Budget, Cost Estimation

Why it is important to know about costs for an architect?

• Usually costs play a key role in an investment.
• Must know:
  where, why and how do arise costs.
• To give advises to the investor or owner.

Sometimes there are extraordinary cases.

Three examples:

Santa Maria del Fiore, Florence, Italy (1294 – 1434)

Time and Cost Management - really?
Time and Cost Management - really?

Dome, Florence, Italy (1294 – 1434)

Filippo Brunelleschi, Florence, Dome
Section and the structure of the cupola


Some examples in the world

Edinburgh Scottish Parliament

Scheduled to open in 2001, it did so in 2004, more than three years late with an estimated final cost of £414 million, many times higher than initial estimates of £150m and £40m.

Olympic Stadium (Montreal), Canada

Despite initial projections in 1970 that the stadium would cost only C$134 million to construct, strikes and construction delays served to escalate these costs. By the time the stadium opened (in an unfinished form), the total costs had risen to C$264 million.

In 1986, a large chunk of the tower fell onto the playing field during another Expos game. A contract for a new permanent steel roof was awarded in 2004, with an estimated C$300 million price tag.

In mid-November 2006 the stadium’s costs were finally paid in full. The total expenditure (including repairs, renovations, construction, interest, and inflation) amounted to C$1,610 million, making it the second most expensive stadium ever built.

Though some Montrealers have called for the stadium to be demolished, it would be an extremely long and expensive project. Due to its unique structural design and the metro line directly underneath, it is not possible to implode the stadium. Instead, it would have to be dismantled piece by piece, which would take an estimated C$700 million.
Some examples in the world

Olympic Stadium (Montreal), Canada

Causes of Cost Overrun

Three types of explanation for cost overrun exist:

Technical: imperfect forecasting techniques, inadequate data, etc,

Psychological: optimism bias
(over-estimating the likelihood of positive events and under-estimating the likelihood of negative events), and

Political-economic: the result of strategic misrepresentation of scope or budgets.

Calculation of Cost Overrun

Percentage: actual cost minus budgeted cost, in percent of budgeted cost

Ratio: actual cost divided by budgeted cost

For example:
the budget for building a new bridge: $100 million
the actual cost: $150 million
the cost overrun: 50 % or the ratio 1.5

Technical Causes of Cost Overrun

- Cost estimates method and the detail of the plan is inadequate,
- defective cost data,
- imprecise cost estimates (calculation) method,
- price increases during the beginning of planning and the delivery of the investment period,

Possibilities to influence the project costs (%)

- additional costs because of the change of the investment program and the plans,
- unforeseen construction conditions (e.g., poorer soil conditions, adverse weather),
- hindering the construction (e.g., late delivered plans, external action of associations),
- lack of cost management in planning and construction process.
How can we calculate costs?
The principle of cost calculation

geometry of the building: qualitative factor:
• functional basic area
• the size of the surfaces of the floors
• surfaces of the facade

quantitative factor:
• using of the building (detached house or hospital)
• claim level of the building
• conditions of the market

That is: ~ is very important at the calculation.

Quantitative factor
• Relevant parameter at the time of the planning, construction and use.
• Quantitative factor is needed for:
  • characterization of the building,
  • definition, controlling and management of the construction costs,
  • comparison of variant design solutions,
  • definition, controlling and management of the operating costs,
  • calculation of the rent,
  • calculation of the worth of the real estate, etc

(DIN 277-1) Volume and surface areas of buildings. Part 1: concepts and methods of calculation

Office building, general floor plan

(DIN 277-1) Division of the gross floor area

(DIN 277-1) Division of the net area

Which structural area belongs to which area?
(DIN 277-1) It is a precise standard.

(DIN 277-1) Volume and surface areas of buildings. Part 1: concepts and methods of calculation

(DIN 277-2) Partition of net floor area

<table>
<thead>
<tr>
<th>Number</th>
<th>Net area</th>
<th>Room category (functions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Functional basic area</td>
<td>housing and recreation</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>office work</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>manufacturing and research</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>storage and sales</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>training, education and culture</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>medicine and nursing</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>other usage</td>
</tr>
<tr>
<td>8</td>
<td>Mechanical floor area</td>
<td>technical equipment</td>
</tr>
<tr>
<td>9</td>
<td>Traffic floor area</td>
<td>traffic</td>
</tr>
</tbody>
</table>

The principle of cost calculation

Cost factor

Expenses fall under two major sections:

Initial expenses:
Initial expenses are usually equal to the investment of a project.

