

## **CHAPTER 1**

### **INTRODUCTION**

Cost is a major factor in most decisions regarding construction, and cost estimates are prepared throughout the planning, design, and construction phases of a construction project, different types of cost estimating from preliminary to detailed are conducted for different purposes. All of these estimates are important because they invariably influence the expenditure of major sums. However, estimates made in the early phases of a project are particularly important because they affect the most basic decisions about a project. In most cases, the final cost (or cost projections during construction) has been significantly higher than the cost estimates prepared and released during initial planning, preliminary engineering, final design, or even at the start of construction.

#### **1.1 The Construction Project**

A project is defined, whether it is in construction or not, by the following characteristics:

- A defined goal or objective.
- Specific tasks to be performed.
- A defined beginning and end.
- Resources being consumed.

The goal of construction project is to build something. What differentiate the construction industry from other industries is that its projects are large, built on-site, and generally unique. Time, money, labor, equipment, and, materials are all examples of the kinds of resources that are consumed by the project.

Projects begin with a stated goal established by the owner and accomplished by the project team. As the team begins to design, estimate, and plan out the project, the members learn more about the project than was known when the goal was first established. This often leads to a redefinition of the stated project goals.

## **1.2 Project Life-Cycle**

The acquisition of a constructed facility usually represents a major capital investment, whether its owner happens to be an individual, a private corporation or a public agency. Since the commitment of resources for such an investment is motivated by market demands or perceived needs, the facility is expected to satisfy certain objectives within the constraints specified by the owner and relevant regulations.

From the perspective of an owner, the project life cycle for a constructed facility may be illustrated schematically in [Figure 1.1](#). A project is expected to meet market demands or needs in a timely fashion. Various possibilities may be considered in the conceptual planning stage, and the technological and economic feasibility of each alternative will be assessed and compared in order to select the best possible project. The financing schemes for the proposed alternatives must also be examined, and the project will be programmed with respect to the timing for its completion and for available cash flows. After the scope of the project is clearly defined, detailed engineering design will provide the blueprint for construction, and the definitive cost estimate will serve as the baseline for cost control. In the procurement and construction stage, the delivery of materials and the erection of the project on site must be carefully planned and controlled. After the construction is completed, there is usually a brief period of start-up of the constructed facility when it is first occupied. Finally, the management of the facility is turned over to the owner for full occupancy until the facility lives out its useful life and is designated for demolition or conversion.

Of course, the stages of development in [Figure 1.1](#) may not be strictly sequential. Some of the stages require iteration, and others may be carried out in parallel or with overlapping time frames, depending on the nature, size and urgency of the project.

Furthermore, an owner may have in-house capacities to handle the work in every stage of the entire process. By examining the project life cycle from an owner's perspective we can focus on the proper roles of various activities and participants in all stages regardless of the contractual arrangements for different types of work.

