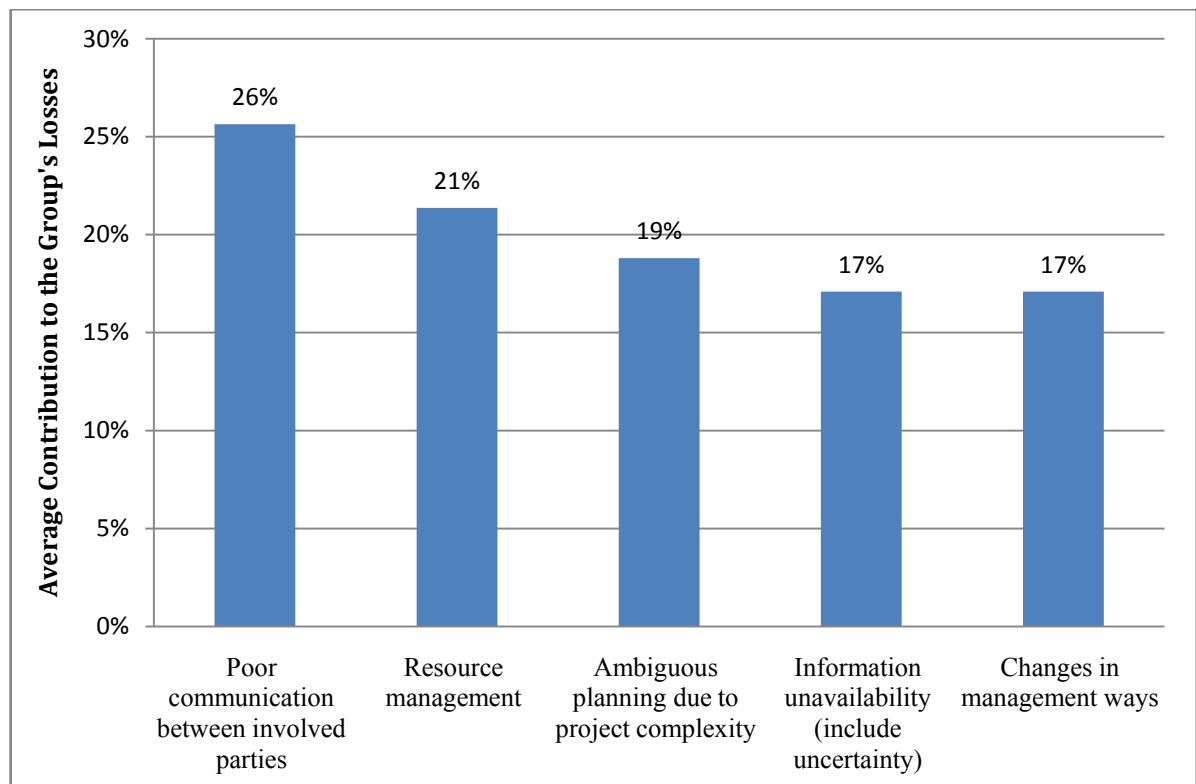


Figure 4.7: The average percentage contribution of each management risk factor to its group's potential total losses

6. Political and legal risks

Table 4.20 and figure 4.8 illustrate that difficulty to get permit and delayed dispute resolutions have the highest risks of all political and legal risks. As Khalafallah (2002) points out, most of these risks are shared between the contractor and the owner. The government policy, rules and regulations should encourage alleviating the problem of political and legal risks concerning difficulty to get permit in particular and all risks in general. There should be clear and precise legislative agreement.

In line with this, as Hendrickson(2000) states it is important for the owner to use legal counselors as advisors to mitigate conflicts before they happen rather than to wield conflicts as weapons against other parties. He also points out that the owner should recognize the more enlightened approaches for mitigating conflicts and unforeseen risks using arbitration, mediation and other extra-judicial solutions for disputes among various parties.

