Welcome to Construction Contract Risk Management for Public Contracts

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Risk Management for Public Construction Contracts

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CDM Smith
Themes

- Risk and uncertainty
- Risk management processes
- Qualitative and quantitative risk analysis
- The human factor
Why do projects “fail”?

Failure = Not meeting expectations

Ultimately due to sub-optimal performance in:
- Governance
- Stakeholder Management
- Risk Management
Public Sector Projects

- Many Stakeholders
- Many Constraints
- Penalties for violating constraints outweigh rewards of achieving results
Public Sector Risks

- Schedule
- Cost
- Scope
- Political
- Publicity

- Stakeholder
- Process
- Budget Process
- Resource reduction

- Stakeholders look at projects differently and also have different risk tolerances
What is a Risk?

- “An uncertain event or condition that, if it occurs, has a positive or a negative impact on at least one project objective” (PMI)

- Risk is uncertainty that matters

- Only completed projects have no risks
We cannot eliminate uncertainty

- The information you have is not the information you want
- The information you want is not the information you need
- The information you need is not the information you can obtain
- The information you can obtain costs more than you want to pay
We cannot eliminate uncertainty

“Nature has established patterns originating in the return of events, but only for the most part”

Liebniz to Jacob Bernoulli (1703)
Risk Management Objective

- To provide a process for early identification of risks and opportunities in order to properly assess them, track them, and manage them throughout the project.

- “Risk management is project management for grownups” (Lister)
Risk Management Frameworks

- Project Management Institute (PMI)
  - PMBOK, Practice Standard for Project Risk Management
- Association for the Advancement of Cost Engineering International (AACEI)
  - Total Cost Management Framework, Recommended Practices
- Office of Government Commerce (OGC)
  - The Orange Book, MoR
- CMAA Standards of Practice, Guidelines
- Construction Industry Institute (CII) Best Practices
- Corps of Engineers Cost and Schedule Risk Analysis Guidance
Building a model of risks

“Models: Organizing devices that facilitate a continuous explicit dialogue among multiple sources of data and assumptions.”

Britt
Risk Management Processes

- Planning
- Identification
- Analysis
- Mitigation & Response
- Monitoring & Control
Risk Management Processes

- Risk Management Planning
- Risk Identification
- Qualitative and Quantitative Risk Analysis
- Risk Monitoring and Control:
  - Monitor and evaluate
  - Revisions, re-baseline, updates
  - Reporting and communicating
- Risk Response and Mitigation Actions:
  - Avoidance
  - Mitigation
  - Transfer
  - Acceptance

Cost of Risk Management
Risk Management Plan

- Methodology, Terminology
- Resources
- Stakeholder Risk Tolerance
- Communication
- Roles, Responsibility, Authority
- Tools, Guidelines
- Integration with other aspects of Project Management
Risk Identification

- Start early in the lifecycle
- A Team Effort!
- Risks and Opportunities
- Brainstorming
- Checklists
- Experience
- Iterative
- Allow for Emergent risks
## Risk Statements

<table>
<thead>
<tr>
<th>Cause</th>
<th>Risk</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to get from A to B on time for the meeting</td>
<td>X this is simply the converse of the objective.</td>
<td></td>
</tr>
<tr>
<td>Being late and missing the meeting</td>
<td>X This is a statement of the impact of the risk, not the risk itself.</td>
<td></td>
</tr>
<tr>
<td>There is no buffet on the train so I get hungry</td>
<td>X this does not impact on achievement of the objective.</td>
<td></td>
</tr>
<tr>
<td>Missing the train causes me to be late and miss the meeting</td>
<td>This is a risk which can be controlled by making sure I allow plenty of time to get to the station.</td>
<td></td>
</tr>
<tr>
<td>Severe weather prevents the train from running and me from getting to the meeting</td>
<td>This is a risk which I cannot control, but against which I can make a contingency plan.</td>
<td></td>
</tr>
</tbody>
</table>

**Objective** – to travel by train from A to B for a meeting at a certain time.
Risk Statements

- Serious worker injury, caused by weak safety culture, that leads to a lawsuit and financial loss for the owner.
- Amtrak permit delayed, caused by Amtrak permit review and approval process, that leads to project delays and/or increase in project costs.
- Data theft, caused by weak user password, that leads to bad publicity.
Creating the Risk Register

- Risk Categories
  - Technical
  - Organizational
  - Political
  - Internal
  - External

- Risk Owner
- Triggers
- Likelihood
- Consequences
- Response Strategy
- Residual Risk
Qualitative Risk Analysis

- Two elements:
  - Likelihood
  - Consequences
Likelihood – What are the chances?

- Relative frequency approach
  - Probability of an uncertain event is its relative frequency of occurrence in repeated trials or experimental sampling of the outcome

- Subjective, degree-of-belief approach
  - Probability of an uncertain event is the quantified measure of one’s belief or confidence in the outcome, according to their state of knowledge at the time it is assessed

Vick, Degrees of Belief
Often, a five-level scale such as...

- Probable
- Likely
- Possible
- Unlikely
- Improbable
But can we agree on what these mean?