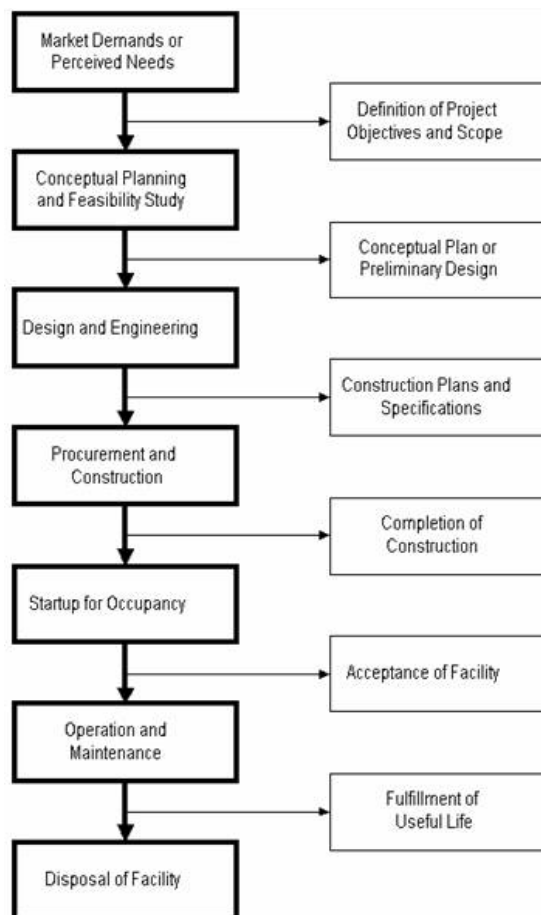


Figure 1.1: Project life cycle

The project life cycle may be viewed as a process through which a project is implemented from beginning to end. This process is often very complex; however, it can be decomposed into several stages as indicated by the general outline in [Figure 1.1](#). The solutions at various stages are then integrated to obtain the final outcome. Although each stage requires different expertise, it usually includes both technical and managerial activities in the knowledge domain of the specialist. The owner may choose to decompose the entire process into more or less stages based on the size and nature of the

project. Very often, the owner retains direct control of work in the planning stages, but increasingly outside planners and financial experts are used as consultants because of the complexities of projects. Since operation and maintenance of a facility will go on long after the completion and acceptance of a project, it is usually treated as a separate problem except in the consideration of the life cycle cost of a facility. All stages from conceptual planning and feasibility studies to the acceptance of a facility for occupancy may be broadly lumped together and referred to as the Design/Construct process, while the procurement and construction alone are traditionally regarded as the province of the construction industry.

There is no single best approach in organizing project management throughout a project's life cycle. All organizational approaches have advantages and disadvantages, depending on the knowledge of the owner in construction management as well as the type, size and location of the project. It is important for the owner to be aware of the approach which is most appropriate and beneficial for a particular project. In making choices, owners should be concerned with the life cycle costs of constructed facilities rather than simply the initial construction costs. Saving small amounts of money during construction may not be worthwhile if the result is much larger operating costs or not meeting the functional requirements for the new facility satisfactorily. Thus, owners must be very concerned with the quality of the finished product as well as the cost of construction itself. Since facility operation and maintenance is a part of the project life cycle, the owners' expectation to satisfy investment objectives during the project life cycle will require consideration of the cost of operation and maintenance. Therefore, the facility's operating management should also be considered as early as possible, just as the construction process should be kept in mind at the early stages of planning and programming.

### **1.3 Types of Contracts**

There are many types of contracts that may be used in the construction industry. Construction contracts are classified according to different aspects. They may be classified according to the method of payment to the contractor. When payment is based on prices which submitted by the contractor in his tender, they are called cost-based

contracts. Examples are cost-reimbursable and target cost contracts. Contracts may be classified in the point of view of the risk involved. The range of risk runs from a fixed-price contract to a totally non-risk cost-reimbursable contract at the other end (Figure 1.2).

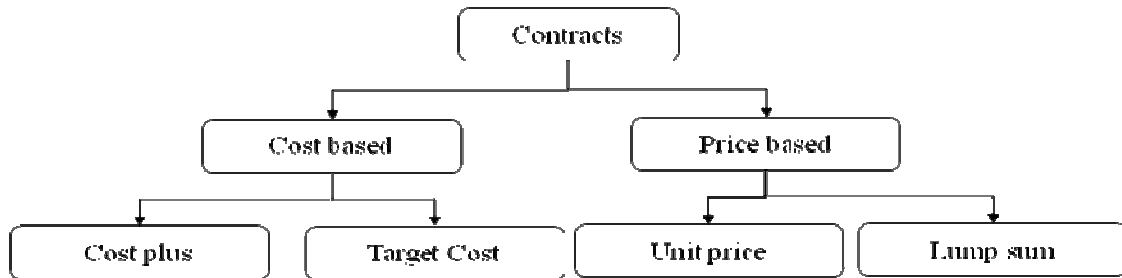


Figure 1.2: Contracts classification

### 1.2.1 Lump-sum contract

A single tendered price is given for the completion of specified work to the satisfaction of the client by a certain date. Payment may be staged at intervals on the completion. The contract has a very limited flexibility for design changes. The tendered price may include high level of financing and high risk contingency. Where considerable risk has been placed with the contractor, this contract may lead to cost cutting, trivial claims, or bankruptcy. Contract final price is known at tender. A lump-sum contract would seem to prevent risks for the client where in fact it just changes them. An important risk to the client is that of not receiving competitive bids from desirable contractors who may avoid a high-risk lump-sum contract. This contract may be used for a turnkey construction. It is appropriate when work is defined in detail, limited variations are expected, level of risk is low and quantifiable, and client does not wish to be involved in the management of his project.