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Table 4.20 Average contribution (%) of potential loss to political and legal risk factor

Fifth: Political and legal Risks		
Item	Factor	Average Contribution to the Group's Losses
A	Difficulty to get permit	23%
B	Delayed dispute resolutions	23%
C	Ambiguity to work legislations	19%
D	No specialized arbitrators to help settle fast	19%
E	Legal disputes during the construction	16%
	Total	100%

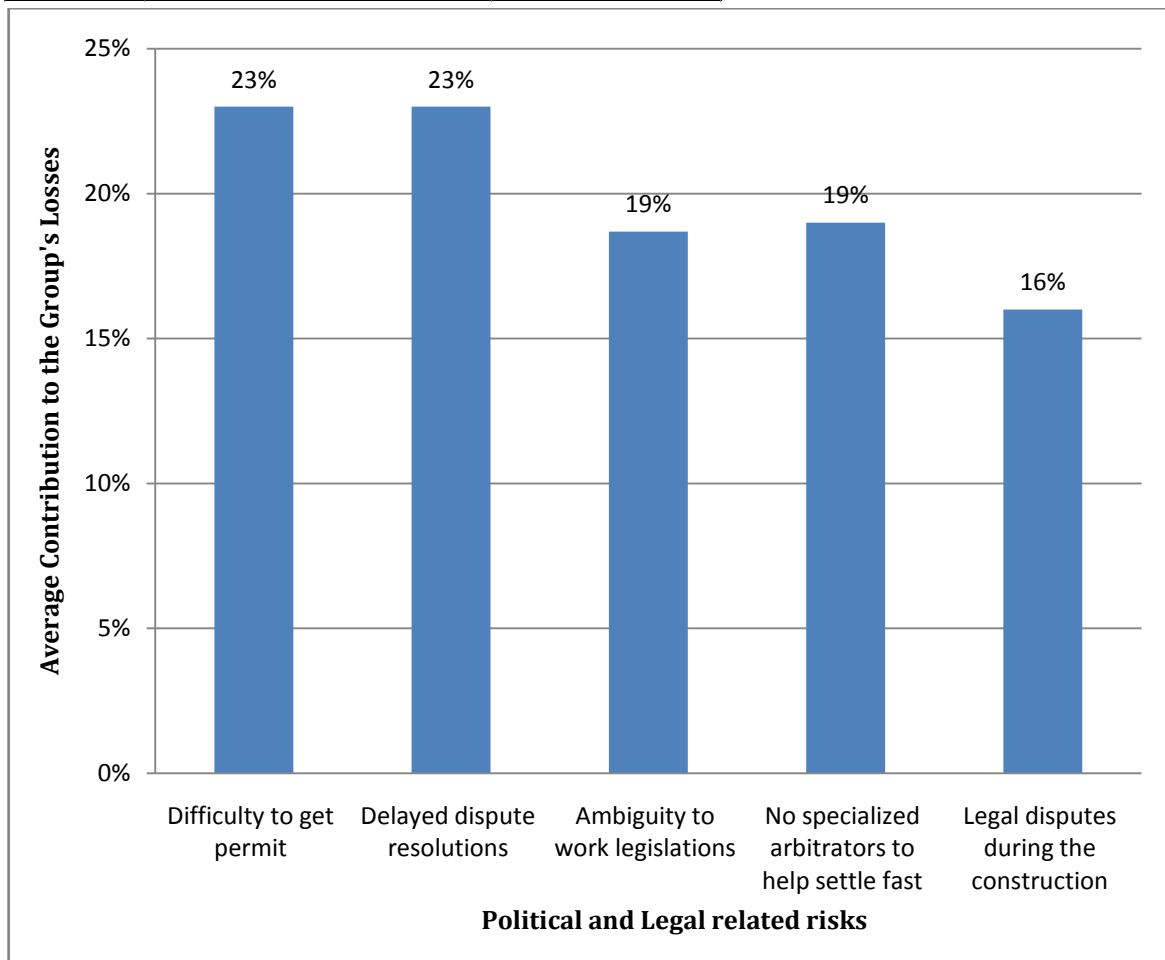


Figure 4.8: The average percentage contribution of each legal risk factor to its group's potential total losses

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4.2.5. Factors affecting cost estimating

Table 4. 21 shows that almost all respondents (96%) agree tender period and market condition have been frequently affecting cost estimates on building projects. This may refer to the limited amount of time dedicated to tender and high inflation of basic material price including cement, aggregate and rate for equipments.

