Every estimate, whether it is generated in the conceptual phase of a project or at bidding time, must consider a number of issues

- Project Size
- Project Quality
- Project Location
- Time (start of construction)
- Market Conditions

The accuracy of an estimate is directly affected by the ability of the estimator to properly analyze these basic issues
Estimate Considerations

Project Size

- As a general rule in construction, as a project gets bigger, the cost of the project increases.
- Size is handled differently depending on the stage in the project’s life at which the estimate is being conducted.
- At the conceptual phase, size will be an issue of basic capacity, such as:
  - Apartment units for a real estate developer
  - Miles of roadway for a highway engineer
  - Number of rooms in an hotel

Estimate Considerations

Project Size

- As the project becomes a little better understood, the project’s size will begin to be quantified more accurately.
- The capacities will begin to be thought of in terms of more specific parameters such as:
  - Square footage of floor or roof
  - Quantity of excavation
- Further design leads to more specific quantities, eventually ending with exact numbers for every project item.
Estimate Considerations

Project Size

- The principle of economy of scale must be considered when addressing project size
  - Essentially, as projects get bigger they get more expensive
  - The larger the project, the more efficiently people and equipment can be utilized
  - As people repeat a task, particularly many times over and over, they get better and faster at it, thus reducing the cost of labor
  - This is called the effect of learning

Learning states that whenever the quantity of a product doubles, the unit or cumulative average cost-hour, man-hour, dollars, etc. will decline by a certain percentage

This percentage is called the learning rate which identifies the learning achieved
Estimate Considerations

Project Quality

- As the quality and complexity of a project increases, so does the project's cost.
- A high level of quality may be required for:
  - Aesthetic reasons as specified by the project architect
  - The safety of the project users or the public
- As the expected quality of a project increases, the cost of providing this quality increases as well.

Estimate Considerations

Project Location

- The location of the project is a major consideration in the preparation of an estimate. Depending on the location:
  - Variation exists in the purchasing of materials and their delivery
  - Material costs are a factor of availability
  - Competition between suppliers, and access to efficient methods of transportation
- The cost of labor is a factor of the level of training found at the project location
- On some projects, the number and the skill levels of workers are not available locally, so labor forces have to be imported.
Estimate Considerations

Project Location

- The cost of constructing projects in different locations can be predicted by establishing what are called **location indices** for different cities and parts of the country.
- An index is created for a particular city by comparing the cost of labor, equipment, and material for that city to the national average.
- This allows an estimator using national average costs to adjust the estimate to a particular location.
- Major design and construction companies have developed a set of location indices for their pricing.

Estimate Considerations

Project Time

- The time at which a project is built can have a major impact on the cost of the project.
- Since estimates are prepared in advance of the actual construction, the estimator must “project” or “forecast” to the future what the cost of the work will be.
- The estimate must predict what the cost of material and labor will be when they will be paid – not when the estimate is prepared.
- Initial estimates are often two or more years in advance of the start of construction, and if the project takes three years to construct, the estimator therefore must identify costs five years into the future.
**Estimate Considerations**

**Project Time**

- **Time indices** can be used to adjust the cost of a past project to one today
- This concept is similar to the **location indices**
- This combined adjustment allows an estimator to estimate the cost of a new project today in one location by looking at a similar project built several years ago and hundreds of miles away
- Sometimes, it is difficult to project with accuracy what the index will be for a future year, so the best an estimator can do is to look at the current trends and anticipate future labor and material prices

**Estimate Considerations**

**Other Conditions**

- In a market without much work, contractors may bid for a project with little profit to keep their staff employed
- On complex projects, contractors may bid the work low in the hopes of making additional profit on future change orders
- Sometimes, contractors provide very competitive prices when they enter a new market or work with a new owner
- These issues are difficult to quantify, but should be considered in the preparation of the estimate
Conceptual Cost Estimating