### 1.2.2 Admeasurement contract

In this type of contracting, items of work are specified in Bills of Quantities or Schedule of Rates. The contractor then specifies rates against each item. The rates include risk contingency. Payment is paid monthly for all work completed during the month. The

contract offers a facility for the client to introduce changes in the work defined in the tender documents. The contractor can claim additional payment for any changes in the work content of the contract. Claims resolution is very difficult because the client has no knowledge of actual cost or hidden contingency. Tender price is usually increased by variations and claims. Two forms of admeasurement contract are usually used: bill of quantities and schedule of rates.

The admeasurement contract is well understood and widely used. It can be used when little or no changes are expected, level of risk is low and quantifiable, and when design and construction need to be overlapped.

### ***1.2.3 Cost-reimbursable contract (cost-plus contract)***

The contractor is reimbursed for actual cost plus a special fee for head office overheads and profit, no special payment for risk. Payment may be made monthly in advance. The contract involves a high level of flexibility for design changes. Final price depends on changes and extent to which risks materialize. The contractor must make all his records and accounts available for inspection by the client or by some agreed third party. The fee may be a fixed amount or a percentage of actual costs. This contract has no direct financial incentives for the contractor to perform efficiently. It may be used when it is desirable for design to proceed concurrently with construction and when the client wishes to be involved in contract management.

### ***1.2.4 Target cost contract***

Cost targets may be introduced into cost-reimbursable contracts. In addition to the reimbursement of actual cost plus percentage fee, the contractor will be paid a share for any saving between target and actual cost, while the fee will be reduced if actual cost exceeds the target. The target figure should be realistic and the incentive must be sufficient to generate the desired motivation. Specified risk' can be excluded from the tendered target cost. When these occur, the target cost is adjusted accordingly and the client pays the actual cost incurred by the contractor. The target may also b' adjusted for

major changes in work and cost inflation. This contract can be used in the same circumstances as the cost-plus contract.

#### **1.4 Estimating**

Estimating is not an exact science. Knowledge of construction, common sense and judgment are required. Estimating material costs can be accomplished with a relatively high degree of accuracy. However, accurate estimating of labor and equipment costs is considerably more difficult to accomplish. Estimating material costs is a relatively simple and easy task. The quantity of materials for a particular job can be accurately calculated from the dimensions on the drawings for that particular job. After the quantity of material is calculated and knowing the unit prices, the cost could be estimated by multiplying the quantity by the unit prices. Estimating labor and equipment costs is more difficult than estimating material costs. The cost of labor and material depends on productivity rates, which can vary substantially from one job to another. The skill of the labor, job conditions and many other factors affect the productivity of labor.

Estimating plays important roles in forecasting future events in construction process. It consists of two distinct tasks: determining the probable cost and determining the probable time to build a project

Cost estimate has been defined in different ways. For example:

Estimating is the compilation of all the costs of the elements of a project or effort included within an agreed upon project scope. To a contractor, this is the cost that will most likely be incurred to complete the project as defined in the contract documents and to turn it over to the owner. In another definition, it is the production of a statement of the approximate quantity of materials, time and costs to perform construction decisions. Cost estimating is, also defined as, the process of analyzing a specific scope of work and predicting the cost of performing the work. The basic challenges the construction contractor faces are to estimate the cost of constructing a project, schedule the specific construction activities, and then build the project within the estimated cost and schedule.