Secondly, the majority of the contractors (94%) agree complexity of design and construction affect cost estimates frequently. According to Budisuanda (2011), complexity of design and construction can greatly increase the cost of the project. These conditions may include renovations, heavy loading, hazardous materials etc. Renovation, especially if it requires altering or moving structural components, can be costly because it necessitates demolition as well as rebuilding.

The 3rd factor (the number of competitors in the market) as mentioned by most of the respondents (91%) affects cost estimates frequently. Lack of competition often leads to higher bid prices and generally, projects that are tendered during a period of time when a large number of contractors are available bid more competitively (Transport, 2013). Budisuanda (2011) pointed out that the competition among contractors in the area where the project is being constructed will also affect the cost of the project and the more qualified contractors, the greater the potential for competitive pricing and the lower the construction cost. He also stated that if the project is awarded to the low bidder, there may be real problems getting a quality project built and in this case, the drawings and specifications must be specific enough to convey to the contractor the level of quality expected.

The 4th factor (project duration) is mentioned by most of the respondents (87%) as one of the factors affecting cost estimation. It has an impact on the resources required for the project and affects the pricing of preliminaries including site overheads and general overheads (Akintoye, 2000). The effect of contract period or the estimated duration of the project should be evaluated while determining the mark-up amount and it is obvious that the larger the contract period, the higher the uncertainty of the occurrences of unforeseen events that may affect the accuracy of the estimate (Abraham, 2008).

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The 5th factor (Method/techniques of construction) is mentioned by most respondents (84%) as one of the factors affecting cost estimation. It is considered that technical complexity of building construction affects contract duration and consequently the construction cost. As to the opinion of the researcher, it is obvious that method of construction is an important variable in determining the appropriate cost estimation and the better the method of construction the more successful and accurate in completing the project.

The 6th factor (availability and supplies of labor and materials) is reported by most of the respondents (82%) as a factor affecting cost estimates. This may be referred to the fact that the non-availability of raw materials and labor supply causes an increase in material prices and labor costs resulting in project delays and cost overrun.

The 7th factor (project team's experience of the construction type) is mentioned by 80% of the respondent as a factor affecting cost estimation. The project team's experience on site work is important as it determines the level of efficiency achieved on a construction site and consequently, the profitability of the project. The experienced team available within the company in terms of quality and quantity must match the project type and quality expectation. Hence, it is worth nothing that the better the project experienced team, the more accurate and reliable the cost estimates will be.

The 8th: quality and flow of information is reported by more than half of the respondents as a factor affecting cost estimation. The better the quality and flow of information provided by the consultant, the more accurate and reliable the cost estimate. In this case the consultant should be well experienced and qualified in supplying detail information during tender stage.

The 9th and 10th factors: site constraint (access and storage limitation) and type of structure (concrete, steel, masonry, etc.) are agreed by almost half of the respondents as factors affecting cost estimates in building projects frequently since these variables have direct consequences for the production performance on site and negatively affects the profitability of a particular project (Akintoye, 2000).

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The 11th factor: Geographical location of project is mentioned by slightly half of the respondents (46%) as a factor affecting cost estimation. The project location, whether in a densely populated area (urban) or sparsely populated (rural) area, should be considered in establishing bid prices (Department of Transport, 2013). As per the opinion of researcher, remoteness, landform and other factors of geographical location of site must be analyzed completely for cost elements that are unique to the location since it has the great effect on the cost estimate.

12th and 13th factors: Method of Procurement (traditional, design and build, etc) and clients' financial situation and budget are mentioned by less than half of the respondents as factors affecting cost estimate. In view of the researcher, if these two factors are handled, considered and evaluated properly beforehand, they may result in successful cost estimation promoting profit for the contractor and achieving the desired quality within the expected time limit of the building project. However, the effect can be the opposite if handled vice-versa.

