Target Value Design Simulation

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Learning Objectives

→ Understand and apply the basic elements of Target Value Design
How can we make BETTER QUALITY buildings FINANCIALLY FEASIBLE?
Target Value Design
Materials required for simulation (Munakami 2012)
Simulation built on *Marshmallow Challenge* by Peter Skillman…

**Round One:**

- Each team makes a tower that is 2 ft. tall with a marshmallow on top.
- No more than 2 in. out of plumb
- Freestanding (not attached to the table)
How much did each team’s tower cost?
Teams report their quantities to facilitator in charge of overall spreadsheet.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit cost</th>
<th>Number of units</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spaghetti sticks</td>
<td>$1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coffee stirrers</td>
<td>$5.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking straws</td>
<td>$2.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bamboo skewers</td>
<td>$3.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masking tape (per joint)</td>
<td>$0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit (10%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Market Cost:** Into a spreadsheet, facilitator inputs the cost of each tower, and adds 10% profit. The average is the Market Cost.

**Allowable Cost:** Facilitator takes the Market Cost and reduces it by 20%. This is the MUST HAVE cost that must be met in order for the project to proceed. Otherwise it will be cancelled.

**Target Cost:** Each team declares a Target Cost “stretch goal.” This is the NICE TO HAVE cost. It is nice to have though not critical for the project to proceed.
Round Two:

• Teams make a tower that is 2 ft. tall with a marshmallow on top.
• No more than 2 in. out of plumb
• Freestanding (not attached to the table)
• Teams MUST meet Allowable Cost but should also aim for the Target Cost, if possible.
Which team met all the criteria at the lowest cost?
Some examples of past results
### ROUND I: Establish Market Cost, Allowable Cost, and Target Cost

<table>
<thead>
<tr>
<th></th>
<th>TEAM A</th>
<th>TEAM B</th>
<th>TEAM C</th>
<th>TEAM D</th>
<th>TEAM E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spaghetti sticks</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$1.00</td>
</tr>
<tr>
<td>Coffee Stirrers</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$5.00</td>
</tr>
<tr>
<td>Drinking straws</td>
<td>$2.00</td>
<td>$2.00</td>
<td>$2.00</td>
<td>$2.00</td>
<td>$2.00</td>
</tr>
<tr>
<td>Bamboo skewers</td>
<td>$3.00</td>
<td>$3.00</td>
<td>$3.00</td>
<td>$3.00</td>
<td>$3.00</td>
</tr>
<tr>
<td>Masking tape</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
</tr>
<tr>
<td><strong>No. of units</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spaghetti sticks</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Coffee Stirrers</td>
<td>21</td>
<td>1</td>
<td>11</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Drinking straws</td>
<td>30</td>
<td>12</td>
<td>5</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>Bamboo skewers</td>
<td>16</td>
<td>15</td>
<td>2</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Masking tape</td>
<td>17</td>
<td>9</td>
<td>3</td>
<td>8</td>
<td>8</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>$224.50</td>
<td>$84.50</td>
<td>$81.50</td>
<td>$116.00</td>
<td>$32.00</td>
</tr>
<tr>
<td><strong>Profit (10%)</strong></td>
<td>$22.45</td>
<td>$8.45</td>
<td>$8.15</td>
<td>$11.60</td>
<td>$3.20</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$246.95</td>
<td>$92.95</td>
<td>$89.65</td>
<td>$127.60</td>
<td>$101.20</td>
</tr>
</tbody>
</table>

### Establish Target Cost

- **Market Cost** (average of all towers): $131.67
- **Allowable Cost** (20% lower than Market cost): $105.34
- Teams Declare **Target Cost preferences**:
  - TEAM A: 94.31
  - TEAM B: 80
  - TEAM C: 85
  - TEAM D: 70
  - TEAM E: 85

**TARGET COST**: 82.86 (average of all declared TCs)

### ROUND 2: Design to Target Cost

<table>
<thead>
<tr>
<th></th>
<th>TEAM A</th>
<th>TEAM B</th>
<th>TEAM C</th>
<th>TEAM D</th>
<th>TEAM E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spaghetti sticks</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$1.00</td>
</tr>
<tr>
<td>Coffee Stirrers</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$5.00</td>
</tr>
<tr>
<td>Drinking straws</td>
<td>$2.00</td>
<td>$2.00</td>
<td>$2.00</td>
<td>$2.00</td>
<td>$2.00</td>
</tr>
<tr>
<td>Bamboo skewers</td>
<td>$3.00</td>
<td>$3.00</td>
<td>$3.00</td>
<td>$3.00</td>
<td>$3.00</td>
</tr>
<tr>
<td>Masking tape</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
</tr>
<tr>
<td><strong>No. of units</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spaghetti sticks</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Coffee Stirrers</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Drinking straws</td>
<td>3</td>
<td>12</td>
<td>3</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Bamboo skewers</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Masking tape</td>
<td>13</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$40.50</td>
<td>$55.00</td>
<td>$55.00</td>
<td>$38.00</td>
<td>$42.00</td>
</tr>
<tr>
<td><strong>Profit (10%)</strong></td>
<td>$4.05</td>
<td>$5.50</td>
<td>$5.50</td>
<td>$3.80</td>
<td>$4.20</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$44.55</td>
<td>$60.50</td>
<td>$61.05</td>
<td>$41.80</td>
<td>$46.20</td>
</tr>
</tbody>
</table>

