Fundamentals of Capital Cost Estimating
A TCM approach

Lou Vidotto
Managing Director of Vidotto Group
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Background

• Lou Vidotto;
• Over 35 years of project and study experience;
• Site engineer – Contractor;
• Project Controls engineer and manager:
  – EPCM’s and Owners teams.
• Business owner;
• Project Developer.
Background

• Major resource projects – Australia and International
  – Alumina and Aluminium;
  – Copper, Gold and base metals;
  – Coal;

• Reviews and Audits;

• Training and project controls education;
Introduction

• We have been running training courses for over 2 years;

• We are finding a common theme on projects and studies:
  − Lack of training and mentoring;
  − Inexperienced Managers and Personnel;
  − Poor Project Controls;
  − **Inadequate baselines**;
  − Failure to Manage Change;
  − Project processes are not in place or supported to facilitate good project controls.
How the Owner explained it  How the project leader understood it  How the project leader scoped it out  The estimators view  What the team wanted to build

Backup documentation  What was procured  What construction built  What the Owner really needed
Introduction

• Tonight, I would like to briefly discuss the importance of the estimating function:
  – TCM context;
  – Planning estimates;
  – Capturing the scope;
  – Delivering the results.

QUESTIONS ARE WELCOME
Total Cost Management

• AACEi:
  – “A systematic approach to managing cost throughout the life cycle of any enterprise, program, facility, project, product or service”
  – “This is accomplished through the application of cost engineering and cost management principles, proven methodologies and the latest technology in support of the management process”
Total Cost Management

• What does this mean?
  – A systematic approach to management of costs on a project, from concept to production;
  – Everything relates to costs and management of assets;
  – **Achieving the results that were planned for.**

• My view
  – Do the basics right
Total Cost Management

• 4 pillars of a project:
  – Scope definition  What is being built?
  – Execution plan  How it is going to be built?
  – Estimate  How much will it cost?
  – Schedule  How long will it take?
Total Cost Management

• Estimating is a key component of the TCM process.
  – Snapshot of costs at a point in time to reflect where the study or project stands at that level of definition;
  – Snapshot of the status of the 4 pillars;
  – Quantities, resources, costs.
• Same principles for any type of project
• Project controls professionals input is vital at every step.
Types of Estimates

- **Prefeasibility**
  - Many options/capacities to achieve the business case,
  - One selected.

- **Feasibility**
  - One studied,
  - One recommended,
  - If not then recycle.

- **Financial Closure**

- **Execution Phase**
  - One Built.
  - Project Closeout.

- **Concept Studies**
  - Business Case,
  - Development Strategy,
  - Defined by the Owner relating to how they want to setup/run their business.

**PROJECT LIFE CYCLES**

**Operations**
## Types of Estimates

<table>
<thead>
<tr>
<th></th>
<th>Estimating</th>
<th>Cost Engineering</th>
<th>Planning/Scheduling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept Studies</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Prefeasibility Studies</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>Feasibility Studies</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Project Execution</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>Project Closeout</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
# Types of Estimates

AACEi define the classes of estimates and the level of effort required to produce an estimate.

<table>
<thead>
<tr>
<th>ESTIMATE CLASS</th>
<th>MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition</th>
<th>END USAGE Typical purpose of estimate</th>
<th>METHODOLOGY Typical estimating method</th>
<th>EXPECTED ACCURACY RANGE Typical variation in low and high ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 5</td>
<td>0% to 2%</td>
<td>Concept screening</td>
<td>Capacity factored, parametric models, judgment, or analogy</td>
<td>L: -20% to -50% H: +30% to +100%</td>
</tr>
<tr>
<td>Class 4</td>
<td>1% to 15%</td>
<td>Study or feasibility</td>
<td>Equipment factored or parametric models</td>
<td>L: -15% to -30% H: +20% to +50%</td>
</tr>
<tr>
<td>Class 3</td>
<td>10% to 40%</td>
<td>Budget authorization or control</td>
<td>Semi-detailed unit costs with assembly level line items</td>
<td>L: -10% to -20% H: +10% to +30%</td>
</tr>
<tr>
<td>Class 2</td>
<td>30% to 75%</td>
<td>Control or bid/tender</td>
<td>Detailed unit cost with forced detailed take-off</td>
<td>L: -5% to -15% H: +5% to +20%</td>
</tr>
<tr>
<td>Class 1</td>
<td>65% to 100%</td>
<td>Check estimate or bid/tender</td>
<td>Detailed unit cost with detailed take-off</td>
<td>L: -3% to -10% H: +3% to +15%</td>
</tr>
</tbody>
</table>