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Table 4.21 Factors affecting cost estimates

The Factor		V.F	F	Σ V.F + F	So	Se	N.A
Complexity of design and construction	No.	22	43	65	4	0	0
	%	32	62	94	6	0	0
Method /techniques of construction	No.	8	50	58	11	0	0
	%	12	72	84	16	0	0
Tender period and market condition	No.	55	11	66	3	0	0
	%	80	16	96	4	0	0
Clients financial situation and budget	No.	5	14	19	48	2	0
	%	7	21	28	72	3	0
Availability and supplies of labor and materials	No.	17	39	56	12	1	0
	%	25	57	82	18	1	0
Project team' s experience of the construction type	No.	20	35	55	9	5	0
	%	29	51	80	13	7	0
Project duration	No.	39	21	60	7	2	0
	%	57	30	87	10	3	0
Geographical location of project	No.	2	30	32	37	0	0
	%	3	43	46	54	0	0
Site constraint - access and storage limitation	No.	8	28	36	33	0	0
	%	11	40	51	49	0	0
Quality and flow of information	No.	5	31	36	18	15	0
	%	7	45	52	26	22	0
Method of procurement(traditional, design and build ,etc)	No.	0	25	25	32	10	2
	%	0	36	36	46	14	3
Type of structure (Concrete, steel, masonry, etc.)	No.	14	20	34	30	5	0
	%	20	29	49	43	7	0
Number of competitors in the market	No.	50	13	63	6	0	0
	%	72	19	91	9	0	0

(V.F= Very Frequently, F=Frequently, So=Sometimes, Se= Seldom, N.A= Not at all)

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4.2.5. Cost Estimating Process

A).Degree of necessity and using pricing tools in general

In this part, there are ten pricing tools forwarded to the respondents by questionnaire and the results and discussions concerning these are as follows;

Table 4. 22 shows that the majority of respondents consider detailed drawings and specifications necessary and usually use this tool during the estimation process.22% of the contractors say that they use detailed drawing and specifications occasionally. This may be due to the negligence of the designers to provide clear and detailed or complete drawings such as embedment's, reinforcing bars, wall openings, pipes and cable tray routing. As to the opinion of the researcher, this problem (drawback)of negligence of the designers should not occur and estimators should use detail drawings and specifications consistently.

Table 4.22 also illustrates that the majority of contractors believe assessment of risk and profit is necessary and usually use these tools.

This table also illustrates that the majority of respondents consider good understanding of the magnitude and the scale of the project as necessary in cost estimating process and usually, most of them use it.

Similarly, 80% of the contracting companies consider preparing detail estimate as necessary, but only 55% of the respondents usually use this tool in tender estimating. This result may be related to the limited time available for estimating process.

Surprisingly, less than two third of the respondents (61%) considered site visit during estimating process as necessary although this tool is indispensable in cost estimating process. And also 23 % of the respondents said that they use these tools occasionally because this may be due to the limited amount of time given for tender process or to the fact that most projects which are executed are small in size and values (total cost).

The results on table 4.22 also show that about half of contracting companies consider that examining the project design is necessary but 58% of them usually use this tool. This result demonstrates that the least important tool in estimating is examining the

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project design. This may be due to the reason that most project's detail design and working drawings are prepared and given to the contractor after the award of the contract. Hence, the estimators are forced to use assumptions, past experience, and creative visualizations of the construction building but these reasons may be the causes for the inaccuracy of cost estimates. Therefore, the designers should prepare and provide clear, accurate, detailed and complete drawings and specification before the bidding process to the owner/client.

Table 4.22 also shows that 77% of respondents consider assessment of project overhead necessary but 72% of them usually practice this tool while 68% of the respondents consider assessment of general overhead as necessary tool but less than half of them 43% usually use this tool. This indicates the low awareness of contractors about the overhead cost which has a noticeable effect on project cost especially in building projects.