- A conceptual estimate is also known as a top-down, order of magnitude, feasibility, analogous, or preliminary estimate
- A conceptual estimate is usually performed as part of the project feasibility analysis at the beginning of the project
- The estimate is usually made without detailed design and engineering data
- However, the owner must know the approximate estimate to evaluate the economic feasibility of proceeding with the project
- Consultant to compare design alternatives
**Conceptual Cost Estimating**

**Definition**

- A "conceptual estimate" is an estimate prepared by using engineering concepts and avoiding the counting of individual pieces.
- The forecast of project costs that is performed before any significant amount of information is available from detailed design and with incomplete work scope definition.
- It is used as the basis for important project decisions like go/no-go and the appropriation of funds decisions.
- A conceptual estimate is also used to set a preliminary construction budget.
- All pre-construction estimates start with a database of past projects.

**Characteristics**

- Early project stages
- Accuracy ± 25 %
- The availability of a good, complete scope definition is considered the most crucial factor for conceptual estimating.
- Conceptual estimating is a resource restricted activity where the time and cost available for making the estimate is restricted.
- Therefore, the estimate, although important, cannot be given much time and resources.
**Conceptual Cost Estimating**

**Characteristics**

- Cost taken from past projects must also be adjusted to the future
- If the proposed project will be smaller or larger than normal, the cost can also be adjusted for size
- An appropriate **contingency** should be applied to allow for scope adjustments as well as economic or market conditions
- Conceptual estimates can be done quickly, in 10-15 minutes, and provide an accuracy in the plus or minus 20% range

**Estimate preparation**

- Request made by management to estimate the cost of a project
- The first task for the estimator is to study and interpret the project scope and produce an estimating plan
- The next task is to collect historical data related to similar past projects
- It is very important to describe in detail all the information, assumptions and adjustments considered in the estimate
- The outputs from this stage are the project conceptual cost estimate
Conceptual Cost Estimating

RSMeans
- RSMeans data are based on an average of over 11,500 projects as reported to Means from contractors, designers and owners.
- These costs are all adjusted to the current year and averaged
- To adjust for quality, the unit costs are divided into three columns, ¼, median, and ¾. This allows the estimator to adjust for quality quickly
- The median cost value represents the cost of average quality projects
- The ¾ cost value represents the cost of higher quality projects
- The ¼ cost value represents the cost of lower quality projects

Conceptual Estimating Methods

Unit method
- Depends on the cost per functional unit of the building, a functional unit being, for example, a hotel bedroom
- It is suitable for clients who specialize in one type of project; for example, hotel or supermarket chains
- Schools – cost per pupil
- Hospitals – cost per bed
- Note that, all other adjustments must be also made (time, location and unit)
Conceptual Estimating Methods

Square foot (meter) method

- The square meter method is a single price rate method based on the cost per square meter of the building
- The most frequently used method of approximate estimating
- Quick and simple to use
- Similar to the unit rate method with more accuracy
- Quantities of materials and labor required to build a project are also reported per square meter
- With the quantities held constant, each year the unit prices are adjusted to reflect current costs for labor and materials

Square Meter method: Example

- Gross floor area for office block = 10.0 x 25.0 - 2 x 3.0 x 7.50 = 205.0 m²
- Area of 5 floors 205.0 x 5 = 1025.0 m² x LE1100 /m² = LE1,127,500.0
- Basement 7.00 x 25.0 = 175.0 m² x LE1300 /m² = LE227,500.0
- Estimate for block = LE1,355,000.0
Conceptual Estimating Methods

Assembly Estimate (Approximate quantities)

- **Assemblies estimating** – also called **Systems Estimating** – is best accomplished concurrently with the design phase of a project.
- Most accurate preliminary method of estimating, provided that there is sufficient information to work on.
- Group items corresponding to a given operations and relating them to a common unit of measurement.
- This estimate is prepared by working with the system or assembly unit of a project.