Cost estimating is the process of analyzing a specific scope of work and predicting the cost of performing the work. The basic challenges the construction contractor faces are to estimate the cost of constructing a project, schedule the specific construction activities, and then build the project within the estimated cost and schedule. The objective of cost estimate is to produce an accurate, cost effective prediction of what a project will most likely cost and it needs to be done in different manners at different stages. Cost 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. At the beginning of a project, the estimate cannot be expected to carry a high degree of accuracy since little information is known. As the design progresses more information is known and accuracy should improve (Figure 1.3).

*Required information:* Detailed plans, specifications, available site data, available resource data (labor, material, & equipment), contract documents, resource cost information, pertinent government regulations, applicable owner requirements. Various names have been given to estimates by several organizations. However, there is no industry standard that has been established for defining estimates.

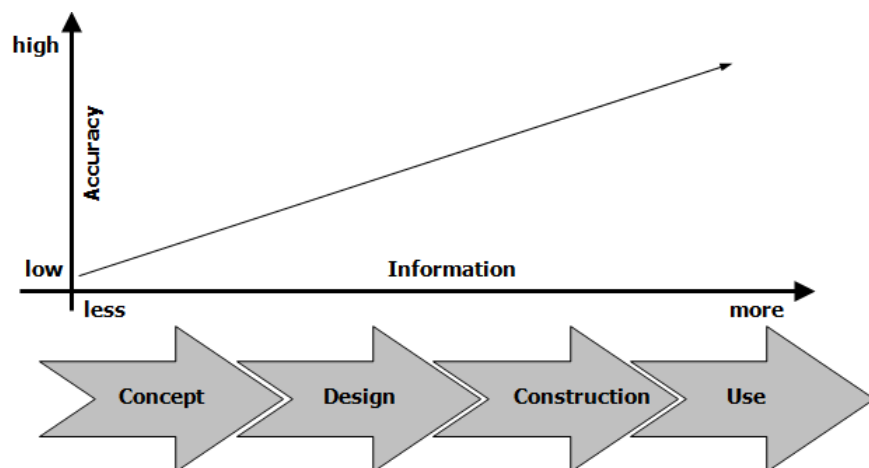


Figure 1.3: Cost estimate stages



## **1.5 An Estimator**

The estimator (or quantity surveyor, or cost engineer) is the person who prepares estimates in the planning, design, and perhaps construction stages. An estimator is always involved for studies requiring thorough understanding of the principles and methods of engineering economics. He or she must often work closely with managers, accountants, financial analysts, and engineers to forecast the cash or borrowing needs for the project. As major decision is made from information contained in the conceptual or preliminary estimate, this places a responsibility and liability on the estimator. He or she will risk reputation when insufficiently accurate estimate is prepared for a bid but the owner or the contractor will risk money.

A good estimator must conceptualize the complete building before it is fully designed. He or she must be able to think, and perceive the details of the project. The estimator must also have the ability to anticipate design decisions and communicate those assumptions made during the conceptual estimating process. He or she must also be knowledgeable of the expected life of construction materials, accounting, taxation, law, economics, and awareness of engineering design. Qualifications for a good estimator include: patience of detail; technical knowledge; good memory; knowledge of construction process; able to plan the works; have an idea of relative costs and good judgment. An estimator must not spend so much time and effort to analyze unnecessary details in determining the costs of insignificant items as the estimating will take time and be expensive. In a bill of quantities for civil engineering project, 80% of the costs can be attributed to 20% of the items, and vice versa.

## **1.6 Purpose of Estimating**

The purpose of estimating is to determine the forecast costs required to complete a project in accordance with the contract plans and specifications. For any given project, the estimator can determine with reasonable accuracy the direct costs for materials, labor, and equipment. The bid price can then be determined by adding to the direct cost the costs for overhead (indirect costs required to build the project), contingencies (costs for

any potential unforeseen work), and profit (cost for compensation for performing the work). The bid price of a project should be high enough to enable the contractor to complete the project with a reasonable profit, yet low enough to be within the owner's budget.