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Table 4.22 Degree of necessity and using of pricing tools in general

Tool		Necessity Degree			Usage Degree		
		N	SN	UN	U	O	R
Detailed Drawings and specifications	No.	65	4	0	54	15	0
	%	94	6	0	78	22	0
Good understanding of the magnitude and the scale of the project	No.	58	11	0	56	13	0
	%	84	16	0	81	19	0
Site visit during estimating process	No.	42	20	7	49	16	4
	%	61	29	10	71	23	6
Quantity survey	No.	38	29	2	50	16	3
	%	58	38	3	72	23	4
Examine the project design	No.	35	28	6	40	24	5
	%	51	41	9	58	35	7
Structuring the estimate	No.	50	16	3	42	17	10
	%	72	23	4	61	25	14
Preparing detail estimate	No.	55	12	2	38	15	16
	%	80	17	3	55	22	23
Assessment of project over head	No.	53	15	1	50	16	3
	%	77	22	1	72	23	4
Assessment of general over head	No.	46	21	2	30	24	15
	%	68	29	3	43	35	22
Assessment of Risk and Profit	No.	60	5	4	51	16	2
	%	87	7	6	74	23	3

(N = Necessary, S.N. = Somehow Necessary, UN

=Unnecessary) (U Usually, O = Occasionally, R=Rarely)

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B). Shortcomings in skills, knowledge and data in cost estimating

Table 4.23 shows, the majority of the respondents (84%) show their agreement that there are deficiencies in skills, knowledge and data in cost estimating. It has to be noted that almost all respondents acknowledge these problems that hinder the profession. The estimator should be capable of estimating accurately the construction cost in order to perform well in the business with reasonable profit without compromising quality. The highest dissatisfaction shown by contractors may be emanated from their challenges in staying in business with sufficient cash flow. The majority of the 84% of the respondents stress lack of site knowledge of construction process by estimators and poor tender documentation, particularly BOQ is the main reason for the cause of shortcomings in skills. Only 16% of the contractors believes there are no deficiencies in skills, knowledge and data in cost estimating process. As to the researchers' point of view, these shortcomings in skills, knowledge and data are the key problems to be solved in order to improve the cost estimating practice in achieving the required quality, estimated time and to minimize cost overrun.

Table 4.23 Shortcoming in skills, knowledge and data in cost estimating

Variable		Contractors	
		No	%
Shortcoming in skills, knowledge and data in cost estimating	Yes	58	84
	No	11	16
	Total	69	100

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

This chapter is comprised of conclusions and recommendations that conform to the research objectives by considering the results, analysis and discussions. The research carried out has shown some of the problems associated with the existing local contractors' cost estimating system. The recommendations drawn from the evaluation may help the local contractors to improve their practices in cost estimating in particular and the national construction industry in general. It also introduces recommendations for further researches concerning cost estimation.

5.1 Conclusions

1. Cost estimating system used by the local building contractors seems to have some drawbacks due to the shortage of skilled professionals and technicians, lack of diligence by estimators due to insufficient time and lack of guidelines or established standards to follow during estimating process.
2. Local building contractors' competence with regard to three major goals (optimizing cost, maintaining the desired quality and minimizing delays of project delivery) is perceived by the majority of the respondents as more or less competent. However, as to the researcher's observation, there are some major drawbacks such as shortage of experienced, qualified or skilled professionals and lack of computerized database system that affect their competence negatively.
3. Most contractors are interested in using detailed analysis for all components of single items which are advantageous in getting accurate cost estimates. However, 55% of them use detailed analysis only for big value items which may be due to limited time available for tender. This is a major drawback that affects the accuracy of cost estimation. However, this problem can be solved by using cost estimating software to alleviate the shortage of time for cost estimation.
4. In estimating site and general overhead costs, the estimators should consider not only their profit but also the quality of work with the scheduled time.
5. The majority of the respondents agree on the importance and necessity of using material database in cost estimating especially the building material database. They

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also consider updating the database when estimating new projects as very important. However, they should update the database consistently whether there are new projects or not.