Future expenses:
Future expenses are usually equal to the incurring costs after the occupation of a facility.
There are two standards in Germany which summarise the costs in the building industry:

- the Standard 276-1 (DIN, 2006) contains the total investment cost of a project (Initial expenses) and
- the other German Standard 18960 (DIN, 2008) defined the future expenses at the life of a building.

The German Standard 18960 (DIN, 2008) defined the following future expenses at the life of a building:

100 Capital costs: interest loss and amortization
200 Object management costs: personal costs in connection with the operation of the building and other material expenditures
300 Operating costs
400 Maintenance costs

The Standard 276-1 (DIN, 2006) contains the total investment cost of a building project. The aim of the DIN 276-1 standard is to give the opportunity to stand up a complete structure of building costs and makes it possible to project all costs of a planned investment.

Each cost element is encoded and divided to three levels.

The first level refers to all the costs of the project (budget):

- 100 Building plot
- 200 Infrastructural facilities
- 300 Building – constructions
- 400 Building – installations
- 500 Outdoor constructions and installations
- 600 Furniture and artworks
- 700 Additional expenses

### DIN 276-1

110 Plot price (value)
120 Incidental costs of ownership
121 alignment
122 cost of legal procedures
123 notary costs
124 estate agent pay
125 duty
126 valuation, and related expertise
127 authorization fees
128 plot alteration, withdrawal from cultivation
129 other incidental expenses
130 Liberation costs of the plot
131 indemnification
132 resolving form restrictions
139 other
DIN 276-1

DIN 276-1

DIN 276-1

DIN 276-1

DIN 276-1

DIN 276-1

DIN 276-1
Building Cost Documentation

The data are set up on the one hand based on empirical values of buildings completed – *analytical method* –.

On the other hand based on forecasting made from plans, designs and standards (norms) – *synthetic method*.

The calculation of costs should take into account all factors which may impact on costs.
$\textbf{Building Cost Documentation}$

- **Analytical method**
  - Empirical values of buildings completed
  - Factors: not necessarily justified
  - Assumed values

- **Synthetic method**
  - Cost and quantity components based on plans and designs

**Factors affecting the cost**

- **Cost element related factors**
  - Example: cost element: basement excavation
    - Soil class
    - Shape and depth of the excavation pit
    - Transport distance
    - Building location (city, outer space)
    - Type of ground support (slope, shotcrete, slurry wall, timber shoring...)
    - Type of dewatering (does not exist at all or exists...)

**Factors affecting the cost**

- **Independent factors not related to cost elements**:
  - Cyclical effect on the market (the date of execution)
  - Regional market conditions (local price levels, degree of competition)
  - Method of the competition
  - Type of construction contract
  - Scale of the investment
  - User requirements
  - Site conditions
  - Building geometry
  - Aesthetic and structural specialties

**Price index**

- The price index is given for the cost update.
  If you want to use data from more building cost documentations you have to convert the data to a common price level.

- The prices are also used for forecasting.
  Example:
  - Conversion from 2002 to 2011 price level, if the base year is the 2005th (2005 = 100%)
    - Price level in 2002: 92.0
    - Price level in 2011: 118.0

  - Unit price in 2002: €2,500,000
    - Unit price in 2011:
      \[ \frac{2,500,000 \times 118}{92} = €3,206,522 \]
Sorting of the calculation methods

**Function-orientated methods**
- based on function-unit (for example workplaces, parking spaces or the number of hospital beds)
- based on useful basic area
- based on room-categories (the counting depends on only the program of rooms, the building’s type is equal)

**Building-orientated methods**
- “two –factors methods”
- based on surface model
- by distribution to building construction units

**Realization-orientated methods**
- by distribution to work types
- based on specifications
- based on ABC-analysis

1. Function-orientated methods

Example: based on useful basic area

<table>
<thead>
<tr>
<th>Building type: Office building</th>
<th>Average technical equipment</th>
<th>Cost: Building cost</th>
<th>Total cost</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>300 + 400 Cost Group</td>
<td>11 450 000 €</td>
</tr>
<tr>
<td>Price validity: November 2002</td>
<td>Gross price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 000 m² useful basic area</td>
<td>62 000 €/m²</td>
<td>11 450 000 €</td>
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2. Building-orientated methods

