Contract Cash Flow

How much is the total cost?

How to arrange for financing?

Cash Flow = Cash In – Cash Out

= Income – Expense

= Revenue - Cost
**Project Finance & Contract Pricing**

**Project Expenses**

- The project cost types:
  - Fixed cost (equipment, ...)
  - Time-related cost (distributed over the duration of an activity, e.g., salaries, ...)
  - Quantity (Production)-related costs (costs per unit of materials or unit of resource usage)

- When these costs are paid, it is named *expenses*
**Project Finance & Contract Pricing**

**Project Expenses**

- The project S-Curve:

  ![S-Curve Graph](image)

**Project Income**

- Project revenue is the summation of the activities prices
- Represents the payment made by the owner to the contractor
- Mostly, the contractor receive his payments after one month from submitting his/her invoice
- Retainage of 5 or 10 to ensure that no problems will arise during construction
- When the contractor receive his/her payments, it is called Income
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**Project Income (Stepped curve)**

\[ \text{LE x1000} \]

\[ \begin{array}{|c|c|c|c|c|c|c|c|c|}
\hline
\text{Time} & 0 & 2 & 4 & 6 & 8 & 10 \\
\hline
\text{Revenue} & 0 & 100 & 200 & 300 & 400 & 500 \\
\hline
\text{Income} & 0 & 100 & 200 & 300 & 400 & 500 \\
\hline
\end{array} \]

---

**Example**

- Consider the construction operation of a foundation activity
- Activity duration 8 weeks
- Labor cost of LE 1600 paid weekly
- Equipment cost of LE 4000 paid weekly after 2-month credit facility
- Material cost of LE 800 paid weekly after 3-month credit facility
- Subcontractor cost of LE 2400 paid weekly after 1-month credit facility

- *When each payment by the contractor is due and how much?*
**Project Finance & Contract Pricing**

**Example**

- Activity total cost = LE 8800

<table>
<thead>
<tr>
<th>Week</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payments</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
</tr>
<tr>
<td>Total</td>
<td>1100</td>
<td>2200</td>
<td>3300</td>
<td>4400</td>
<td>5500</td>
<td>6600</td>
<td>7700</td>
<td>8800</td>
</tr>
</tbody>
</table>

**Project Finance & Contract Pricing**

**Expenses**

<table>
<thead>
<tr>
<th>wk</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>200</td>
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<td>600</td>
<td>600</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
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Contract Cash Flow

Cost (LE) vs. Month

- Emad Elbeltagi

Contract Cash Flow - Admeasurements contract

Cumulative cost (LE) vs. Time

- Emad Elbeltagi
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Contract Cash Flow - Admeasurements contract with advanced payment

Cumulative Cost (LE)

Advanced payment

Time

Income

Expense

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Contract Cash Flow – Lump sum contract with three payments

Cumulative Cost (LE)

Expense

Income

Time

13/11/2014
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**Contract Cash Flow**

**Variables needed to calculate cash flow**
- The project bar chart (project schedule)
- Activities’ direct and indirect cost
- Contractor method of paying his/her expenses
- Contractor’s markup
- Retention amount and its payback time
- Time of payment delay by owner
- Advanced or mobilization payment

---

**Procedure to calculate cash flow**
- The project bar chart (project schedule)
- Perform project schedule
- Draw bar chart based on early or late timings
- Calculate the cost per time period
- Calculate the cumulative cost
- Adjust the cost to produce the expenses
- Calculate cumulative revenue: revenue = cost x (1 + markup)
- Adjust the revenue to produce the income
- Calculate the cash flow (cash flow = income – expense).
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Example

![Network Diagram]

