Risk Analysis Workshop

Presented by:
Greg Davis, P.E., State Estimates Engineer and
Kurt Lieblong, P.E., State Project Review Administrator

Risk Analysis Process Training
Presentation Format

- Risk Introduction and Pre-workshop Activities
  Greg Davis, P.E.
  State Estimates Engineer

- Risk Analysis Workshop
  Kurt Lieblong, P.E., C.V.S.
  State Project Review Administrator

Risk Introduction
What is Risk?

- **Project Management Institute (PMI) Says:**
  “An uncertain event or condition that, if it occurs, has a positive or negative effect on the project’s objectives.”

Why Risk Analysis?

**Traditional**
- Contingency is intended to include all risk (known & unknown)
- Little control of cost and schedule
- Reactive

**Risk-Based**
- Risk are clearly identified and quantified
- Reasonable control of cost and schedule
- Proactive
Why Risk Analysis?

- Stabilize & Support Work Program with better cost estimates and schedules:
  - Validate cost & schedule for accurate project delivery
  - Replace general project contingency with risk-based cost
- Enhance Risk Assessment/Mitigation activities in Project Management;
- Support FHWA requirement for financial plans on major projects by providing risk-based cost estimates.

Maximizes the Likelihood of Meeting Time & Budget Goals

Typical Project Scenario without Risk Management
(Nationwide Trend)
**Typical Project Scenario with Risk Management**

(Nationwide Trend)

![Chart showing the typical project scenario with risk management.](chart.png)

**Cost**  
PD&E  
PD&E  
PD&E  

**Time**  
Design  
Construction  
Within Budget  
On-time  
Project Actual  

**Project Risk Management Overview**

Risk Management is the systematic process of identifying, assessing, and responding to risks in order to manage or reduce potential adverse effects on the achievement of program and project goals.
**Goal of Risk Management**

- Risk Management’s aim is to:
  - Assess potential impact of various scope, event, and budget risks on the project’s cost and schedule.
  - Identify opportunities and mitigation strategies to reduce both the likelihood of an event occurrence and the potential effect if it occurs.

![Risk Management Diagram](image)

**Risk Management Objectives**

- Decrease the probability and impact of negative risk events
- Increase the probability and impact of positive risk event
- Make better decisions
- Allocate risks to those who can best control them
- Increase agency credibility
- Foster good relationships with project stakeholders

![Risk Management Process Diagram](image)
Risk Management Outcomes

- Validation of Project Cost and Schedule
- Managed Risk Response Plan
  - Identification of high cost and schedule risk drivers
  - Reduced Contingency as project evolves
- Understand and Communicate Cash Flow Requirements in Financial Plans

When to Use Risk Management

- Early planning and budgeting
- Evaluation of project delivery alternatives
- Financial Planning Support
- Establishing Risk Allocation between parties
- Preparation of project contract documents
- Throughout Project Delivery Lifecycle
Risk Management Process

- Step 1: Baseline Risk Assessment
- Step 2: Risk Response
- Step 3: Risk Analysis on Response Strategies
- Step 4: Tracking, Monitoring, and Control

Pre-Workshop Activities
Baseline for Risk Assessment

- Define purpose & need of project
- Establish scope of work
- Validate base cost estimate
- Develop project flowchart

Before the Workshop...

- **Preparation Session** with the project team to:
  - Educate
  - Plan
  - Set the stage
  - Build expectations with the project team.
Preparation Session

- Risk Analysis Process Overview
- Project Overview & Identify Risk Areas
- Develop Project Starter Risk List
- Create a flowchart of the project schedule
- Review Base Cost Estimate
- Assign tasks to the project team
- Set the agenda for the workshop
## Base Cost Variability Review

### Common Terminology

**Base Costs**
- The Base Cost represents the cost which can reasonably be expected if the project materializes as planned. Base Costs are initially estimated by the Project team and reviewed and validated during the Risk Workshop by the Cost Team and Subject Matter Experts.

**Base Cost Uncertainty:**
- An estimate of the error or tolerance within the quantity or unit price of an item. The level of uncertainty is directly related to the project life cycle: the earlier in the project development process, the greater the uncertainty, the less certainty.

### Pay Items

<table>
<thead>
<tr>
<th>Pay Items</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Base</td>
<td>Low High</td>
<td>Low Base</td>
</tr>
<tr>
<td>102-1</td>
<td>19%</td>
<td>19%</td>
<td>$107,238,808.30</td>
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<tr>
<td>101-1</td>
<td>8%</td>
<td>10%</td>
<td>$117,962,689.13</td>
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<tr>
<td>160-4</td>
<td>480,762,353,040,455,028,838.56</td>
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<td>$2.75</td>
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<tr>
<td>285-704</td>
<td>5,341,560,635,976,387.67</td>
<td>$9.81</td>
<td>$10.90</td>
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<tr>
<td>285-709</td>
<td>166,635,801,747,791,833,303.78</td>
<td>$14.85</td>
<td>$16.50</td>
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<tr>
<td>285-711</td>
<td>90,469.49</td>
<td>94,952.96</td>
<td>$17.10</td>
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<td>285-712</td>
<td>9,365.28</td>
<td>10,456.19</td>
<td>$17.64</td>
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<td>327-70-1</td>
<td>3,133.39</td>
<td>3,290.06</td>
<td>$4.50</td>
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<tr>
<td>327-70-4</td>
<td>7,526.13</td>
<td>7,986.13</td>
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<tr>
<td>327-70-6</td>
<td>6,384.43</td>
<td>6,714.15</td>
<td>$4.50</td>
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<td>334-1-xx</td>
<td>117,245,031,207,930,099,953</td>
<td>$82.02</td>
<td>$96.34</td>
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<tr>
<td>337-7-xx</td>
<td>19,750.22</td>
<td>20,737.73</td>
<td>$93.80</td>
</tr>
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</table>
### Base Cost Variability Review