Example: two –factors method

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<td>20 000 m³ gross build up volume</td>
<td>450 €/m³.g³</td>
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<td>450 €/m³.g³</td>
<td>12 300 000 €</td>
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2. Building-orientated methods

Example: two –factors method based on cost breakdown structure

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<tr>
<td>Price validity: November 2002</td>
<td>Gross price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building: 300 + 400 cost groups</td>
<td>100 %</td>
<td>11 450 000 €</td>
<td></td>
</tr>
<tr>
<td>200 Structural facilities</td>
<td>5 %</td>
<td>572 500 €</td>
<td></td>
</tr>
<tr>
<td>300 Building – construction</td>
<td>15 %</td>
<td>9 150 000 €</td>
<td></td>
</tr>
<tr>
<td>400 Building – installation</td>
<td>20 %</td>
<td>2 290 000 €</td>
<td></td>
</tr>
<tr>
<td>950 Outdoor construction and installation</td>
<td>10 %</td>
<td>1 145 000 €</td>
<td></td>
</tr>
<tr>
<td>400 Furniture and artworks</td>
<td>10 %</td>
<td>220 000 €</td>
<td></td>
</tr>
<tr>
<td>700 Additional expenses</td>
<td>18 %</td>
<td>2 061 000 €</td>
<td></td>
</tr>
</tbody>
</table>

Total cost: 12 300 000 € (without the group 100 (Net price or value))
2. Building-orientated methods

The shape of the buildings can be described with the main building units.
3. Realization-orientated methods

<table>
<thead>
<tr>
<th>PROJECT STAGES</th>
<th>EXISTING DOCUMENTS, COST</th>
<th>COST ESTIMATING AND CALCULATING METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DEFINITION</td>
<td>LIST OF ROOMS, FUNCTIONS, REQUIREMENTS</td>
<td>BUDGET based on function unit based on useful basic area based on room-categories ‘tie relations methods’</td>
</tr>
<tr>
<td>2. PLANNING, PRELIMINARY DESIGN</td>
<td>BUILD-UP IDEAS, SKETCHES, FINAL PRELIMINARY DESIGN</td>
<td>COST ESTIMATION based on surface model</td>
</tr>
<tr>
<td>3. DESIGN AND BIDDING PERMIT</td>
<td>CONSTRUCTIONS, MATERIALS, DETAIL, DESCRIPTIONS</td>
<td>COST ESTIMATION by distribution to building construction units</td>
</tr>
<tr>
<td>4. DESIGN - FINAL CONSTRUCTION DRAWING</td>
<td>DETAILS, FINAL SOLUTIONS</td>
<td>COST ESTIMATION method based on specifications</td>
</tr>
<tr>
<td>5. COMPETITION PUBLIC PROCUREMENT</td>
<td>SPECIFICATIONS, CONTRACTOR BIDDINGS</td>
<td>COST ESTIMATION by distribution to work types</td>
</tr>
<tr>
<td>6. CONSTRUCTION AND SUPERVISION</td>
<td>BILLS, DATA REALISED</td>
<td>COST CONTROL based on MPR</td>
</tr>
<tr>
<td>7. DOCUMENTATION</td>
<td>UPDATING COST DOCUMENTATION</td>
<td></td>
</tr>
</tbody>
</table>

1st phase: Cost estimation
- It is important to keep the participants of the investment in intensive connection
- Have to determine the target planned
- Have to make the designs
- Have to organise competition for the constaction

Cost estimation always must be synchronised with the design.

2nd phase: Comparison the actual costs with the budget
- The costs as they actually occur are continuously compared with the budget.
- Cost reports are prepared at regular time intervals (making it possible for the owner to determine the cost status of the project)
- Information in proper time is required if effective action against cost overruns is to be taken.
3rd phase: Feedback

- Significant differences lead to change of the designs.
- Management consideration is quickly focused on those job areas that need attention.
- Prefering the alternative biddings at the competition is suggested.

Criteria

- Using such a cost estimating method, that we can use in each project stages.
- Data could be transported to one project phase to the other.
- Systematic Work Breakdown Structure of the costs.
- Use of project cost code.
- Documentation of cost data of buildings accomplished.
- Use of Building Cost Documentation with data of analyzed method.
- Treatment of costs: both direction among the project phases.

thank you very much for your attention.

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