- Rates are built up for these items.
- All measurements are taken as gross.
- In units estimate a gross unit is established, for example the number of hospital beds required.
- In square foot estimating the estimator works with the project area.
- In assemblies estimating the estimator will use more detailed units such as: (square feet of partition wall, number of plumbing fixtures, or square feet of carpet).
Conceptual Estimating Methods

Assembly Estimate (Approximate quantities)

- Each of the major elements of the project would be quantified and priced by its major assemblies.

<table>
<thead>
<tr>
<th>Div</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Foundation</td>
</tr>
<tr>
<td>2</td>
<td>Substructure</td>
</tr>
<tr>
<td>3</td>
<td>Superstructure</td>
</tr>
<tr>
<td>4</td>
<td>Exterior Closure</td>
</tr>
<tr>
<td>5</td>
<td>Roofing</td>
</tr>
<tr>
<td>6</td>
<td>Interior Construction</td>
</tr>
<tr>
<td>7</td>
<td>Conveying</td>
</tr>
<tr>
<td>8</td>
<td>Mechanical</td>
</tr>
<tr>
<td>9</td>
<td>Electrical</td>
</tr>
<tr>
<td>10</td>
<td>General Conditions</td>
</tr>
<tr>
<td>11</td>
<td>Specialties</td>
</tr>
<tr>
<td>12</td>
<td>Site Work</td>
</tr>
<tr>
<td></td>
<td>Foundations and excavation</td>
</tr>
<tr>
<td></td>
<td>Slab on grade</td>
</tr>
<tr>
<td></td>
<td>Floor and roof structures and superstructures</td>
</tr>
<tr>
<td></td>
<td>Building envelope – windows, doors and walls</td>
</tr>
<tr>
<td></td>
<td>Roofing – membrane, insulation, and flashing</td>
</tr>
<tr>
<td></td>
<td>Partitions, interior doors, finish floors, and ceilings</td>
</tr>
<tr>
<td></td>
<td>Elevators, escalators, and dumbbellers</td>
</tr>
<tr>
<td></td>
<td>Plumbing, heating and cooling, and fire protection</td>
</tr>
<tr>
<td></td>
<td>Service, power and lighting</td>
</tr>
<tr>
<td></td>
<td>General Conditions</td>
</tr>
<tr>
<td></td>
<td>Architectural equipments and furnishings</td>
</tr>
<tr>
<td></td>
<td>Excavation, roadways and parking, and landscaping</td>
</tr>
</tbody>
</table>

Conceptual Cost Estimating

Estimate Basics

- Unit cost should be determined as an average of previous projects data not depending on one project.
- \( UC = (A + 4B + C) / 6 \)
  - \( UC \) = forecast unit cost
  - \( A \) = minimum unit cost of previous projects
  - \( B \) = average unit cost of previous project
  - \( C \) = maximum unit cost of previous projects

Total cost = Number of units \( \times \) unit cost
Estimate Basics

Example

Use the weighted unit cost to determine the conceptual cost estimate for a proposed parking that is to contain 135 parked cars.

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Cost (LE)</th>
<th>No. of cars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>466,580</td>
<td>150</td>
</tr>
<tr>
<td>2</td>
<td>290,304</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>525,096</td>
<td>120</td>
</tr>
<tr>
<td>4</td>
<td>349,920</td>
<td>90</td>
</tr>
<tr>
<td>5</td>
<td>259,290</td>
<td>60</td>
</tr>
<tr>
<td>6</td>
<td>657,206</td>
<td>220</td>
</tr>
<tr>
<td>7</td>
<td>291,718</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>711,414</td>
<td>180</td>
</tr>
</tbody>
</table>