There are two distinct tasks in estimating: determining the probable cost and determining the probable time to build a project. With an increased emphasis on project planning and scheduling, the estimator is often requested to provide production rates, crew sizes, equipment spreads, and the estimated time required to perform individual work items. This information, combined with costs, allows an integration of the estimating and scheduling functions of construction project management. Because construction estimates are prepared before a project is constructed, the estimate is, at best, a close approximation of the actual costs. The true cost of the project will not be known until the project has been completed and all costs have been recorded.

## **1.7 Construction Project Costs**

The principal components of a contractor's costs and expenses result from the use of labors, materials, equipment, and subcontractors. Additional general overhead cost components include taxes, premiums on bonds and insurance, and interest on loans. The sum of a project's direct costs and its allocated indirect costs is termed the project cost.

The costs that spent on a specific activity or project can be classified as;

- *Fixed cost*: costs that spent once at specific point of time (e.g., the cost of purchasing equipment, etc.)
- *Time-related cost*: costs spent along the activity duration (e.g., labor wages, equipment rental costs, etc.)
- *Quantity-proportional cost*: costs changes with the quantities (e.g., material cost)

### *Project direct costs*

The costs and expenses that are incurred for a specific activity are termed direct costs. These costs are estimates based on detailed analysis of contract activities, the site

conditions, resources productivity data, and the method of construction being used for each activity. A breakdown of direct costs includes labor costs, material costs, equipment costs, and subcontractor costs.

### *Project indirect costs*

Other costs such as the overhead costs are termed indirect costs. Part of the company's indirect costs is allocated to each of the company's projects. The indirect costs always classified to: project (site) overhead; and General (head-office) overhead.

#### Project overhead

Project overhead are site-related costs and includes the cost of items that cannot be directly charged to a specific work element and it can be a fixed or time-related costs. These include the costs of site utilities, supervisors, housing and feeding of project staff, parking facilities, offices, workshops, stores, and first aid facility. Also, it includes plants required to support working crews in different activities.

A detailed analysis of the particular elements of site-related costs is required to arrive at an accurate estimate of these costs. However, companies used to develop their own forms and checklists for estimating these costs. Site overhead costs are estimated to be between 5% - 15% of project total direct cost.

#### General overhead

The costs that cannot be directly attributed a specific project called general overhead. These are the costs that used to support the overall company activities. They represent the cost of the head-office expenses, managers, directors, design engineers, schedulers, etc. Continuous observations of the company expenses will give a good idea of estimating reasonable values for the general overhead expenses. Generally, the general overhead for a specific contract can be estimated to be between 2% - 5% of the contract direct cost. The amount of the general overhead that should be allocated to a specific project equals:

Project direct cost x general overhead of the company in a year

Expected sum of direct costs of all projects during the year

Having defined the direct costs, indirect costs, then the project total cost equals the sum of both direct and indirect costs.

## **1.8 Types of Cost Estimating**

There are many types of cost estimates that can be performed on a project, each type having different levels of accuracy. The estimating process becomes increasingly more expensive as more detailed and accurate techniques are applied. Estimating can be categorized into several classes according to purposes, budget, limitation, time, and accuracy. Generally, the nature and characteristics of estimating can be summarized as follow: accuracy improves with the development of the project such that the distribution of errors narrows from feasibility to settlement; underestimates are more likely than overestimates and the final cost of a project cannot be established until the settlement of project accounts.

For example, cost estimates is divided into seven types: 1- Preliminary or rough cost or approximate estimate is prepared to decide the financial aspect and accompanied by detailed report, brief specifications, layout plan showing the proposal in hand; and brief idea of rates for different items; 2- Detailed estimate, is prepared in detail prior to inviting of tenders; 3- Quantity estimate, is a complete estimate of quantities for all items of work required to complete a project; 4- Revised estimate is also a detailed estimate and is prepared afresh, when the original sanctioned detailed estimate exceeds by 5% or more; 5- Annual repair or maintenance prepared in order to keep the structures in proper condition; 6- Supplementary estimate, when some additions are done in the original work; and 7- Extension estimate, when some changes and extensions are required to be made in old work.

