Introduction
Introduction

Project Characteristics

- Defined goal or objective stated by the owner and accomplished by the project team
- Specific tasks to be performed
- Defined beginning and end
- Resources being consumed. The 4 Ms (Manpower, Machinery, Materials, and Money,)
- As the project progresses, the project team learns more about the project
Introduction

Project Life Cycle

The project life cycle may be viewed as a process through which a project is implemented from beginning to end

- From the owner’s Perspective
Introduction

Project Life Cycle (Project stages)

As the construction progresses, the cost increases while the influence decreases.
Introduction

Types of Contracts

Contracts are classified according to the method of payment to the contractor.

- Cost based
  - Cost plus
  - Target Cost
- Price based
  - Unit price
  - Lump sum
Introduction

Type of Contracts

What is the difference between cost & price?

Price

- Margin
  - Profit
  - Risk allowance
  - Financial charge

Cost

- Indirect cost
  - Site overhead
  - Office overhead

- Direct cost
  - Labor
  - Material
  - Equipment
  - Subcontractors
Introduction

Type of Contracts

1. Unit Price
2. Lump Sum
3. Cost Plus
4. Target Cost

Factors favoring the use of a specific contract

- Providing incentive for efficient performance
- Introducing changes during construction
- Allocation of risk between owner & contractor
Introduction

Type of Contracts

1. Unit Price
2. Lump Sum
3. Cost Plus
4. Target Cost

Unit price or Admeasurement contract

- Work items are given in detail (BOQ; Bill of Quantities)
- The contractor set a price for each item; the owner doesn’t know the details of each item pricing
- Changes are allowed with 25% only
- When new items are added, the price of these items should be studied.
- Claims might arise between owner and contractor.
**Introduction**

**Type of Contracts**

1. Unit Price
2. Lump Sum
3. Cost Plus
4. Target Cost

**Unit price contract**

<table>
<thead>
<tr>
<th>Name of the work</th>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical work</td>
<td>6700 m²</td>
<td>m²</td>
<td>6700</td>
<td>6700</td>
</tr>
<tr>
<td>Structural work</td>
<td>1500 kg</td>
<td>kg</td>
<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>25</td>
<td></td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

Used for typical projects and civil engineering projects where changes are limited.
Introduction

Type of Contracts

1. Unit Price
2. Lump Sum
3. Cost Plus
4. Target Cost

Unit price contract

Advantages:
- Owner aware of the project details
- Widely used; about 80% of projects
- Project period is defined

Disadvantages:
- All attention are given to the prices only
- Allows limited design changes
- Errors of quantities leads to disputes
- Disputes may arises when new items of work are added
Introduction

Type of Contracts

1. Unit Price
2. Lump Sum
3. Cost Plus
4. Target Cost

Lump Sum (عقد المقطوعية)

- A single tendered price is given for the completion of specified work
- Payment may be staged at intervals on the completion
- Very limited flexibility for design changes
- Contract final price is known at tender
- This contract may be used for a turnkey construction
- It is appropriate when work is defined in detail
Introduction

Type of Contracts

1. Unit Price
2. Lump Sum
3. Cost Plus
4. Target Cost

Cost-Plus (عقد التكلفة مع استرداد نسبة من المصروفات أو التكلفة بالإضافة)

- The contractor is reimbursed for actual cost plus a special fee for head office overheads and profit
- High level of flexibility for design changes
- Final price depends on changes and risks
- High level of owner involvement
- The fee may be a fixed amount or a percentage of actual costs
- It may be used when it is desirable for design to proceed concurrently with construction
- the client wishes to be involved in contract management
Introduction

Type of Contracts

1. Unit Price
2. Lump Sum
3. Cost Plus
4. Target Cost

Target Cost (عقد التكلفة المستهدفة)

- Same as previous type (cost-plus)
- owner and contractor agree on a target cost for the project
- contractor will be paid a share for any saving
- When work is added or removed, target cost is adjusted
- The contractor has an incentive to reduce the cost
Introduction

Cost Estimating

Cost Estimating may be defined as:

- *Estimating is the compilation of all the costs of the elements of a project within an agreed upon project scope*
- *it is the production of a statement of the approximate quantity of materials, time and costs to perform construction decisions*
- *The basic challenges the construction contractor faces are to estimate the cost of constructing a project*
- *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*
Introduction

Cost Estimating

Required data:

- Detailed plans, specifications, available site data, available resource data (labor, material, & equipment), contract documents, resource cost information, pertinent government regulations, applicable owner requirements an agreed upon project scope
Introduction

Estimator (Quantity Surveyor)

- the person who prepares estimates in the planning, design, and perhaps construction stages
- Understanding of the principles and methods of engineering economics
- Estimator decisions are very crucial for this/her company
- 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
Introduction

Construction Project Costs

- The principal components of a contractor's costs result from the use of labors, materials, equipment, and subcontractors
- The costs that spent on a specific activity or project can be classified as:
  - Fixed cost
  - Time-related cost
  - Quantity-proportional cost
- Project direct costs
- Project indirect costs
Introduction

Cost Estimating: Indirect cost

Indirect costs comprises project (site); and General (head-office) overheads

Project overheads

- The cost of items that cannot be directly charged to a specific work element
- It includes site utilities, supervisors, parking, offices, workshops, stores, first aid facility, et.
- A detailed analysis of site-related costs is required to arrive at an accurate estimate of these costs
- Companies use their own forms and checklists for estimating these costs. Site overhead costs are estimated to be between 5% - 15% of project total direct cost
Introduction

