Estimating Process

Agenda

- Definition of estimating
- What is estimating in construction?
- Cost variable in construction
- Types of estimates
- Conceptual estimate
- Detailed estimate
- Avoiding Errors in Estimates
ESTIMATING CONSTRUCTION COSTS

• The key to a good job and successful cost control is the development of a good estimate as the basis for bid submittal.

• Estimating is the process of looking into the future and trying to predict project costs and resource requirements.

• To minimize errors, a consistent procedure or set of steps for preparing an estimate is needed to minimize errors and achieve reliable results.

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Probable contingency as %</th>
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<tbody>
<tr>
<td>Bid</td>
<td>6</td>
<td>5 10 15 20 25 30</td>
</tr>
<tr>
<td>Engineer's</td>
<td>5</td>
<td>5 10 15 20 25</td>
</tr>
<tr>
<td>Definitive</td>
<td>4</td>
<td>5 10 15</td>
</tr>
<tr>
<td>Preliminary</td>
<td>3</td>
<td>5 10 15</td>
</tr>
<tr>
<td>Conceptual</td>
<td>2</td>
<td>5 10</td>
</tr>
<tr>
<td>Magnitude</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

Basic data
1. Craft wage rates and fringe benefits
2. Payroll taxes and insurance
3. Local sales use other taxes
4. Design and construction schedule
5. Insurance requirements

Green field plant without historic plant cost or work in existing plants
Green field plants with historic data
## TYPES OF ESTIMATES

<table>
<thead>
<tr>
<th>Type</th>
<th>When?</th>
<th>How?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual</td>
<td>Prior to the commencement of design</td>
<td>A representative unit is multiplied by a price per unit to obtain a gross estimate (± 10% accuracy) of the facility cost.</td>
</tr>
<tr>
<td>Preliminary</td>
<td>40% completion of the total design</td>
<td>By the architect or architect/engineer to reflect expected costs based on more definitive data.</td>
</tr>
</tbody>
</table>
| Engineer      | Detail design is accomplished | • Total job cost minus markup  
• Should achieve approximately ±3% accuracy. |
| Bid           | Bidding phase                 | • On the basis of the bidding documents,  
• Include a markup for profit. |

### Building Cost Index History (1923-2005)

![Building Cost Index History](chart.png)

Construction Management, 3/E by Daniel W. Halpin  
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Example 1: A 5M GPD desalination plant was constructed in 1995 at a cost of 20M. What would be the cost of 15M GPD in 2005, if the cost capacity factor is 0.37, and Desalinization Index $DI_{2005}=107$, and $DI_{1995}=99$.

Cost-Capacity formula is of the form: $C_y = C_2 \left( \frac{Q_1}{Q_2} \right)^x$, where $x = \text{cost - capacity factor (< 1)}$

\[
C_y = C_2 \left( \frac{Q_1}{Q_2} \right)^x = 20 \left( \frac{15}{5} \right)^{0.37} = 20 \cdot 3.07 = 30M
\]

$C_y(\text{now}) = 30 \cdot 107/99 = 32.4M$

Example 2: You are required to submit an estimate for 6m high, 3000 m² warehouse construction. You looked up your cost file and found that you had built an 8m high, 2500 m² for 2.5M, 7 years ago when the cost index was 120. If the cost index is now 165, what is your cost estimate per cubic meter?

\[
\text{Cost/m}^3(\text{-7}) = \frac{2500,000}{8 \cdot 2500} = 125
\]

\[
\text{Cost/m}^3(\text{Now}) = 125 \times 165/120 = 171.88
\]

Estimate = $171.88 \times 6 \times 3000 = 3,093,840$
1. Break the project into cost centers.

2. Estimate the quantities required for cost centers that represent physical end items (e.g., cubic yards of earth, lineal feet of pipe, etc.). For physical systems this procedure is commonly called *quantity takeoff*. For those cost centers that relate to nonphysical items, determine an appropriate parameter for cost calculation (e.g., the level of builder's risk insurance required by the contract or the amounts of the required bonds).