Example data: Mark up = 5%

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration (day)</th>
<th>Total Cost (LE x 1000)</th>
<th>Total Revenue (LE x 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4</td>
<td>04.00</td>
<td>04.20</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
<td>12.00</td>
<td>12.60</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>04.00</td>
<td>04.20</td>
</tr>
<tr>
<td>D</td>
<td>8</td>
<td>16.00</td>
<td>16.80</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>20.00</td>
<td>21.00</td>
</tr>
<tr>
<td>F</td>
<td>10</td>
<td>20.00</td>
<td>21.00</td>
</tr>
<tr>
<td>G</td>
<td>16</td>
<td>16.00</td>
<td>16.80</td>
</tr>
<tr>
<td>H</td>
<td>8</td>
<td>24.00</td>
<td>25.20</td>
</tr>
<tr>
<td>I</td>
<td>6</td>
<td>12.00</td>
<td>12.60</td>
</tr>
<tr>
<td>J</td>
<td>6</td>
<td>12.00</td>
<td>12.60</td>
</tr>
<tr>
<td>K</td>
<td>10</td>
<td>10.00</td>
<td>10.50</td>
</tr>
</tbody>
</table>
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Example

Example data:

- Contractor expenses will be paid immediately
- Retention = 10% will be paid with the last payment
- Calculations made every 8 days
- Owner payment will be delayed one period
- First invoice after at the end of the period
- No advanced payment
### Project Finance & Contract Pricing

#### Example

<table>
<thead>
<tr>
<th></th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>8</th>
<th>8</th>
<th>6</th>
<th>6</th>
<th>2</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cost/2 days x LE1000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Cost each period x LE1000</td>
<td>46</td>
<td>52</td>
<td>32</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Cumulative cost x LE1000</td>
<td>46</td>
<td>98</td>
<td>130</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Cumulative Expense x 1000</td>
<td>46</td>
<td>98</td>
<td>130</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Revenue = row 3 x 1.05</td>
<td>48.3</td>
<td>54.6</td>
<td>33.6</td>
<td>21</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Revenue - retention = row 5 x 0.9</td>
<td>43.47</td>
<td>49.14</td>
<td>30.24</td>
<td>18.90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Retention x LE1000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>15.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Cumulative revenue x LE1000</td>
<td>43.47</td>
<td>92.61</td>
<td>122.85</td>
<td>141.75</td>
<td>157.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Cumulative income x LE1000</td>
<td>-</td>
<td>43.47</td>
<td>92.61</td>
<td>122.85</td>
<td>157.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Cumulative cash flow x LE1000 = row 9 – row 4</td>
<td>-46</td>
<td>-96/-54.53</td>
<td>-86.53/-37.39</td>
<td>-57.39/-27.15</td>
<td>-27.15/+7.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Example Diagram:**

- Area = LE 10,000 x 1 period (8-days)

---

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**Example**

![Graph](image)

**Minimizing Contract Negative Cash Flow**

- Loading of rates
- Adjustment of work schedule to late start timing
- Reduction of delays in receiving revenues
- Asking for advanced or mobilization payment
- Increasing the mark up and reducing the retention
- Adjust the timing of delivery of large material orders
- Delay in paying labor wages, equipment, material
24 unit areas, interest rate 1% per period

Cost = 24 x 10000 x 0.01 = LE 2400

Time scale is much longer spans the whole life of a project

Feasibility studies

Execution

Operation

Profitability indicators

Payback period

Maximum capital – maximum negative cash

Profit
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**Project Cash Flow**

![Diagram of Project Cash Flow](image)

- Cumulative cash flow
- Payback period
- Maximum capital
- Project duration
- Profit

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**Project Cash Flow: Example**

- Project net cash flow

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project A (LE x 1000)</td>
<td>-10</td>
<td>-40</td>
<td>-30</td>
<td>20</td>
<td>60</td>
<td>20</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Project B (LE x 1000)</td>
<td>-30</td>
<td>-80</td>
<td>30</td>
<td>50</td>
<td>10</td>
<td>20</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

