Project Risk Management, Cost Estimating, and Value Engineering

BY CHARLES NICKEL, P.E.
LA. DOTD COST ESTIMATOR & VALUE ENGINEERING DIRECTOR

- Risk impacts every aspect of project development which includes:
  - Cost Estimating
  - Value Engineering
- A Cost Estimate is more than just a number – Don’t let it deceive you.
- Value Engineering is more than just about saving money.
- Risk Management is more than just about identifying threats.
What is an Estimate?
(www.merriam-webster.com)

Simple Definition:

- A **guess** that you make based on the information you have about the size, amount, etc., of something.

- A statement **about** how much a job will cost.

- An **opinion** or **judgment** about how good or bad something is.
PIDOMA
Method of Estimating
PIDOMA

Is the acronym for:

Pulled It Directly Out of Mid Air
What makes a good Estimate?

- A **good understanding** of the **cost driving relationships**.

- **Risk** is **uncertainty** associated with these cost driving relationships.

- **Risk** can be a **cost driving relationship** itself.

- **Effective project cost management** relies on **identifying** and **pro-actively managing** these relationships.
Known Unknowns

Stealth Bomber
Example Risks to Project Costs

Uncertainties associated with,

- Market Conditions
- Funding Availability
- New Technologies
- Accessibility

- Field Conditions
- Competition
- Quantities
- Etc…
Unknown Unknowns

I need a budget estimate for my project, but I don't have a scope or a design for it yet.

Okay, my estimate is $3,583,729.

You don't know anything about my project. That makes two of us.
Item Bid History Spreadsheet Application (From the Internet)
Spreadsheet Applications

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Find forms and publications and learn what's new at DOTD.

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Engineering
Management & Finance
Multimodal Planning
Operations
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Traffic Cameras

Emergency Information

Travel Information

Projects in My Area

DOTD
Louisiana Department of Transportation & Development
Spreadsheet Applications

Project Management
Spreadsheet Applications

Cost Estimating Tools
Value Engineering (VE)
- About Value Engineering
- Projects Requiring a VE
- Tools and Information
- VE Links
Downloads
- Electronic Standards for Plans
- Standard Plans
- Standard Specifications
Manuals
- Project Delivery Manual
- Stage 0 - Manual of Standard Practices
- Stage 1 - Manual of Standard Practice
- Transportation Alternatives Program
- TAP Announcements
- TAP Links
Links
- DOTD Only

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Project Management

This site will provide you with information on our mission and section contacts. Downloads and Links are provided for project and plan development and design related web sites.

Mission Statement:

The mission of the Project Management Section is to institutionalize a culture and governing resource to manage DOTD projects in such a manner as to maximize efficiency, value, and quality while minimizing their associated costs and risks.

Location Information

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1201 Capitol Access Rd.
Baton Rouge, LA 70802

Mailing Address: P.O. Box 94245
Baton Rouge, LA 70804-9245

Phone Number: (225) 379-1325
Fax Number: (225) 379-1501

Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RONALD JOHN BROADBENT</td>
<td>225-379-1727</td>
<td>System Preservation Engineering</td>
</tr>
<tr>
<td>JEFFREY MICHAEL BURST</td>
<td>225-379-1356</td>
<td>Project Management Director</td>
</tr>
<tr>
<td>BLAKE J. COFFEE</td>
<td>225-379-1550</td>
<td>Engineer Technician</td>
</tr>
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### DOTD Cost Estimating Tools

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2015 Superpave Asphaltic Concrete Cost (Unit Price verses Quantity)

$900 Variance in Cost
Effects of Competition on Bids

Number of Bidders versus Bid Percent of Estimate
January 9, 2013 to December 10, 2014
For Projects > $500,000

Percent of Estimate

Number of Bidders

Average Percent of Estimate
Log (Average Percent of Estimate)
2015 Superpave Asphaltic Concrete Cost (Unit Price verses Quantity)

- Projects with 3 or more bidders.
- Only the low bidder and 2nd low bidder.
2015 Superpave Asphaltic Concrete Cost (Unit Price verses Quantity)

- Projects with 3 or more bidders.
- Only the low bidder and 2nd low bidder.
- Quantities between 10,000 and 20,000 Tons.
2015 Superpave Asphaltic Concrete Cost (Unit Price verses Quantity)

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- Only the low bidder and 2nd low bidder.
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2015 Superpave Asphaltic Concrete Cost (Unit Price verses Quantity)

What is the Unit Price for 15,000 Tons?