Example

Unit cost per car

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Unit cost (LE/car)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3,110.4</td>
</tr>
<tr>
<td>2</td>
<td>3,628.8</td>
</tr>
<tr>
<td>3</td>
<td>4,375.8</td>
</tr>
<tr>
<td>4</td>
<td>3,888.0</td>
</tr>
<tr>
<td>5</td>
<td>4,321.5</td>
</tr>
<tr>
<td>6</td>
<td>2,978.3</td>
</tr>
<tr>
<td>7</td>
<td>4,167.4</td>
</tr>
<tr>
<td>8</td>
<td>3,952.3</td>
</tr>
</tbody>
</table>

Then, the average unit cost = 30,431.5 / 8 = LE3,803.94 / car

The forecast unit cost = (2,987.3 + 4 × 3,803.94 + 4,375.8) / 6 = 3,763.14.

The cost estimate for 135-cars parking = 135 × 3,763.14 = LE508,023
Conceptual Estimate Adjustment

Time adjustment

- The adjustment should represent the relative inflation or deflation of costs with respect to time due to factors such as labor rates, material costs, interest rates
- Time value of money
- Index numbers are used to reflect changes in money values
- Various organizations publish indices that show the economic trends of the construction industry with respect to time

New project cost = Past project cost \( \frac{\text{New year index}}{\text{past year index}} \)

Time adjustment: Example

- The economic indices for building projects are shown below. It is required to use the cost of a LE843,500 project completed last year to prepare a conceptual estimate for a project proposed for construction 3 years from now.

<table>
<thead>
<tr>
<th>Year</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 years ago</td>
<td>358</td>
</tr>
<tr>
<td>2 years ago</td>
<td>359</td>
</tr>
<tr>
<td>1 year ago</td>
<td>367</td>
</tr>
<tr>
<td>Current year</td>
<td>378</td>
</tr>
</tbody>
</table>
**Conceptual Estimate Adjustment**

**Time adjustment: Example**

- The equivalent interest rate can be calculated based on the change in the cost index during the 3-year period as follow:
  - \((378/358) = (1 + i)^3\)
  - Then \(i = 1.83\%\)
- Accordingly, the cost of the project should be adjusted for time as follows:
  - \(Cost = LE843,500 \times (1 + 0.0183)^4 = LE906,960\)

**Location adjustment**

- Tender price levels vary according to the **region of the country** where the work is carried out.
- the use of cost information from a previous project should be adjusted to represent the difference in cost between the locations of the two projects.
- The adjustment should represent the relative difference in costs of material, equipment and labor of the two locations.
- Indices that show the relative difference in construction costs with respect to location is published by many organizations.
Location adjustment: Example

The indices for different location of construction costs are shown below. The construction cost of a project completed at city A is LE387,200, it is required to prepare a conceptual estimate for a similar project proposed in city D.

The cost of the proposed project:

\[
\text{Cost} = LE387,200 \times \left(\frac{1.105}{1.025}\right)
\]

\[
= LE417,420
\]

Size adjustment

In general, the cost of a project is directly proportional to its size.

The use of cost information from a previous project to forecast the cost of a future project will not be reliable unless an adjustment is made that represents the difference in size of the two projects.

The adjustment is generally a simple ratio of the size of the proposed project to the size of the previous project from which the cost data are obtained.
Conceptual Estimate Adjustment

**Size adjustment**

- Knowing the Typical Building area, the cost multiplier for the size adjustment can be calculated as follows:

  \[
  \text{Size factor} = \frac{\text{Proposed building area}}{\text{Typical building area}}
  \]

- Using the size factor, a cost multiplier could be identified from recorded data.

  \[
  \text{Size adjusted cost} = \text{Base cost} \times \text{Cost multiplier}
  \]

---

Conceptual Estimate Adjustment

**Combined adjustment: Example**

- Prepare the conceptual cost estimate for a building with 62,700 m² of floor area. The building is to be constructed 3 years from now in city B. A similar type of building that cost LE2,197,540 and contained 38,500 m² completed 2 years ago in city E.