- Project cumulative cash flow

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project A (LE x 1000)</td>
<td>-10</td>
<td>-50</td>
<td>-80</td>
<td>-60</td>
<td>0</td>
<td>20</td>
<td>35</td>
<td>65</td>
</tr>
<tr>
<td>Project B (LE x1000)</td>
<td>-30</td>
<td>-110</td>
<td>-80</td>
<td>-30</td>
<td>-20</td>
<td>0</td>
<td>40</td>
<td>80</td>
</tr>
</tbody>
</table>
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Project Cash Flow: Example

Present value (PV)
- Current values of money
- Discounted value due to inflation
- Change in currency power purchasing

Discounted Cash Flow

\[ C = P \times \left( \frac{1}{1+r} \right)^n (1 + r) \]

\[ P = \frac{C}{(1+r)^n} \]

Net present value (NPV) = PV income - PV expense
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Net Present Value

Project net cash flow

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Project A (LE )</td>
<td>500</td>
<td>400</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project B (LE )</td>
<td>100</td>
<td>200</td>
<td>200</td>
<td>400</td>
</tr>
</tbody>
</table>

Which project would you prefer?

Interest rate (discount rate) = 10% /year

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Net Present Value

Project A

\[
\text{NPV} = -1000 + \frac{500}{(1+.10)^1} + \frac{400}{(1+.10)^2} + \frac{200}{(1+.10)^3} + \frac{200}{(1+.10)^4} + \frac{100}{(1+.10)^5} = $134.08
\]

Project B

\[
\text{NPV} = -1000 + \frac{100}{(1+.10)^1} + \frac{200}{(1+.10)^2} + \frac{200}{(1+.10)^3} + \frac{400}{(1+.10)^4} + \frac{700}{(1+.10)^5} = $114.31
\]

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Internal rate of return (IRR)

- The least discount rate (investment rate) that acceptable by the contractor or greater than the return on capital
- It is the discount rate with zero NPV

Internal rate of return: Example

- Same previous example
- **Project A**

\[
0 = -1000 + \frac{500}{(1 + \text{IRR})^1} + \frac{400}{(1 + \text{IRR})^2} + \frac{200}{(1 + \text{IRR})^3} + \frac{200}{(1 + \text{IRR})^4} + \frac{100}{(1 + \text{IRR})^5}
\]

\[\therefore \text{IRR} = 16.82\%
\]

- **Project B**

\[
0 = -1000 + \frac{100}{(1 + \text{IRR})^1} + \frac{200}{(1 + \text{IRR})^2} + \frac{200}{(1 + \text{IRR})^3} + \frac{400}{(1 + \text{IRR})^4} + \frac{700}{(1 + \text{IRR})^5}
\]

\[\therefore \text{IRR} = 13.28\%
\]
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Finalizing Bid Price

Price

- Markup
  - Risk allowance
  - Financial charge
  - Profit

- Cost
  - Indirect cost
  - Direct cost

Indirect Cost

Project Overheads (Site)

- Does not apply to a specific activity
- Cost of site utilities, supervisors, workshop,...
- A detailed analysis can be carried out
- Generally assumed 5 – 15 % of direct costs
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**Indirect Cost**

**General Overheads (Head-office)**

- Does not apply to a specific project
- Cost of head-office, managers, estimators,…
- Generally assumed 2 – 5 % of direct costs
- For a specific project: \( \text{Project direct cost} \times \text{general overhead of the company in a year} / \text{Expected sum of direct costs of all projects during the year} \)

---

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**Profit Margin**

- The contractors’ competition to win a project
- A contractor’s desirability for work
- Volume of work that the contractor has at a certain time
- Size of the project and it complexity
- Identity of the client and the engineer
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**Risk Management**

- Uncertainty and risks usually leads to project completion delays and cost overruns
- Process: Identification of risks
- Responses to avoid, reduce, or transfer risk
- Analysis and assessment of residual risks after the risk responses
- Adding time and/or cost contingency for residual risks in the project estimates

---

**Project Finance & Contract Pricing**

**Risk Management**

*Generally the risk should be carried out by the party who is best able to define it. If there is any doubt, it should be carried out by the client. This is because, it is better for the client to pay for what does happen rather than for what the contractor thought might happen*
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**Risk Management**