About $35 Variation

- Projects with 3 or more bidders.
- Only the low bidder and 2nd low bidder.
- Quantities between 10,000 and 20,000 Tons.
The Number **Will** Deceive You

A single number for an estimate could insinuate false expectations.
Deterministic verses Probabilistic

- Assuming the estimated cost for a project is an average, then there is a 50% probability of exceeding the estimated cost.
Monte Carlo Simulations?

- Monte Carlo Simulation: A technique of multiple trial runs of random values that incorporate the underlying variability of individual elements to jointly determine a range of potential outcomes for a single output (i.e., project cost) by compiling all of the trial statistics.
Monte Carlo Simulations?

Major Item 1

Major Item 2

Risk Element 1
Monte Carlo Simulations

For this example project, out of 45 items only 9 major items accounted for over 80% of the cost of the project.

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Units</th>
<th>Quantity</th>
<th>Minimum</th>
<th>Most Likely</th>
<th>Maximum</th>
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<tbody>
<tr>
<td>Removal of Permanant Concrete Median Barrier</td>
<td>LNFT</td>
<td>1894</td>
<td>$0.50</td>
<td>$3.50</td>
<td>$10.00</td>
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<tr>
<td>Temporary Precast Concrete Barrier (Contractor Furnished)</td>
<td>EACH</td>
<td>383</td>
<td>$440.00</td>
<td>$630.00</td>
<td>$975.00</td>
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<td>Concrete Roadway Barrier (Double Faced)</td>
<td>LNFT</td>
<td>1894</td>
<td>$235.00</td>
<td>$250.00</td>
<td>$300.00</td>
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<tr>
<td>Removal of Portland Cement Concrete Pavement</td>
<td>SQYD</td>
<td>19857</td>
<td>$5.00</td>
<td>$9.00</td>
<td>$15.00</td>
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<tr>
<td>Portland Cement Concrete Shoulder (13” Thick)</td>
<td>SQYD</td>
<td>7948</td>
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<td>$80.00</td>
<td>$115.00</td>
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<td>Portland Cement Concrete Pavement (13” Thick)</td>
<td>SQYD</td>
<td>12370</td>
<td>$65.00</td>
<td>$75.00</td>
<td>$110.00</td>
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</table>

Percent of Total Construction Cost

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Minimum</th>
<th>Most Likely</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Layout</td>
<td>0.45%</td>
<td>1.19%</td>
<td>1.65%</td>
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<tr>
<td>Temporary Signs and Barricades</td>
<td>0.35%</td>
<td>1.13%</td>
<td>3.22%</td>
</tr>
<tr>
<td>Mobilization</td>
<td>4.12%</td>
<td>9.94%</td>
<td>12.00%</td>
</tr>
<tr>
<td>Low Competition</td>
<td>-10.00%</td>
<td>5.00%</td>
<td>20.00%</td>
</tr>
</tbody>
</table>
Monte Carlo Simulations

Assuming Low Competition as a Risk:

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Cost</th>
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<tbody>
<tr>
<td>5%</td>
<td>$3,496,180.35</td>
</tr>
<tr>
<td>10%</td>
<td>$3,583,385.74</td>
</tr>
<tr>
<td>15%</td>
<td>$3,651,097.82</td>
</tr>
<tr>
<td>20%</td>
<td>$3,709,068.07</td>
</tr>
<tr>
<td>25%</td>
<td>$3,760,832.30</td>
</tr>
<tr>
<td>30%</td>
<td>$3,804,737.42</td>
</tr>
<tr>
<td>35%</td>
<td>$3,846,809.39</td>
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<tr>
<td>40%</td>
<td>$3,889,796.33</td>
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<tr>
<td>45%</td>
<td>$3,929,970.77</td>
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<tr>
<td>50%</td>
<td>$3,973,385.74</td>
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<tr>
<td>55%</td>
<td>$4,013,038.47</td>
</tr>
<tr>
<td>60%</td>
<td>$4,057,160.32</td>
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<tr>
<td>65%</td>
<td>$4,105,656.09</td>
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<tr>
<td>70%</td>
<td>$4,158,165.39</td>
</tr>
<tr>
<td>75%</td>
<td>$4,209,504.90</td>
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<tr>
<td>80%</td>
<td>$4,267,913.77</td>
</tr>
<tr>
<td>85%</td>
<td>$4,336,787.70</td>
</tr>
<tr>
<td>90%</td>
<td>$4,429,680.39</td>
</tr>
<tr>
<td>95%</td>
<td>$4,551,708.34</td>
</tr>
<tr>
<td>100%</td>
<td>$5,320,418.03</td>
</tr>
</tbody>
</table>
Simulation verses Actual Low Bid