Typically, cost estimates are divided into three major types: 1- Conceptual cost estimates are developed using incomplete project documentation; 2- Semi-detailed cost estimates are prepared when parts of the project have been completely designed; and 3- Detailed cost estimates are prepared based on fully developed construction drawings and

specifications. The accuracy of the estimate depends on the completeness of the contract documents and the experience of an estimator. The typical accuracy of the various types of cost estimates is shown in [Table 1.1](#).

Table 1.1: Accuracy of different types of cost estimates

Type of Estimate	Construction Document Development	Expected Percent Error*
Conceptual	Schematic Design 0-30% Construction Documents	± 10-20 %
Semi-Detailed	Design Development 30-90% Construction Documents	± 5-10 %
Detailed	90-100% Plans and Specifications	± 2-4 %

\* Percent error means the expected variation between cost estimate and actual cost

There are many types of cost estimates and re-estimates for a project based on the stage of project development. Estimates are performed throughout the life of a project, beginning with the first estimate and extending through the various phases of design and into construction. Initial cost estimates form the basis to which all future estimates are compared. Future estimates are often expected to agree with (i.e., be equal to or less than) the initial estimates. However, too often the final project costs exceed the initial estimates. Estimates are performed throughout the life of a project, beginning with the first estimate and extending through the various phases of design and into construction, as shown in [Figure 1.4](#).

Traditionally, the different classifications of estimates conclude that there are three main types of estimates:

1. Conceptual cost estimates.
2. Semi-detailed cost estimates.
3. Detailed cost estimates.

Stage	Concept	Design		Tender	Construction
		Preliminary	Detailed		
Type	Preliminary	Elemental		Unit Price	
Accuracy	± 25%	± 15 %		± 5%	
Level of Detail	Cost per unit	Assemblies Cost		Quantity Takeoff and Method Statement	
Method	Parametric			Detailed	

Figure 1.4: Level of accuracy of cost estimates

### 1.8.1 Conceptual estimate

A conceptual estimate is also known as a top-down, order of magnitude, feasibility, analogous, or preliminary estimate. It is the first serious effort made at attempting to predict the cost of the project. A conceptual estimate is usually performed as part of the project feasibility analysis at the beginning of the project. In this way, the estimate is made with limited information on project scope, and is usually made without detailed design and engineering data.

The conceptual estimate is also defined as approximate estimate and used to know the budget for a project. Considerable experience and judgment are required to obtain a dependable approximate estimate for the cost.

### 1.8.2 Semi-detailed estimate

Semi-detailed cost estimates are developed while basic design decisions are being made to verify that the project can be constructed at its intended scope within the owner's budget. Some aspects of the project may be completely designed. Detailed estimating methods can be used to estimate the cost of project components that have been designed, and conceptual estimating methods are used to estimate the cost of those components that remain to be designed. This means that databases are used to estimate the cost of components for which the design is not complete, and project data are used to estimate

the cost of components for which the design is complete. Therefore, these estimates are known as semi-detailed cost estimates.

### 1.8.3 Detailed estimate

A detailed estimate is also known as a bottom-up, fair-cost, or bid estimate. Detailed estimates are prepared once the design has been completed and all construction documents prepared. The estimator divides the project into individual elements of work and estimates the quantities of work for each element. Next, the individual elements of work are priced to determine an estimated cost for each one. The estimated costs are summed, and overhead costs are added to cover the contractor's cost of managing the work.

The breakdown of tender price is illustrated in Figure 1.5. The tender price consists of two components, the construction cost estimate and mark-up (margin). The direct cost is the combined costs of labor, equipment, material, and subcontractor's costs. The addition of site overheads and office overheads to the direct cost produces the construction cost estimates. The second component of the tender price is the mark-up (margin) which consists of the profit margin, risk allowance, and financial charge.