**Risk Identification**

- Risk is the possibility of undesirable extra cost or delay due to factors having uncertain future outcome
- Material may not be available prior to construction thus delay the project
- Risks defined through: check lists, experts opinions, comparisons with other

**Risk Management: identification**

**Administrative**

- Delay in possessions of site
- Limited working hours
- Limited access to the site
- Troubles with public services

**Logistical**

- Shortage or late supply of different resources
- Site remoteness problems
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Risk Management: identification

Physical

- Periods of high temperature
- Placing fill in dry season
- Diverting water canals in time of low flow

Construction

- Limited work space
- Changes in soil condition
- Availability of skilled labor
- Equipment breakdown

Design

- Design incomplete
- Design changes
- Design errors

Financial

- Inflation
- New restrictions applied on importing
- Exchange rate fluctuation
- Availability of funds
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Risk Management: identification

Political

- Change of local laws and regulations
- Necessity to use local resources
- Effect of wars and revolutions

Disasters

- Floods and storms
- Earthquakes
- Accidents
- Diseases

Risk Management: Response

- Using construction methods with high success
- Using extra resources
- Securing alternative suppliers
- Providing temporary roads
- Allowing free housing near construction
- Locating site facilities away of the working space
- Assuming realistic reduced resources output
- Using equipments with available spare parts
- Providing facilities for mechanical maintenance
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**Risk Management: Response**

**Time contingency**

- extra time that added to the contract time to offset the effect of risks
- A general allowance is added to the overall contract duration, e.g., weather conditions
- Allowance is added to a particular activity affected by the risk

**Cost contingency**

- extra cost is added to the estimate and the contract price
- Based on the experience, a fixed percentage is added
- This might not be accurate
- A detailed risk analysis may be done to determine the suitable contingency
**Project Finance & Contract Pricing**

**Pricing Policy**

- *direct cost are associated directly to contract activities*
- *Indirect costs and markup are related to the whole contract*
- *Pricing policy is the method by which the indirect costs and markup will be distributed among the items of the bill of quantities*

---

**Project Finance & Contract Pricing**

**Pricing Policy**

*Balanced bid (Straight forward)*

The share of specific item =

\[
\text{Direct cost of this item} \times (\text{total indirect cost + markup}) \quad \text{Total contract direct cost}
\]
Pricing Policy: Balanced Bid

Example

- Contract price 3,500,000
- Direct cost 2,800,000
- If the direct cost of an activity is 400,000
- Determine the price of that activity

Bid price = direct cost + indirect cost + markup

Indirect cost + markup = 3,500,000 - 2,800,000 = LE 700,000

Indirect cost + markup for the activity =
400,000/2,800,000 x 700,000 = 100,000

Activity price = 400,000 + 100,000 = 500,000
**Project Finance & Contract Pricing**

**Pricing Policy: Unbalanced Bid**

- Called also loading of rates
- Increasing prices for early items in the BOQ
- Increase the cash revenue at the beginning
- Decrease negative cash flow
- May be risky to the owner or the contractor

**Example**: Consider the following project

<table>
<thead>
<tr>
<th>Activity</th>
<th>Quantity</th>
<th>Direct cost rate</th>
<th>Balanced bid Rate</th>
<th>Balanced bid Price</th>
<th>Unbalanced bid Rate</th>
<th>Unbalanced bid Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100</td>
<td>4</td>
<td>5</td>
<td>500</td>
<td>6</td>
<td>600</td>
</tr>
<tr>
<td>B</td>
<td>100</td>
<td>8</td>
<td>10</td>
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</tr>
<tr>
<td>C</td>
<td>100</td>
<td>16</td>
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<td>2000</td>
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<td>1800</td>
</tr>
<tr>
<td>D</td>
<td>100</td>
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<td>20</td>
<td>2000</td>
<td>18</td>
<td>1800</td>
</tr>
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<tr>
<td>Tender price</td>
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<td>6500</td>
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</tbody>
</table>
Project Finance & Contract Pricing