- With normal competition, the 70\textsuperscript{th} percentile cost was $3,826,850.67.
- With low competition, the 70\textsuperscript{th} percentile cost was $4,158,165.39.
- Five contractors bid with the low bid at $3,606,362.98.
- About 6.1\% below model for normal competition.
- About 13.3\% below the model for low competition.
- May should have reviewed competition a little closer.
Risk Management & Value Engineering
Value Engineering (VE):
(Code of Federal Regulations, Title 48)

Value engineering means an analysis of the functions of a program, project, system, product, item of equipment, building, facility, service, or supply of an executive agency, performed by qualified agency or contractor personnel, directed at improving performance, reliability, quality, safety, and life-cycle costs.
LADOTD VE Process

- Pre-Study Activities (1 to 2 months)
- Value Engineering Study (Usually 5 days)
- Post Study Activities (2 months)
Pre-Study Activities

- Get Plans, Project Description, Environmental Documents, Cost Estimate, Contacts, etc.
- Determine a “Plan of Attack”
- Request Task Order
- Determine Team Composition
- Schedule Time and Place for Study
Value Engineering Study

- Kick-off meeting with the Project Manager and key project personnel.
- Site-Visit
- Function Analysis
- Brainstorming
- Evaluation
- Development
- Presentation.
Post Study

- Submit Draft Report to Project Manager for review.
- Receive Final Report
- Submit Decisions on V.E. Study Recommendations to the Chief for approval.
- Document Results of V.E. Study.
Risk:
(www.merriam-webster.com)

- The possibility that something **bad** or **unpleasant** (such as an injury or a loss) will happen.

- Someone or something that may cause something **bad** or **unpleasant** to happen.

- A person or thing that someone judges to be a **good** or **bad** choice for insurance, a loan, etc.
Project Risk Management

Project risk management delivers a number of values to the project, including:

- Recognizes uncertainty and provides forecasts of possible outcomes.
- Produces better business outcomes through more informed decision making.
- Has a positive influence on creative thinking and innovation.
- Creates better project control—reduces overhead and time, and enhances benefits.
- Contributes to project success.
Risk and Value Engineering

**Project Risk Management** is focused on threats and opportunities, adding value to the project, while

**Value Engineering** is focused on opportunities to add value.

These processes can be complementary to each other.
Future Possibilities for Risk Management in LADOTD

With limited resources available, in order to improve the Project Risk Management process, it should

- Be simple and easy to use
- Be scalable to project size and complexity
- Pull communication of risks across project milestones and phases
- Actively manage risk to enhance project success
- Integrate into the current project delivery process, and
- Involve all functional units in the management of risks.
Future Possibilities for Risk Management in LADOTD

- Start with projects requiring a Value Engineering (VE) Study (> $40 Million)
- Perform a Risk Workshop early, during Stage 0.
- Provides an updated cost estimate.
- Provides Project Manager with a Risk Management Plan.
Future Possibilities for Risk Management in LADOTD

- Perform VE Study later in design.
- Risk Management Plan provides VE team with additional information.
- VE recommendations may include new/improved mitigation strategies.
- Provides an updated Risk Management Plan.
- Decision is backed by the Chief Engineer.
Future Possibilities for Risk Management in LADOTD


Eventually, move to a scalable process of managing risks for ALL projects.

From Caltrans's “Project Risk Management Handbook: A Scalable Approach”

<table>
<thead>
<tr>
<th>Scalability Level</th>
<th>Estimated Cost (Capital and Support)</th>
<th>Risk Management Requirements</th>
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</thead>
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<tr>
<td>Minor A, Minor B, and other projects less than $1 million</td>
<td>Risk register encouraged</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Less than $5 million</td>
<td>Risk register</td>
</tr>
<tr>
<td>2</td>
<td>$5 million to $100 million</td>
<td>Risk register with qualitative analysis</td>
</tr>
<tr>
<td>3</td>
<td>Greater than $100 million</td>
<td>Risk register with quantitative analysis</td>
</tr>
</tbody>
</table>
Some of the Benefits of Project Risk Management

- Improved communication with the public.
- Improves/Validates Estimate.
- Useful for project planning and management.
- Improved team communication.
Some of the Benefits of Project Risk Management

- Project Managers take action pro-actively to avoid, transfer or mitigate risk.
- Accepted risks are known.
- Potential response strategies, especially pro-active measures, are identified early.
- Risk register can be used and updated during VE Studies.
Resources:


Charles Nickel, P.E.
La. DOTD Cost Estimate & Value Engineering Director
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(225) 379-1078
The Challenge
Value Engineering Solutions Often Involve Some Risks

- Threat
- Opportunity

A Little Concerned?
Success Favors the Active