Estimate the probable cost of the proposed building.
Conceptual Estimate Adjustment

Combined adjustment: Example

- **Original building:**
  - Area: 38,500
  - Year: 2 years ago
  - City: E (1.24)

- **Proposed building:**
  - Area: 62,700
  - Year: 3 years from now
  - City: B (index 1.17)
  - Inflation: 1.83%

Proposed cost

\[ \text{Proposed cost} = \text{Previous cost} \times \text{Time adjustment} \times \text{Location adjustment} \times \text{Size adjustment} \]
\[ = \text{LE}2,179,540 \times (1 + 0.0183)^5 \times (1.17 / 1.24) \times (62,700 / 38,500) \]
\[ = \text{LE}3,700,360 \]

Without time and location adjustment

\[ \text{Without time and location adjustment} = \text{Previous cost} \times \text{Size adjustment} \]
\[ = \text{LE}2,179,540 \times (62,700 / 38,500) = \text{LE}3,549,537 \]
Conceptual Estimate Adjustment

Unit cost adjustment

- Although the total cost of a project will increase with size, the cost per unit may decrease.
- For example, the cost of an 1800-m² house may be LE535/m² whereas the cost of a 2200 m² house of comparable construction maybe only LE487/m².
- Certain items such as furniture, garage, etc., are independent of the size of the project.
- The estimator must obtain cost records from previous projects to develop appropriate adjustments for new projects.

Conceptual Estimate Adjustment

Unit cost adjustment: Example

- Cost records from previous projects are shown below. Find the adjusted unit cost.

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Cost (LE)</th>
<th>Size, no. of units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,250</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>1,485</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>2,467</td>
<td>120</td>
</tr>
<tr>
<td>4</td>
<td>2,730</td>
<td>150</td>
</tr>
<tr>
<td>5</td>
<td>3,401</td>
<td>190</td>
</tr>
</tbody>
</table>
Unit cost adjustment: Example

- Plot these points and find the linear equation

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Unit cost (LE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22.5</td>
</tr>
<tr>
<td>2</td>
<td>24.75</td>
</tr>
<tr>
<td>3</td>
<td>20.56</td>
</tr>
<tr>
<td>4</td>
<td>18.20</td>
</tr>
<tr>
<td>5</td>
<td>17.90</td>
</tr>
</tbody>
</table>

Unit cost = \([(17.9 - 24.75) / (190 - 60)] x + 24.75

= - 0.0526 x + 24.75

where 60 < x < 190, then y = 24.75 – 0.0526 (S – 60)

---

Conceptual Estimate Adjustment

Unit cost adjustment: Example

- Using Excel curve fitting
- Add trend line
- Write the equation

Unit cost = - 0.056 x + 27.81
**Parametric Cost Estimating**

**Parametric cost estimate**

- The parametric model uses historical data as the basis of the model's predictive features.
- Parametric models calculate the dependent variables of cost and duration based on one or more independent variables.
- These independent variables are quantitative indices of performance and/or physical attributes.
- The output of parametric models includes the cost of major phases, duration of project major phases, total project cost, and resource requirements.

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**Parametric Cost Estimating**

**Parametric cost estimate**

- A parametric model, for a construction project, would use the data provided by the user on any or all of the following characteristics: project type, frame material, exterior material, ground conditions, desired floor space, and roof type.
- Then, using the general relationships developed between these input and output variables, the model provides an estimate of some or all of the output variables.
- Depending on the organizational environment and on the nature of targeted projects, these models use different statistically derived algorithms.
Conceptual Estimate Presentation

- In presenting any estimate, it is important to consider the purpose of the estimate as well as understand what is included and not included in the price.
- It is also important to understand all of the included assumptions and the accuracy of the data.
- Conceptual estimates are the first costs that are presented to the owner. Although they are normally accomplished with little information, they tend to be the number most remembered.
- It is important to identify information that has to be adjusted for. Cost of land, demolition if required and design fees have not been included in the price and would have to be added.