Hilson
**Virgin and Experienced Risks**

<table>
<thead>
<tr>
<th></th>
<th>Out of Mind</th>
<th>Recognized</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Occurrences</td>
<td>Virgin Risks</td>
<td>Contemplated Risks</td>
</tr>
<tr>
<td>Past Occurrences</td>
<td>Neglected Risks</td>
<td>Experienced Risks</td>
</tr>
</tbody>
</table>

- After the occurrence of a virgin risk, people will overestimate the probability of another occurrence in the near future.
- After an experienced risk occurs, people will under-update their assessment of another event occurring soon.
Uses of probability assessments

- We can’t always put our thoughts squarely into one approach or the other
- Serve as a communication tool
- Relative rankings valuable in qualitative analysis
- Values and density functions become more important in quantitative analysis
Consequence Evaluation

- Consequence Categories – Project Specific
  - Cost
  - Schedule
  - Satisfaction / Quality
  - Safety
  - Public Relations
  - Legal / Regulatory
Consequence Severity

- Similar to Likelihood – often a 5-level scale
  - Very High
  - High
  - Medium
  - Low
  - Very Low
What is your risk appetite?

<table>
<thead>
<tr>
<th>Risk Consequence Criterion</th>
<th>Consequence Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Financial</td>
<td>Less than $100k</td>
</tr>
<tr>
<td>Project Schedule Impacts</td>
<td>1 to 7 days</td>
</tr>
<tr>
<td>Social environment</td>
<td>Complaints from local public</td>
</tr>
<tr>
<td>Regulatory / Legal</td>
<td>Isolated non-compliance</td>
</tr>
<tr>
<td>Health &amp; Safety</td>
<td>Minor injury or near-miss</td>
</tr>
</tbody>
</table>
Insights from Behavioral Economics

- Difference in risk appetite depending on how questions are posed
  - When choices involve gains, we are risk-averse
  - When choices involve losses, we are risk takers
We are not always rational

- Given $30
  - A) Flip a coin for a $9 wager
  - B) Keep the $30
- Given $0
  - A) Flip a coin – win $39 or win $21
  - B) Take $30

- $E[A] = 0.5 \times 21 + 0.5 \times 39 = 10.50 + 19.50 = $30$
- $E[A] = 0.5 \times 21 + 0.5 \times 39 = 10.50 + 19.50 = $30$

- Most people choose A
- Most people choose B
Combining Likelihood and Consequence

If risk has effect in multiple categories, use highest ranking consequence.
Combining Likelihood and Consequence

Numbers or not?

<table>
<thead>
<tr>
<th>Probability</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>b</td>
<td>L</td>
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<td>c</td>
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<td>H</td>
</tr>
</tbody>
</table>

HEAT MAP

**Impact**

a,b,c,d,e
Update the register

- Include likelihood and consequence ratings, prior to any response actions.
- Risk Score (likelihood x consequence if multiplying, L,M,H if not)
- These are absent any control measures
Risk Responses

- **Avoid** – Elimination of the risk or its applicability to the project
- **Mitigate** – Action that reduces likelihood, consequences, or both
- **Transfer** – A risk should be assigned to the party in the best position to manage it
- **Accept** – Likelihood or consequence so small that just monitoring is acceptable
Opportunity Responses

- Exploit – take steps to make sure it happens
- Share – another group may be better positioned to take advantage of it for the benefit of the project
- Enhance – increase probability or impact value
- Accept – Take advantage if it happens
Update the Register

- Include response strategies
- Identify related risks
- Residual Risk
  - Adjust likelihood and consequence only AFTER the response strategy has been implemented
## Example Register

<table>
<thead>
<tr>
<th>Risk Score</th>
<th>Control Measures Implemented (actually in place today)</th>
<th>Residual Likelihood After Mitigation (Blank = Risk Closed)</th>
<th>Financial</th>
<th>Project Schedule</th>
<th>Social Environment</th>
<th>Regulatory Legal</th>
<th>Health and Safety</th>
<th>Operating &amp; Maintenance</th>
<th>Natural Environment</th>
<th>Residual Risk Score After Mitigation Action</th>
<th>Action Item for Risk Mitigation</th>
<th>Action Item Completion Date (Target Date)</th>
<th>Responsible Party or Risk Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Current design includes redundant inflow control gates.</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>Develop O&amp;M procedures and contingency plans for Owner to implement</td>
<td>Construction Phase</td>
<td>Designer / Owner</td>
</tr>
</tbody>
</table>

- Current design includes redundant inflow control gates. Gates have fail-safe operation. Current operation and control design includes buffer at gate closure elevation.

- Failure in system leads to public complaints and damage and impacts to third parties.

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Quantitative Analysis

- Numerical estimate of overall project risks
- USACE CSRA – Cost and Schedule Risk Analysis Draft Guidance
- Provide a probabilistic assessment of outcomes
- Typically a Monte Carlo Analysis
What are the Chances?
Monte Carlo Analysis

Define the Input Distributions

Run the model, sampling randomly from the distributions

Interpret Results

[Graph showing distribution of project costs with a normal distribution curve and a bar chart representing frequency.]
A Powerful Tool, but . . .

- GIGO
- We are interpreting results based on a relative frequency approach, but our inputs are probably based on a degree-of-belief approach
- Are uncertainties correlated or independent?

- “A fool with a tool is till a fool”
Nevertheless . . .

- A powerful analysis method
- Software packages incorporate many features
- Sensitivity Analysis – risk prioritization
- Establish cost and schedule contingency
- Gets us away from point estimates
- Fosters a conversation on accuracy versus precision of estimates
Monitoring, Reporting, Adjusting

- Risk management processes need to continue throughout the lifecycle
- New risks are identified
- Others are retired
- Link contingency allocation to specific risks
Dealing with Residual Risks

- Planning and response actions do not eliminate all risks
- What are the contingency plans for residual risks?
- Use allowances in bid
- Maintain risk visibility
- Assign responsibility appropriately
Questions?

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