6. All contractors consider the risk factor as relatively high in building construction project in Addis Ababa. However, most of contracting companies consider calculating the risk in balanced way because of the high competition in bidding. But, it should be considered seriously and calculated accurately by identifying the risk factors properly.
7. The majority of contractors agree that construction risks especially poor labor and equipment productivity lead them to heavy potential losses. Also, from the list of risk factors, natural risks such as earthquake, collapse and landslide of the land causes the contractors heavy losses. The results also indicate that quality problems, defaults by subcontractors and suppliers cause smaller losses as mentioned by majority of the respondents. This implies that the local practice gives much lower attention to quality issues. However, this factor of construction risks should be considered and handled very seriously so as to attain the desired quality of the building construction.
8. Most of contracting companies considered tender period, market condition, complexity of design and construction as some of the main factors affecting cost estimating. Another important factor that affects cost estimation of building projects is number of competitors in the market and project teams' experience for the construction type as mentioned by most contracting companies.
9. The majority of respondents indicate that good understanding of the magnitude and the scale of the project and assessment of risk and profit allowance are necessary tools in cost estimating process.
10. Even though some of the respondents disagree with the existence of shortcomings in skills, knowledge and data for cost estimating in Addis Ababa, many of them agree that the shortcomings in skills such as lack of detailed site knowledge in construction process by estimators and poor tender documentation, particularly BOQ are the key factors. Also, some of the respondents stress that lack of college courses about cost estimating in building construction as a dedicated subject is the cause for the shortcomings.
11. Moreover, the practice requires raising awareness and creating progressive change of attitude in all involving parties in building construction. The cost estimating system

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should be taken seriously by the contracting companies in order to be competitive so as to deliver the project with the desired quality and the estimated time without cost overrun.

5.2. Recommendations

1. The Ethiopian Contractors Association in close cooperation with experienced professionals should focus more on preparing standard guideline specifically in cost estimating. This will help in improving the effectiveness and efficiency of the local contractors in cost estimating of building projects and may increase the capabilities of qualified professionals in using these estimating guidelines.
2. Intensive trainings, workshops and seminars should be arranged by cost estimating experts to manage the problems that arise from lack of skill, awareness and knowledge. Where the losses in quality cost and time delay could substantially be reduced or avoided through proper cost estimating system. These will in-turn promote the competence of the national construction sector as well.
3. Attaining accurate estimate is naturally based on realistic information. Hence, it is recommended that each contracting company continuously keeps records and update using price index for all cost related data not only for building materials and building historical database. This unique database should be the main source of information that will be used in estimating future projects.
4. While considering risk factor as an important element in the bid price, the estimator should calculate risk factors and profits separately. This enables the contractors to estimate the risk factor and profit in more accurate way. Hence, the contractor can be benefited and be in a better position to win the bid since it decreases the possibility of loss and increases the possibility of gaining the desired profit without compromising the quality, time schedule.
5. On-site training programme has to be provided for the cost estimators to gain on-site experience of construction process by experts of the fields since lack of site knowledge in construction process is the major reason for shortcomings in skills and reliable data for cost estimating in Addis Ababa.
6. Contractors are recommended to coordinate their effort to convince the concerned body of the government to regulate the inflation on material, labor and equipment costs.

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7. It is recommended that the contractors should visit the project sites and thoroughly evaluate contract documents before submitting their tenders. Moreover, the public employers are advised to arrange pre-bid meetings with all interested contractors and discuss about the identified and expected risks of the project.
8. In order to improve accuracy during cost estimating process in building project, it is very important to consider time value of money with an inflation adjustment to the cost of the project.
9. The designers should provide complete and correct drawings with sufficient information to minimize risky and faulty assumptions during the estimation process.
10. Even though there is limited time for bidding process, the local cost estimating system still relies more on the traditional way of estimating (unit rate methods) which requires more time to develop estimates. Therefore, local contracting companies are advised to develop software system for more efficient and effective estimating technique in order to address this problem and improve the accuracy of the estimated cost and submit the bid within the specified date.
11. In general, the contracting companies should give the necessary attention for proper cost estimating system to be competitive in the market and accomplish the three major goals (maintaining the desired quality, minimizing time delay and optimizing costs) of the project delivery.
12. Last but not least, the contracting companies should be rational, fair, devoted, committed and loyal to their profession and duty to work not only for their own profit but also for the satisfaction of the end users and for their country's development.