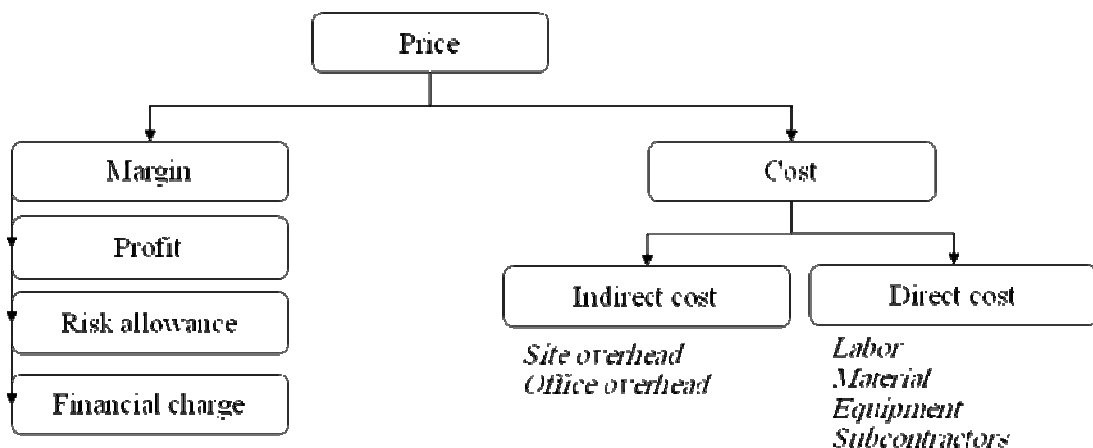


Figure 1.5: Schematic diagram of the structure of tender price

The various estimates discussed above are carried out in sequence, the previous cost estimate being the input to the next one. The estimates are successively refined, incorporating new information and thus keeping a continuously updated estimate that becomes the budget, available for control process. As the project progresses, the amount of unknowns and uncertainties decreases, while the level of details and the project information increases. In this way, the accuracy of the estimate improves as it moves from conceptual to detailed estimate.

A detailed estimate is prepared by determining the costs of materials, labor, equipment and subcontractor work. Detailed estimate is prepared from a complete set of contract documents before the submission of a bid. It follows a systematic procedure begins with a thorough review of the complete set of contract documents, drawing and technical specification. A site visit should be done to observe factors that can influence the cost of construction such as: available space for material storing, security, control of traffic and existing underground utilities.

The estimator prepares a material quantity take-off of all materials from the drawings. The quantity of material multiplied by the unit cost of the materials yields the material cost. The quantity of work required of equipment is divided by the equipment production rate and then multiplied by the unit cost of equipment to obtain the total cost of equipment and similarly, the cost of labor are calculated.

The direct cost of a project includes material, labor, equipment, and subcontractor costs. Upon the completion of the estimate of direct costs, the estimator must determine the indirect costs of taxes, bonds, insurance and overhead required to complete the project. A risk analysis of uncertainties is required to determine an appropriate contingency to be added to the base estimate to account for the unforeseen work that develops during construction. Upon calculation of the direct and indirect costs, analysis of risk and assignment of contingency, a profit is added to the estimate to establish the bid price. The amount of profit can vary considerably, depending on numerous factors such as the size and complexity of the project, amount of work in progress by the contractor, accuracy



and completeness of the bid documents, competition for work. The steps for preparing a detailed estimate are listed in [Table 1.2](#).

Table 1.2: Steps for preparing a detailed cost estimate

1	Review the scope of project. Consider the effect of location, security, traffic, available storage space, underground utilities, etc. on costs.
2	Determine quantities. Perform a material quantity takeoff for all work items.
3	Obtain suppliers' bids.
4	Price material. Material cost = quantity x unit price.
5	Price labor based on their probable production rate.
6	Price equipment based on their probable production rates.
7	Obtain specialty contractors' bids.
8	Calculate taxes, bonds, insurance and overhead.
9	Contingency and markup. Add costs for potential unforeseen work.
10	Profit. Add costs for compensation for performing the work.

### 1.9 Quantity Takeoff

To prepare an estimate, the estimator reviews the plans and specifications and performs a quantity takeoff to determine the type and amount of work required to build the project. The quantity of material in a project can be accurately determined from the drawings. The estimator must review each sheet of the drawings, calculate the quantity of material and record the amount and unit of measure. The unit cost of different materials should be obtained from material suppliers and used as the basis of estimating the costs of materials for the project. If the costs of the materials do not include delivery, the estimator must include appropriate costs for transporting materials to the project.