Pricing Policy: Unbalanced Bid

Example

- Draw the cash flow curves for both balanced and unbalanced bids
- Determine the effect of increasing quantity of activity B by 50%
- Determine the effect of increasing quantity of activity C by 50%
### Project Finance & Contract Pricing

#### Pricing Policy: Unbalanced Bid

**Example:** Effect of Increasing activity B by 50%

<table>
<thead>
<tr>
<th>Activity</th>
<th>Quantity</th>
<th>Direct cost rate</th>
<th>Balanced bid</th>
<th>Unbalanced bid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rate</td>
<td>Price</td>
</tr>
<tr>
<td>A</td>
<td>100</td>
<td>4</td>
<td>5</td>
<td>500</td>
</tr>
<tr>
<td>B</td>
<td>150</td>
<td>8</td>
<td>10</td>
<td>1500</td>
</tr>
<tr>
<td>C</td>
<td>100</td>
<td>16</td>
<td>20</td>
<td>2000</td>
</tr>
<tr>
<td>D</td>
<td>100</td>
<td>16</td>
<td>20</td>
<td>2000</td>
</tr>
<tr>
<td>E</td>
<td>100</td>
<td>8</td>
<td>10</td>
<td>1000</td>
</tr>
</tbody>
</table>

**Tender Price**

- Balanced bid: **7000**
- Unbalanced bid: **7200**

---

**Example:** Effect of Increasing activity C by 50%

<table>
<thead>
<tr>
<th>Activity</th>
<th>Quantity</th>
<th>Direct cost rate</th>
<th>Balanced bid</th>
<th>Unbalanced bid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rate</td>
<td>Price</td>
</tr>
<tr>
<td>A</td>
<td>100</td>
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<tr>
<td>E</td>
<td>100</td>
<td>8</td>
<td>10</td>
<td>1000</td>
</tr>
</tbody>
</table>

**Tender Price**

- Balanced bid: **7500**
- Unbalanced bid: **7400**
Project Finance & Contract Pricing

Pricing Policy: Method related charge

- In conventional BOQ, all costs are related to quantity of work
- Result in financial problems
- Example, site overheads
- Specifying independent items from quantities as separate items in the BOQ
- These items may be fixed cost or time related

Sample BOQ in Method Related Charge

<table>
<thead>
<tr>
<th>Activity / Resource</th>
<th>Fixed charge</th>
<th>Time-related charge</th>
<th>Unit</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish site</td>
<td>-</td>
<td>-</td>
<td>Sum</td>
<td>Month</td>
</tr>
<tr>
<td>Site overheads</td>
<td>-</td>
<td>-</td>
<td>Day</td>
<td>Day</td>
</tr>
<tr>
<td>Bulldozers</td>
<td>-</td>
<td>Time-related</td>
<td>Day</td>
<td>Month</td>
</tr>
<tr>
<td>Excavators</td>
<td>-</td>
<td>Time-related</td>
<td>Day</td>
<td>Month</td>
</tr>
<tr>
<td>General overheads</td>
<td>-</td>
<td>Time-related</td>
<td>Day</td>
<td>Month</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------</td>
<td>---------------------</td>
<td>----------</td>
<td>-----------</td>
</tr>
</tbody>
</table>

13/11/2014 Emad Elbeltagi
<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
<th>UNIT</th>
<th>UNIT PRICE</th>
<th>TOTAL PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heath Safety Equipment and Monitoring.</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Project Site Mobilization.</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Steel Structure Decontamination.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Decontaminate steel structure</td>
<td>1100</td>
<td>Square Meters</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) Load and haul debris to Landfill in Alexandria</td>
<td>5</td>
<td>Ton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Walls Decontamination and Coating.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Support walls</td>
<td>1200</td>
<td>Square Meters</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) Rolling Scaffold</td>
<td>1200</td>
<td>Square Meters</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>