5.3. Recommendation for Further Studies

- Development of computerized software aiming at facilitating cost estimates performed by local contractors.
- Assessment of cost control variables of building construction in Addis Ababa.
- Assessment of the risk and contingencies in estimating practice of local contracting companies.
- Assessment of cost estimating practices of road construction projects in Addis Ababa.

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APPENDIX

QUESTIONNAIRE COVER LETTER

ADDIS ABABA UNIVERSITY

Questionnaires survey

Dear Sir,

This is a questionnaire designed for a research purpose in Addis Ababa University Institute Technology, at the Program of Construction Technology and Management. The questions are prepared for the requirement of the partial fulfillment of the M.Sc. degree program under the title of **Evaluation on the Cost Estimating System of Building Contractors in Addis Ababa**. Thus, your responses to the questions would be kept confidential and be used only for academic purpose.

Therefore, please be helpful and give precise and correct answers to the following questions. The responses will be used for study purposes only and perhaps for further recommendations to improve similar works in the future.

The purpose of this questionnaire is to investigate the actual practices of cost estimating system of building projects in Addis Ababa.

Research objectives

- Identify the major shortcomings, deficiencies and limitations of the cost estimating system used by local contractors.
- Explore some factors that influence the accuracy of cost estimates of building project cost in Addis Ababa.
- Evaluate the cost estimating current practice in promoting the competence of local building contractors.
- Provide the local contracting companies with a structured approach or ways to minimize the problems such as time delay, delivering poor quality and suffering in bankruptcy.

I thank you in advance for giving your precious time to fill the questionnaire and returning them back on time.

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Section 1 .General Organizational Information

Tick (√) “ONLY ONE” of the answers provided

1. Company name _____
2. Year of establishment _____
3. Class of the company
 - a).Building Contractor Grade I Grade II Grade III
 - b).General Cont Grade I Grade II Grade III
4. Average total number of Permanent employees in your company during 5 years

5. Average executed Building projects during 5 years
 1-10 projects 11-20 projects 21-30 projects 31-40 projects
 more than 40
6. Value of executed projects during the last five years (in million Birr)
 Less than or equal 1 1.1-3.0 3.1-5.0 5.1-7.0 above 7.0
7. General experience of the person in charge of estimating process
 1-3 year's 4-6 years' 7-10 years' more than 10 years
Others (*Please specify*) _____
8. Job title of the person charge of cost estimating
 Company owner Project manager Site engineer Office Engineer
Other (*Please specify*) _____

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Section (2): General Questions

Tick (✓) “ONLY ONE” of the answers provided

9. In general, how do you describe the performance of the local contractors in Cost estimating Practice?

Very Good Good Bad Very Bad

Other (*Please specify*) _____

If your answer is bad, what challenges may have contributed in your opinion for the poor competence? (*Please check all that apply in your point of view*)

- Lack of competent and experienced professionals
- Inappropriate and malpractices in the construction industry (fraud, corruption etc.)
- Insufficient information provided of drawings and specifications by the designers
- Lack of published price information (labor, material, equipment etc.)

Other (*Please specify*) _____

10. Proper cost estimation system is vital to optimize cost, quality and to minimize delays of project delivery.

How do you rate cost estimating practices in Addis Ababa to achieve these goals?

Very Competent Competent Incompetent Very Incompetent

If it is incompetent or very incompetent, what factor(s) do you believe be hind the problem?