Table 1 – Cost Estimate Classification Matrix for Process Industries
Work Breakdown Structure

The key to tying together the 4 pillars of the project is the WBS:

• The need to capture all the elements of a project in an organised fashion;
• Breaking down large, complex projects into smaller project pieces provides a better framework for organising and managing the project;
• WBS can facilitate resource allocation, task assignment, responsibilities, measurement and control of the project.

Reference: Tenrox Project Management Services
Area/Facility Codes

- Convention will follow the following breakdown:

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>facility</td>
<td>sub facility</td>
</tr>
<tr>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>1000</td>
<td>1100</td>
<td>1120</td>
</tr>
</tbody>
</table>

Direct Costs
- 1000 Mining
- 2000 Process plant
- 3000 Onsite Infrastructure
- 4000 Offsite infrastructure

Common Distrib
- 5000 Temporary Facilities
- 6000 Construction support

Indirects
- 7000 EPCM
- 8000 Owners cost
- 9000 Contingency, escalation etc
### Commodity Codes

- Convention will follow the following breakdown:

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<thead>
<tr>
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<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>A</td>
<td>AA</td>
<td>AAA</td>
</tr>
</tbody>
</table>

**DIRECT COST**

- A Site Development
- B Earthwork
- C Concrete
- D Steel
- E Architecture & Buildings
- F Mechanical Bulks
- G Mechanical Equipment
- H Pipe
- I Electrical Equipment
- J Electrical Bulk
- K Instrumentation and Control
- L Mobile Equipment

**INDIRECT COST**

- V Common Distributions
- X EPCM
- Y Operating Cost
- Z Contingency and Escalation
Estimate structure

• Directs
  – The facilities that will be left in place when the project is complete

• Common Distributables
  – Temporary Facilities;
  – Construction Support;
  – The facilities required to support the construction of the directs.

• Management costs
  – The costs required to engineer, procure and project manage the project.

• Owners costs
  – Owners costs related to support of the project.

• Indirect costs
  – Escalation;
  – Contingency;
  – Foreign exchange provisions.
Estimate structure

• Quantities
  – The neat line measure of the quantities;
  – Commodity code structure and UOM.

• Installation workhours
  – How long it will take to install the quantity in the field.

• Labour Cost
  – The cost of the installation hours.

• Material costs
  – The cost of the materials required to build the quantity.

• Equipment cost
  – The cost of the equipment defined by the quantity.

• Contractors distributable costs
  – The indirect and overhead cost required to install the quantity;
  – Labour, materials, equipment.
Estimate structure

• At every level the estimate is a reflection of:
  – Scope;
  – Contracting strategy.
  – Duration
  – Scoping estimates all the way to a Lump Sum bid
  – The estimate must have a basis!