<table>
<thead>
<tr>
<th>Component</th>
<th>Low Base High</th>
<th>From To</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction Contract</strong></td>
<td>$127,549,704 $139,854,422 $153,284,902</td>
<td>-9% 10%</td>
</tr>
<tr>
<td><strong>Structures (inc approach slabs)</strong></td>
<td>$53,984,801 $56,684,041 $59,383,281</td>
<td>40.5%</td>
</tr>
<tr>
<td><strong>Pavement</strong></td>
<td>$19,734,817 $22,286,384 $24,960,912</td>
<td>15.9%</td>
</tr>
<tr>
<td><strong>Earthwork</strong></td>
<td>$11,111,886 $12,960,099 $14,931,426</td>
<td>9.3%</td>
</tr>
<tr>
<td><strong>MOB</strong></td>
<td>$9,437,015 $12,700,402 $16,407,311</td>
<td>9.1%</td>
</tr>
<tr>
<td><strong>MOT</strong></td>
<td>$10,723,881 $11,545,820 $12,429,781</td>
<td>8.3%</td>
</tr>
<tr>
<td><strong>Barrier Wall (inc median inlets)</strong></td>
<td>$8,562,779 $8,990,917 $9,419,056</td>
<td>6.4%</td>
</tr>
<tr>
<td><strong>Retaining/MSE Walls &amp; Railing</strong></td>
<td>$6,629,095 $6,960,550 $7,666,155</td>
<td>5.0%</td>
</tr>
<tr>
<td><strong>Drainage</strong></td>
<td>$2,523,303 $2,649,468 $2,775,633</td>
<td>1.9%</td>
</tr>
<tr>
<td><strong>Removal of Existing Structures</strong></td>
<td>$1,866,029 $1,959,330 $2,052,632</td>
<td>1.4%</td>
</tr>
<tr>
<td><strong>Clearing &amp; Grubbing</strong></td>
<td>$1,108,967 $1,164,415 $1,219,864</td>
<td>0.8%</td>
</tr>
<tr>
<td><strong>Veil Collection Equipment</strong></td>
<td>$618,000 $648,900 $679,800</td>
<td>0.5%</td>
</tr>
<tr>
<td><strong>Signing &amp; Pavement Markings</strong></td>
<td>$570,829 $599,370 $627,912</td>
<td>0.4%</td>
</tr>
<tr>
<td><strong>Erosion Control</strong></td>
<td>$442,460 $464,584 $486,707</td>
<td>0.3%</td>
</tr>
<tr>
<td><strong>Miscellaneous Roadway</strong></td>
<td>$85,849 $90,142 $94,434</td>
<td>0.1%</td>
</tr>
<tr>
<td><strong>Initial Contingency</strong></td>
<td>$150,000 $150,000</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

### Project Total

<table>
<thead>
<tr>
<th>Component</th>
<th>Low Base High</th>
<th>From To</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Total</strong></td>
<td>$157,107,796 $176,415,568 $199,129,070</td>
<td>-11% 13%</td>
</tr>
</tbody>
</table>
Workshop Details

Objectives of the Workshops

- Identify the project risk to account for uncertainty surrounding scope, cost and schedule;
- Assess the project risks by quantifying the affects on the cost and schedule:
  - Likelihood of occurrence
  - Impact
- Analyze the project risks through modeling to develop a baseline risk assessment.
- Produce a Risk Register for future monitoring of identified project risks.
**Project Team Roles**

- **Provide Project Information:**
  - Project location maps, overheads, etc.
  - Project cost estimate and backup
  - Design and construction schedule or flow chart
  - Develop comprehensive list of risks, typically using starter risk list

- **Workshop Support:**
  - Provide input on risk identifying, quantification and mitigate
  - Provide information on project history and key decisions as these items come up in discussion

**Who Should Attend Workshop**

- **Project Manager**
- **External Subject Matter Experts**
- **Internal and External Stakeholders**

- **Disciplines**
  - Construction
  - Bridge & Structures
  - Environmental
  - Right of Way
  - Geotechnical
  - Construction
  - Utilities
  - Local agencies
  - Others depending on project scope
Workshop Approach

- Collaborative team approach
- 2 to 3 day structured workshop
- Identify & quantify threats and opportunities
- Identify risk management strategies