- Lack of skilled professional and technicians
- Limited experienced professionals who involved in cost estimating
- Lack of guidelines or established standards to follow
- Lack of diligence by estimators due to insufficient time

Other (*Please specify*) _____

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Section (3): Estimating the Item

11. To which extent you evaluate the necessity and degree of usage of the next tools in cost Estimating?

No.	Tool	Necessity degree			Usage degree		
		Necessary Necessary sary	Necessary somehow	Unnecessary	Usually	Occasionally	Rarely
1	By using the same item rate from previous Projects.						
2	By using detailed analysis only for big value Items.						
3	By using detailed analysis for all components of a single item (material, labor, plant, subcontractor)						
4	By calculating all secondary elements of materials for every item						

Section (4): Indirect Cost

12. Tick (✓) in the correct choice in the following fields according to your practice for estimating indirect costs

a. Site overhead costs are calculating by:

- As a % of direct costs
 As a lump sum
 In detail, as specified in bid

Other (*Please specify*) _____

b. General overhead costs are calculating by:

- As a % of direct costs
 As a lump sum
 In detail, as specified in bid

Other (*Please specify*) _____

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Section (5): Database

14. To which extent you evaluate the necessity and degree of usage of the next techniques in cost estimating

No.	Technique	Necessity degree			Usage degree		
		Necessary	Necessary somehow	Unnecessary	Usually	Occasionally	Rarely
1	Building materials database						
2	Building labor database						
3	Building plant database						
4	Building subcontracting database						
5	Updating the database due to a noticeable change in prices						
6	Updating the database when estimating new project						
7	Updating the database directly due to any changes in prices						

Section (6): Risk Factors

Tick (✓) “ONLY ONE” of the answers provided

15. What is your opinion of estimating risk according to your practice?

- More than it should be
- In balanced way
- Less than it should be.
- No estimation for risk

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16. What do you think contractor's potential loss when considering construction risks?

- Different Site Conditions
- Quality Problems
- Poor Productivity
- Poor Site Safety
- Failures of On Completion

Other (*Please specify*) _____

17. What do you think contractor's potential loss when considering financial and economical risks?

- Inadequate Cash Flow
- Underestimation of Direct Costs
- Inflation, Availability of Foreign Currency and Exchange Rate Changes
- Defaults by Subcontractors and Suppliers

Other (*Please specify*) _____

18. What do you think contractor's potential loss when considering Design related risks?

- Insufficient Detailing
- Design Errors
- Design Changes

Other (*Please specify*) _____

19. What do you think contractor's potential loss when considering Design related risks?

- Earthquake
- Fire
- Floods
- Collapse and Land Slide
- Rainy weather

Other (*Please specify*) _____

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Section (7): Factors affecting Cost Estimates on Building Projects

20. To which extent you evaluate the effect of the next factors on cost estimating.

No.	Factor	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	Complexity of design and construction					
2	Method /techniques of construction					
3	Tender period and market condition					
4	Clients financial situation and budget					
5	Availability and supplies of labor and materials					
6	Project team' s experience of the construction type					
7	Project duration					
8	Geographical location of project					
9	Site constraint - access and storage limitation					
10	Quality of information and low requirements					
11	Project team' s experience of the construction type					
12	Type of structure					
13	Form of procurement and contractual arrangement					

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Section (8): Cost Estimating Process

21. To which extent you evaluate the necessity and degree of usage of the next tools in cost estimating Process.

No.	Tool	Necessity degree			Usage degree		
		Necessary	Necessary somehow	Unnecessary	Usually	Occasionally	Rarely
1	Working drawings and specifications						
2	Good understanding of the magnitude and the scale of the project						
3	Site visit during estimating process						
4	Quantity survey						
5	Examine the project design						
6	Structuring the estimate						
7	Preparing detail estimate						
8	Assessment of project over head						
9	Assessment of general over head						
10	Assessment of Risk and Profit Allowance						
11	Review and approve						

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22. Tick (✓) in the correct choice in the following fields of the cause for shortcomings in skills, knowledge and data for cost estimating in Addis Ababa.

Lack of site knowledge and construction process by estimators

Lack of knowledge of computer applications

Lack of estimating as a dedicated subject in college courses

Poor tender documentation, particularly BOQ

Other (*Please specify*) _____

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DECLARATION

This thesis is a result of my original work and it has not been presented for a degree program in any other university. Furthermore, all sources of material used for the thesis have been duly acknowledged.

Candidate

Name _____

Signature _____