Cost Estimating: Indirect cost

General overheads

- The costs that cannot be directly attributed a specific project
- They represent the cost of the head-office expenses, managers, directors, design engineers, schedulers, etc.
- Continuous observations of the company expenses help estimating reasonable values for the general overhead
- For a given project, it can be estimated between 2% - 5% of the contract direct cost
Introduction

Cost Estimating: Types of Cost Estimate

- Conceptual cost estimates; incomplete project documentation
- Semi-detailed estimates are prepared when parts of the project have been completely developed
- Detailed cost estimates are prepared based on fully developed construction drawings and specifications

<table>
<thead>
<tr>
<th>Type of Estimate</th>
<th>Construction Document Development</th>
<th>Expected Percent Error*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual (Parametric)</td>
<td>Schematic Design</td>
<td>± 10-25%</td>
</tr>
<tr>
<td></td>
<td>0-30% Construction Documents</td>
<td></td>
</tr>
<tr>
<td>Semi-Detailed</td>
<td>Design Development</td>
<td>± 5-15%</td>
</tr>
<tr>
<td></td>
<td>30-90% Construction Documents</td>
<td></td>
</tr>
<tr>
<td>Detailed</td>
<td>90-100% Plans and Specifications</td>
<td>± 2-5%</td>
</tr>
</tbody>
</table>

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

Cost Estimating: estimate accuracy

[Diagram showing the relationship between accuracy and information across the stages of Concept, Design, Construction, and O&M.]
### Introduction

#### Cost Estimating: estimate accuracy

<table>
<thead>
<tr>
<th>Stage</th>
<th>Concept</th>
<th>Preliminary</th>
<th>Design</th>
<th>Detailed</th>
<th>Tender</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type Accuracy</td>
<td>Preliminary</td>
<td>Elemental</td>
<td>Unit Price</td>
<td>± 25%</td>
<td>± 15%</td>
<td>± 5%</td>
</tr>
<tr>
<td>Level of Detail</td>
<td>Cost per unit</td>
<td>Assemblies Cost</td>
<td>Quantity Takeoff and Method Statement</td>
<td>Parametric</td>
<td>Detailed</td>
<td></td>
</tr>
<tr>
<td>Method</td>
<td>Parametric</td>
<td>Detailed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Introduction

Cost Estimating: Parametric Cost Estimation

- A conceptual estimate is also known as a top-down, order of magnitude, or preliminary estimate.
- It is the first effort made to predict the cost of a project.
- Usually made without detailed design and engineering data.
- Using available, historical cost information by applying building parameters (using information such as area, location, size, area, etc.).
Introduction

Cost Estimating: Parametric Cost Estimation

Example: Assume that the cost of a 120-pupil school constructed of wood frame is $1,200,000. Develop an estimate for a 90-pupil school.

Solution: Per-pupil cost = $1,200,000/120 = $10,000/pupil
Cost of the new school = $10,000 X 90 = $900,000

Example: The cost for a 100-bed hospital is $1,250,000. Estimate a 125-bed hospital.

Solution:
Cost per-bed = $1,250,000/100 = $12,500/bed
New hospital = $12,500/bed X 125 bed
= $1,562,500
Introduction

Cost Estimating: detailed estimate

- It is also known as a bottom-up, fair-cost, or bid estimate
- Prepared once the design has been completed and all construction documents prepared
- The estimator must make a complete and thorough job analysis
- For a detailed estimate, a thorough knowledge of labor, material, equipment, crews, and methods of construction should be collected
Introduction

Cost Estimating: detailed estimate

- Rates
- Efficiency
- Formation

Resources
- Labors
- Equip.
- Material
- Subs

Cost

Duration

Constraint
- Method(s)
- Quantity
- Constrained

Project

Task 1

Task i
# Introduction

## Cost Estimating: Steps of detailed estimate

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

Cost Estimating: detailed estimate

Example: The daily production rate of a crew is 175 units/day and the total crew cost per day is $1,800. The material needed for daily work is 4.5 units of $100/unit:

Calculate the time and cost it takes the crew to finish 1,400 units. Calculate the total unit cost. Consider an eight hour work day

Solution
Duration = Quantity / Production per unit of time = 1400 / 175 = 8 days.
Crew Cost = Duration x Cost per unit = 8 days x $1800/day = $14,400.
Total Cost = Crew cost + Material cost = $14,400 + 4.5 units x 8 days x $100/unit = $18,000
Unit cost = Total cost / quantity = $18,000/1400 = $12.86 / unit.
Introduction

Quantity Take-off

- A quantity takeoff is necessary to perform a cost estimate
- The quantity of material in a project can be accurately determined from the drawing
- The estimator must make a complete and thorough job analysis
- The unit cost of different materials should be obtained from material suppliers
- Cost of delivery and wastage should be included
- The material quantity takeoff is extremely important for cost estimating
Introduction

Production Rates

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

Production Rates: Example

- A backhoe with 1 m³ bucket capable of handling 3 bucket-loads per minute. The average volume per bucket is 0.8 m³ and the backhoe is operating for 45 min/hr. 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 = $0.6 \times 180 = 108 \text{ m}^3/\text{hr}$