Spreadsheet for tabulation of tower costs after Rounds I and II.
Round Two: Once target cost was established, teams co-located and worked collaboratively to re-design the tower to meet target cost (Munankami 2012).
An Owner wants to design and build a tower that is 2'-0" tall which is capable of holding a marshmallow at the top and that is no more than 2" out-of-plumb. The tower must be constructed with supplied materials and must be free-standing (i.e., cannot be taped to a table). Participants have 20 minutes to construct a tower without concern for cost (Round 1), and 20 minutes to construct another tower that is 25% less than the average of first tower costs (Round 2).
Concepts associated with

**Target Value Design:**

- Big Room meetings
- Market cost
- Allowable cost
- Target Cost
- Co-location
- A3s
- Set-based Design
- Uniformat estimating
- Choosing by Advantages (CBA) system of decision-making
- Optimization of the whole over the parts
- Relational and Risk-sharing contracts (IFOA, Consensus Docs, etc.)
- Systems Optimization over sub-optimization
<table>
<thead>
<tr>
<th></th>
<th>St. Olaf Fieldhouse</th>
<th>Carleton College Recreation Ctr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion Date</td>
<td>August 2002</td>
<td>April 2000</td>
</tr>
<tr>
<td>Project Duration</td>
<td>14 months</td>
<td>24 months</td>
</tr>
<tr>
<td>Gross Square Feet</td>
<td>114,000</td>
<td>85,414</td>
</tr>
<tr>
<td>Total Cost (incl. A/E &amp;</td>
<td>$11,716,836</td>
<td>$13,533,179</td>
</tr>
<tr>
<td>CM fees )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per square foot</td>
<td>$102.79</td>
<td>$158.44</td>
</tr>
</tbody>
</table>

Comparison of two similar projects using different project delivery systems.

Impact

“Target Value Design is a management practice that drives design to deliver customer value, and develops design within project constraints.”.


Metrics of success

- time
- cost
- quality
- safety

Photo source: http://c12solutions.com/blog1/sustainability-green-business-models-fdu/
market time

target time

TIME ∆
target needs

QUALITY △
Target Value design finds its historical foundation in Target Costing.
What is Target Costing?

Costing terms associated with TVD

The MacLeamy Curve

1. Ability to impact cost and function
2. Cost of design changes
3. Traditional Design-Bid-Build process
4. Integrated Project Delivery Process

Integrated Project Delivery

Travel path of an RFI in traditional (left) versus Lean (right) project delivery

From Clifton et al., Target Costing: Market-Driven Product Design, figure 5.2, p. 73

The role of cost sharing

### The importance of flexible cost boundaries

Adapted from Clifton et al, *Target Costing: Market-Driven Product Design*, figure 5.2, p. 73

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Market Cost</th>
<th>Allowable Cost</th>
<th>Cost Reduction Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsystem 1</td>
<td>100</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>Subsystem 2</td>
<td>80</td>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td>Subsystem 3</td>
<td>60</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>Subsystem 4</td>
<td>40</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>Subsystem 5</td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Subsystem 6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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TVD Early experimental results: Sutter Fairfield (CA)

Sutter Health: California Pacific Medical Center (850,000 SF; 550 beds)

Cathedral Hill Hospital (San Francisco, CA)

California Pacific Medical Center is committed to a vision of healthcare for our community that will encompass a new state of the art facility and programs that will fulfill our mission of clinical excellence, education, and research. The patient and family experience comes first.