3. Price out the quantities determined in step 2 using historical data, vendor quotations, supplier catalogs, and other pricing information. Price development for physical work items may require an analysis of the production rates to be achieved based on resource analysis. If this analysis is used, the estimator must:

   a. Assume work team composition to include number of workers (skilled and un-skilled) and equipment required.
   b. On the basis of team composition, estimate an hourly production rate based on the technology being used.
   c. Make an estimate of the efficiency to be achieved on this job, considering site conditions and other factors.
   d. Calculate the effective unit price.

4. Calculate the total price for each cost center.
Typical Estimate Summary Sheet

QUANTITY TAKEOFF (SURVEYING)

• The development of the quantities of work to be placed in appropriate units (e.g., square feet, cubic yards, etc.).
• The procedures employed by the estimator to calculate these quantities should incorporate steps to minimize errors.
• Five of the most common errors experienced during quantity takeoff are:

1. Arithmetic: Errors in addition, subtraction, and multiplication
2. Transposition: Mistakes in copying or transferring figures, dimensions, or quantities
3. Errors of omission: Overlooking items called for or required to accomplish the work
4. Poor reference: Scaling drawings rather than using the dimensions indicated
5. Unrealistic waste or loss factor.
Work Breakdown Structure WBS

- Foundation
  - Excavation
  - Concrete
  - Steel

Work packages

- A work package is a well-defined scope of work that usually terminates in a deliverable product.
- Each package may vary in size but must be a measurable and controllable unit of work to be perform.
- It also must be identifiable in a numerical accounting system in order to permit capture of both budgeted and actual performance information.
- A work package is a cost center.
1. GENERAL REQUIREMENTS
2. SITE CONSTRUCTION
3. CONCRETE
4. MASONRY
5. METALS
6. WOOD AND PLASTICS
7. THERMAL AND MOISTURE PROTECTION
8. DOORS AND WINDOWS
9. FINISHES
10. SPECIALTIES
11. EQUIPMENT
12. FURNISHINGS
13. SPECIAL CONSTRUCTION
14. CONVEYING SYSTEMS
15. MECHANICAL
16. ELECTRICAL

Division 3 – Concrete

1. Concrete:
   - Plain Concrete
   - Reinforced Concrete: Substructure
   - Reinforced Concrete: Superstructure

2. Formwork
   - Foundations
   - Columns
   - Beams
   - Slabs

3. Reinforcing Steel
Plain Concrete

- Concrete is classified by type, strength, and location
- Concrete volume is measured from detailed drawings in cubic meters, rounded to the nearest 0.5 meter
- Concrete Mat
- Foundation (Spread, Continuous, Raft)
- Pedestal
- Grade Beams
- Shear Walls
- Use 5-10% waste factor

Foundation Details
### ASTM Standard Reinforcing Bars

<table>
<thead>
<tr>
<th>Soft Metric Size</th>
<th>Nom Diam mm</th>
<th>Area mm²</th>
<th>Weight Factors kg/m</th>
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<tbody>
<tr>
<td>10</td>
<td>9.5</td>
<td>71</td>
<td>.560</td>
</tr>
<tr>
<td>13</td>
<td>12.7</td>
<td>129</td>
<td>.994</td>
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<tr>
<td>16</td>
<td>15.9</td>
<td>199</td>
<td>1.552</td>
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<td>19</td>
<td>19.1</td>
<td>284</td>
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<td>22</td>
<td>22.2</td>
<td>387</td>
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<td>25</td>
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<td>819</td>
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<td>36</td>
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<td>1006</td>
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<td>43</td>
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<td>57</td>
<td>57.3</td>
<td>2581</td>
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<table>
<thead>
<tr>
<th>Bar Size</th>
<th>(kg/m)</th>
<th>Area (mm²)</th>
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<tr>
<td>6</td>
<td>0.222</td>
<td>28.3</td>
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<tr>
<td>8</td>
<td>0.395</td>
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<td>12</td>
<td>0.888</td>
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<td>14</td>
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<td>1.58</td>
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<td>40</td>
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<td>50</td>
<td>15.4</td>
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### Small Wall Construction