Each estimator must develop a system of quantity takeoff that ensures that a quantity is not omitted or calculated twice. A well-organized check-list of work will help reduce the chances of omitting an item. The estimator must, also, add an appropriate percentage for waste for those items where waste is likely to occur during construction. The material quantity takeoff is extremely important for cost estimating because it often establishes the quantity and unit of measure for the costs of labor and contractor's equipment.

## 1.10 Production Rates

To determine the time required to perform a given quantity of work, it is necessary to estimate the probable rates of production of the equipment or labor. These rates are subject considerable variation, depending on the difficulty of the work, skill of the labor, management conditions and the condition of the equipment.

A production rate is the number of units of work produced by a unit of equipment or a person in a specified unit of time. The time is usually one hour or one day. The rate could be determined during an interval when production is processing at the maximum possible speed. However, delays or interruptions may hinder the work at any time and reduce the average production rate to less than the ideal rates. So, the production rate is always lowered by a factor to account for such interruptions.

For example, a backhoe with 1 m<sup>3</sup> bucket may be capable of handling 3 bucket-loads per minute under ideal conditions. However, on a given job, the average volume per bucket may be only 0.8 m<sup>3</sup> and the backhoe may be actually operating only 45 min/hr. for these operating conditions, the average output can be calculated as follows:

The ideal output:  $3 \text{ m}^3/\text{min} \times 60 \text{ min/hr} = 180 \text{ m}^3/\text{hr}$

The bucket factor = 0.8

The efficiency factor =  $45/60 = 0.75$

The combined operating factor =  $0.8 \times 0.75 = 0.6$

The average output =  $0.6 \times 180 = 108 \text{ m}^3/\text{hr}$

The average output should be used in computing the time required to complete a job.

## 1.11 Exercises

1. State if True (T) or False (F):

- a. Contract changes are more likely to occur on a single fixed price contract than on a cost plus a fee contract.
  - b. In lump sum contracts, it is allowed to change in the quantity of work performed within a limit of 25%.
  - c. In the admeasurement contracts, the item description, quantity, unit of measure, unit cost and the total cost in the B.O.Q should be cleared.
  - d. The owner has the ability to know the contractor profit in the unit price contracts.
  - e. The direct costs are the summation of the cost of the labor, equipment, materials, and subcontractors.
  - f. Overheads include the cost of items which cannot be directly charged to a specific work element.
  - g. The construction project must have a defined goal or objective.
  - h. The construction project must have a defined beginning and end.
2. What are the main types of construction contracts?
  3. Explain what is meant by the two terms: “Price-based Contracts” and “Cost-based Contracts”.
  4. Compare the following types of contracts from the point of view of flexibility for design changes and variations:
    - Lump Sum.
    - Admeasurement.
    - Target cost.
  5. Compare the lump sum, admeasurements, and cost plus contracts from the following point of view:
    - Early start to construction.
    - Risk sharing.
  6. Select the right answer:
    - I. Site selection and financing would be the responsibility of which project member.
 

a. Owner	b. Designer
c. Construction project manager	d. Subcontractor

- II. Which of the following is not a characteristic of a project?
- Having a specific goal
  - Having a defined beginning and end
  - Resources being consumed
  - usually being performed only once
  - Never being found outside the construction field
- III. The advertising for contractors and review of contractors' bids occurs during which project phase.
- Procurement
  - Design
  - Construction
  - Conceptual planning
- IV. As-built drawings, warranties, and operation manuals are all provided to the owner during which project phase.
- Design
  - Conceptual planning
  - Construction
  - Project closeout
- V. As project moves on in time, the ability to change the project becomes.....difficult and.....expensive.
- more, less
  - less, less
  - more, more
  - less, more
7. Briefly describe the project life cycle.
8. Explain how the cost could be transferred to a tender price?
9. Give three examples of direct and indirect costs.
10. The cost spent of a given activity could be classified into ....., ..... and .....
11. What are the different types of cost estimate and when each one is used?