- Patient-focused care
- Private patient rooms
- Accessibility and ease of way-finding
- Comfortable and varied environments
- Healing environments with natural light
- Visitor hospitality lounges on each floor
- Private medical consulting rooms
- Pleasant dining areas
- Awareness of diversity of cultures
- Parking convenience
- Efficient intercampus transfer and mobility
- One stop registration for all OP [operations]
- Easy access to emergency services
- A design that focuses on the patient
- Physician and staff friendly
- Sustainable
- Cost efficient and constructible

TVD Case Study: Sutter Health’s Cathedral Hill Hospital

Integrated Project Delivery: Co-location

Meetings at Cathedral Hill

Lean-IPD contractual motivators

Pain sharing:
Incentive plan to meet Allowable Cost

Gain sharing:
Incentive plan to reach below Allowable Cost

Pain Sharing

Gain Sharing

Target Value Design
Target Value Design
Lean Project Delivery

- Increasing the relatedness of members of the design and construction team (the “Integrated Project Delivery Team” or “IPD Team”);
- Collaborating throughout design and construction with all members of the IPD Team;
- Planning and managing the Project as a network of commitments;
- Optimizing the Project as a whole, rather than any particular piece;
- Tightly coupling learning with action - Promoting continuous improvement throughout the life of the Project (Kaizen)
Target Value Design
Lean Training

Introduction: Lean History, Concepts & Methods

Basic Training
- Value Stream Mapping
- 5S
- Reliable Promising
- Learning from Experiments & Breakdowns
- Choosing by Advantages
- A3 Reports

Lean Project Delivery
- Last Planner Process
- Target Value Design
- Design Management
- Supply Chain Management
- Design of Construction Operations

Lean Management for Supervisors
- Leader Standard Work
- Daily Accountability Process
- Visual Controls
- Developing People
- Leading Change
- Problem Solving and Process Improvement
- Change Management System
Full-scale cardboard mock-up and testing week during TVD: Akron Children’s Hospital.

(Image source: Bernita Beikman, HKS, with permission, 2013)
Target Value Design of Sutter Health’s Cathedral Hill

Tesmer Diagram

Overcoming initial skepticism

### Cost performance on some typical construction projects

Problematic construction projects (adapted from Forbes and Ahmed 2011, p. 57)

<table>
<thead>
<tr>
<th>Name of Project</th>
<th>Budgeted cost ($ millions)</th>
<th>Final Cost ($ millions)</th>
<th>Growth of cost (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanford Nuclear Facility (2001)</td>
<td>715</td>
<td>1,600</td>
<td>120</td>
</tr>
<tr>
<td>Capitol Hill Visitor Center (2008)</td>
<td>265</td>
<td>621</td>
<td>134</td>
</tr>
<tr>
<td>Denver Airport (1995)</td>
<td>1,700</td>
<td>4,800</td>
<td>180</td>
</tr>
<tr>
<td>Boston Big Dig (2005)</td>
<td>2,600</td>
<td>14,600</td>
<td>460</td>
</tr>
</tbody>
</table>

### Cost performance on construction projects using TVD

Examples of cost results following Target Value Design exercises on reduction of capital cost (Glenn Ballard, personal communication, 2012)

<table>
<thead>
<tr>
<th>Name of Project</th>
<th>Market cost ($ millions)</th>
<th>Final Cost ($ millions)</th>
<th>Reduction of cost (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project A</td>
<td>98,000,000</td>
<td>89,200,000</td>
<td>9.0</td>
</tr>
<tr>
<td>(368,882 SF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project B</td>
<td>13,533,179</td>
<td>11,717,000</td>
<td>13.4</td>
</tr>
<tr>
<td>(114,000 SF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project C</td>
<td>13,600,000</td>
<td>11,200,000</td>
<td>17.6</td>
</tr>
<tr>
<td>(75,362 SF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project D:</td>
<td>22,000,000</td>
<td>17,900,000</td>
<td>18.6</td>
</tr>
<tr>
<td>(230,000 SF)</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Cost performance comparing traditional versus TVD case studies

<table>
<thead>
<tr>
<th>City</th>
<th>Platinum*</th>
<th>Gold*</th>
<th>Silver*</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCSB</td>
<td>7.8 %</td>
<td>2.7 %</td>
<td>1.0 %</td>
</tr>
<tr>
<td>San Francisco</td>
<td>7.8 %</td>
<td>2.7 %</td>
<td>1.0 %</td>
</tr>
<tr>
<td>Merced</td>
<td>10.3 %</td>
<td>5.3 %</td>
<td>3.7 %</td>
</tr>
<tr>
<td>Denver</td>
<td>7.6 %</td>
<td>2.8 %</td>
<td>1.2 %</td>
</tr>
<tr>
<td>Boston</td>
<td>8.8 %</td>
<td>4.2 %</td>
<td>2.6 %</td>
</tr>
<tr>
<td>Houston</td>
<td>9.1 %</td>
<td>6.3 %</td>
<td>1.7 %</td>
</tr>
</tbody>
</table>

Costs as percentage of starting budget; required to meet specified level of LEED.

How might TVD help reduce the first cost premium of green?

Must green design cost more? Even before TVD was developed, it appears that green projects designed in an integrated fashion, with early involvement of stakeholders, did not necessarily cost more. Now imagine what TVD can do!

Overcoming the cost premium of green buildings

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