#### Activity Material List

<table>
<thead>
<tr>
<th>Activity Code</th>
<th>Activity Description</th>
<th>Material Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Cost Code</th>
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<tbody>
<tr>
<td>1</td>
<td>Layout</td>
<td>2 x 4 x 8</td>
<td>104</td>
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<td>2</td>
<td>Field labor</td>
<td>2 x 8 x 10</td>
<td>457</td>
<td>LF</td>
<td>00000</td>
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<td>Field labor</td>
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<td>Field labor</td>
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<td>LF</td>
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<td>5</td>
<td>Field labor</td>
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<td>345</td>
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<td>6</td>
<td>Field labor</td>
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<td>LF</td>
<td>00000</td>
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<td>7</td>
<td>Field labor</td>
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<td>215</td>
<td>LF</td>
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<tr>
<td>8</td>
<td>Field labor</td>
<td>8 x 8</td>
<td>345</td>
<td>LF</td>
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<td>9</td>
<td>Field labor</td>
<td>9 x 9</td>
<td>455</td>
<td>LF</td>
<td>00000</td>
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<tr>
<td>10</td>
<td>Field labor</td>
<td>10 x 10</td>
<td>215</td>
<td>LF</td>
<td>00000</td>
</tr>
</tbody>
</table>

---

The diagram shows the layout of a small wall with dimensions labeled, indicating the locations of materials and labor areas.
**Unit Price**

- If the work is fairly standard, the cost can be calculated by simply taking *dollar per unit* cost from company records and applying this cost with a qualitative correction factor to the quantity of work to be performed.

- Unit pricing values are available in many standard estimating references:
  - R. S. Means Company, *building Construction Cost Data*
  - F. R. Walker's *The Building Estimator's Reference Book*
  - *The Richardson General Construction Estimating Standards*

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### Line Item Cost Development Using R.S. Means

**3.1 FORMWORK**

<table>
<thead>
<tr>
<th>Type</th>
<th>Crew</th>
<th>Daily Output</th>
<th>Unit Cost</th>
<th>BARE COSTS</th>
<th>TOTAL</th>
<th>INC.</th>
<th>TOTAL</th>
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<tr>
<td>FMN</td>
<td>C-1</td>
<td>10</td>
<td>5.75</td>
<td>2.605</td>
<td>9.7</td>
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</tr>
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</table>

**Crew C-1**

<table>
<thead>
<tr>
<th>Item</th>
<th>Base Cost</th>
<th>Labor Hour</th>
<th>Qual. Adj.</th>
<th>Daily Rate</th>
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<tbody>
<tr>
<td>C-1</td>
<td>25.25</td>
<td>624.00</td>
<td>40.25</td>
<td>866.00</td>
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<tr>
<td>C-2</td>
<td>14.68</td>
<td>410.00</td>
<td>31.65</td>
<td>213.90</td>
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<tr>
<td>C-3</td>
<td>35.00</td>
<td>18.00</td>
<td></td>
<td>53.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>376.25</strong></td>
<td></td>
<td></td>
<td><strong>2,862.50</strong></td>
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</tbody>
</table>

**Line Item Definition**

- Major UCA classification = C-1
- Major classification within subdivision = 10
- Line item number = 681
- Composite line number = 3.1-25-10
Avoiding Errors in Estimates

- The accuracy of an estimate is a measure of how accurate or correct the numbers in the estimate are.

- The completeness of an estimate is a measure of whether the bid has all the items needed for the project without duplicating items.
Avoiding Errors in Estimates

- List Cost Codes
- Spend More Time on Large Costs
- Prepare Detailed Estimates
- Mark Items Counted During the Quantity Takeoff

Avoiding Errors in Estimates

- Double Check All Takeoffs
- Include Units in Calculations
- Automate with Spreadsheets
- Use Well Tested and Checked Formulas
- Double Check All Calculations
Avoiding Errors in Estimates

• Perform Calculations in Two Ways

• Drop the Pennies

• Have Someone Review the Estimate

• Review Each Cost Code as a Percentage of the Total Costs

Avoiding Errors in Estimates

• Check Unit Costs for Each Cost Code

• Compare Costs to another Project

• Allow Plenty of Time
Questions