Workshop

- Risk Lead presents a CRA process Overview
- Project Team presents the project
- Base cost presented to and validated by the group
- Base schedule presented to and validated by group
Workshop

- Sessions by Functional Area
  - Identify Risks
  - Quantify Risks
  - Discuss possible Mitigation

- Build Consensus of various stakeholders

- Engage the Internal and External Subject Matter Experts

- Workshop Wrap-up

Workshop

- Typical Functional Sessions
  - Structures/Geotechnical
  - Roadway Design
  - Drainage
  - Environmental
  - Right-of-Way
  - Utilities
  - Construction
  - Maintenance of Traffic
  - Management, Funding & Market Conditions
Type of Risks

- **Budget Risks** (base cost uncertainty)
  - Risk that budget elements will deviate from the estimate.
  - Examples: deviations in unit prices, deviations in quantities.

- **Event Risks**
  - Risk of internal or external events that force the project team to work beyond the estimate just to meet the Project Scope and SOW.
  - Examples: Extreme weather, contractor non-performance.

- **Scope Risks**
  - Risk of significant changes to project scope due to external pressures.
  - Examples: community pressures for changes in alignment.

Risk Register: Risk Identification
**Risk Register: Risk Quantification**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Probability of Occurrence (%)</th>
<th>Potential Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay of NEPA Process</td>
<td>33%</td>
<td>Cost Increase $2M, Schedule Delay by 12 months</td>
</tr>
</tbody>
</table>

**Initial Risk Quantification**

<table>
<thead>
<tr>
<th>Initial Probability of Occurrence (%)</th>
<th>Initial Low Cost</th>
<th>Initial Most Likely Cost</th>
<th>Initial High Cost</th>
<th>Initial P/L Cost</th>
<th>Initial P/H Cost</th>
<th>Initial Low Schedule</th>
<th>Initial Most Likely Schedule</th>
<th>Initial High Schedule</th>
<th>Initial PI Schedule</th>
<th>Initial PUI Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
<td>37</td>
<td>38</td>
<td>39</td>
</tr>
<tr>
<td>100%</td>
<td>$53.40</td>
<td>$53.40</td>
<td>$53.40</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Risk Management Process

Assess

Probability
40%

Impact to Schedule
60 Days

Impact to Cost
$100,000

Modeling and Presentation

- Preliminary results are generated and presented to project team for feedback & review.

- Results are finalized and presented to management
  - Risk based cost and schedule estimates
  - Ranking of key drivers of risks
Baseline Risk Assessment Results

Alternative 1 - Risk-Based Total Cost (Pre-Response)
Alternative 1 - Base Cost Estimate (max value; 2010$)
Alternative 1 - Base Cost Estimate (max value, escalated)

Probability of Not Exceeding Project Cost, Millions of Dollars

$250.0 $350.0 $450.0 $550.0 $650.0 $750.0
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Baseline Risk Assessment Results

<table>
<thead>
<tr>
<th>Expected Value Cost Impact ($ millions)</th>
<th>ENV 20.03a1 - Determination of direct impacts to wetlands - Alt 1</th>
<th>ENV 20.04a1 - Determination of indirect impacts to wetlands - Alt 1</th>
<th>CNS 30.01 - Excavation impacts during construction due to weather</th>
<th>ENV 30.01a1 - Determination of Significance Requiring EIS - Alt 1</th>
<th>STG 10.01 - Design Changes on Bridge or Overpass</th>
<th>ENV 60.06a1 - Development of mitigation plan to offset impacts to public lands - Alt 1</th>
<th>ENV 60.04a1 - New Stormwater Rule - Water quantity and quality issues</th>
<th>RR 20.01 - Cost for Railroad Flaggers</th>
<th>ENV 30.01a32 - Expected Controversy on Environmental Grounds - Alt 1/2</th>
<th>MGT 900.05 - Loss of Toll Revenue due to complex NDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Value Cost Impact ($ millions)</td>
<td>$51.0</td>
<td>$25.5</td>
<td>$3.8</td>
<td>$3.8</td>
<td>$2.3</td>
<td>$2.3</td>
<td>$1.9</td>
<td>$1.7</td>
<td>$1.5</td>
<td>$1.4</td>
</tr>
</tbody>
</table>

Based on Risks that Impact Alternative 1 Activities
Workshop Deliverables

- Final report detailing the results of the workshop
- Final Risk Register for Project Manager to use managing the identified risks

References

- Project Management Handbook  Chapter 19
  http://www.dot.state.fl.us/projectmanagementoffice/PMHandbook/pmhandbookindex.shtm

- Washington State Department of Transportation
  http://www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment/

- FHWA Risk Assessment
  http://international fhwa dot gov/riskassess/index cfm
  http://www fhwa dot gov/ipd/project delivery/resources/risk_management/
Summary

- Pre-workshop Activities
  - Defined risk, risk analysis & risk management
  - Identified activities prior to a workshop

- Risk Analysis Workshop
  - Assessment
  - Workshops

Risk Management

“Hope is not a Strategy”
Questions?

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