QUANTITIES BUILD PROJECTS

– An incorrect estimate has the power to sink companies
<table>
<thead>
<tr>
<th>Project X</th>
<th>New Raw Water pump station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate item</td>
<td></td>
</tr>
<tr>
<td>Project Phase</td>
<td>Item Description</td>
</tr>
<tr>
<td>Facility</td>
<td></td>
</tr>
<tr>
<td>Commodity</td>
<td></td>
</tr>
<tr>
<td>Item number</td>
<td></td>
</tr>
<tr>
<td>Quantity</td>
<td></td>
</tr>
<tr>
<td>Freight unit tonnes</td>
<td></td>
</tr>
<tr>
<td>freight tonnes</td>
<td></td>
</tr>
<tr>
<td>Unit mhrs</td>
<td></td>
</tr>
<tr>
<td>Labour rate</td>
<td></td>
</tr>
<tr>
<td>Contractor</td>
<td></td>
</tr>
<tr>
<td>Distribs rate</td>
<td></td>
</tr>
<tr>
<td>Materials rate</td>
<td></td>
</tr>
<tr>
<td>Equipment rate</td>
<td></td>
</tr>
<tr>
<td>Vendor reps</td>
<td></td>
</tr>
<tr>
<td>Unit freight rate</td>
<td></td>
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<tr>
<td>Subcontract rate</td>
<td></td>
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<tr>
<td>Total estimate rate</td>
<td></td>
</tr>
<tr>
<td>Workhours</td>
<td></td>
</tr>
<tr>
<td>Labour cost</td>
<td></td>
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<tr>
<td>Contractor</td>
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<td>Subcontract cost</td>
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<tr>
<td>Estimate cost</td>
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<tr>
<td>Install package</td>
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<tr>
<td>Supply package</td>
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<tr>
<td>VR package</td>
<td></td>
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<tr>
<td>Freight package</td>
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<tr>
<td>Subcontract package</td>
<td></td>
</tr>
</tbody>
</table>
Estimate Plan

• In order to successfully build an estimate, the estimator must build:
  – The Estimate Plan;
  – What and Why?
Estimate Plan

• The plan will be dependent on the phase of the project
  – How the estimate will be carried out;
  – Where the input will come from and in what format;
  – Quality of the input required.

• Will set out the expectations for the outcome and define the strategy to achieve that expectation.
Estimate Plan

• Define what is to be achieved:
  – Prefeasibility study?
  – Feasibility Study?
  – Definitive estimate?
  – Lump Sum;
  – LSTK;
  – Not to exceed;
  – Performance incentive.

• Each estimate has an expected range to fall into?
Estimate Plan

• Define how it is to be achieved:
  – Estimate input packs (EIP)
  – Pricing plan
  – Labour and installation plan
  – Execution plan
  – Schedule
  – Is the project cost or schedule sensitive
  – Who will do the estimating
Build the Estimate

How do you eat an elephant?
Build the Estimate

One bite at a time:

• If you dissect an elephant into 3D cubes, you end up with:
  – A series of cubes that on their own don’t mean much;
  – All joined together form a complete picture
Build the Estimate

An estimate is a snapshot of the project at any particular point in time:

- During early phases the cubes are larger and don’t give great clarity;
- As the definition progresses the cubes are more refined and defines a better quality picture of the elephant;
- The format doesn’t change, the cubes get smaller and increase in clarity.
Build the Estimate
Build the Estimate

- To build an estimate you must capture
  - the scope – quantities;
  - the contracting and purchasing plan;
  - the execution strategy;
  - the temporary facilities and construction support;
  - the indirects.
  - what is not included and qualifications
  - Engineers own the scope
  - Estimators own the cost
Build the Estimate

• Build the estimate in a way that can be reviewed;

• The team owns the estimate

• Get the QUANTITIES right:
  – Units of measure;
  – QUANTITIES BUILD PROJECTS.
Build the estimate

• Summary of the estimate output;
• Area and facility summaries;
• Quantity summaries;
• Labour summaries
• Material and equipment summaries;
• Contracting package summaries;
• Qualifications and exclusions.
Customers

- Who are really the customers of the estimate?
  - The Board;
  - Investors;
    - Independent reviewers;
  - The project management team;
  - The engineers
  - The planners;
  - The cost engineers.
  - The financial modellers
Customers

• Transparency and understanding is the key;
• The project team needs an estimate that can be used as a budget and used to control the project against. – Baseline
• Build the Estimate the way the project will be managed.
Building the Budget

• The study has been approved;
• The 4 pillars need to be in place:
  – Scope book;
  – Project Execution Plan:
    – Engineering plan;
    – Contracting plan;
    – Purchasing plan.
  – Estimate;
  – Schedule.
Building the Budget

Basis:

• Convert the approved estimate into the budget;
• Grouped by:
  – WBS and Budget code
• Grouped by responsible entity;
• Grouped by work package;
• It is imperative that cost engineers were involved in the estimating phase. They inherit the estimate.
Conclusion

• The estimating function is a key aspect of the TCM philosophy
• The estimate defines the “How much”
  – Quantities
  – Resources
  – Costs
  – Difficulty
Questions?