Gestion des Risques pour Méga-projets
Megaproject Risk Management

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Mega Project Risk Management

Agenda

- Who is exp? (3 min)
- Megaproject Failure Rate (5 min)
- Risk Management Fundamentals (10 min)
- “Top 7” for Megaprojects (22 min)
- Bankable Quality Projects (5 min)
- Questions and Answers (15 min)

“I think we need to take another look at your risk-management strategy.”
What does our group in exp do?

- Designs and implements Project Management Systems and Processes
  - Manages Projects across the entire Project life cycle
    - Pre-Project Phase, from Idea to Project funding
    - Execution Phase
    - Start-up

- Develops and manages Operations Readiness Plans

- Provides tailored Project Management Services
  - Engineering Management
  - Planning & Scheduling
  - Cost Management
  - Contract Management (Goods and Services)
  - 20 other fields of expertise

- Sales and implementation of specialized project management software
Areas of competency

**« Traditional »**
PMI type of services

- Project management training and coaching
- Management of Pre-Project Phase
- Risk Management
- Value Engineering
- Project Direction
- Detailed study coordination
- Construction Management
- Scope Management
- Project Planning and Scheduling
- Cost Control
- Performance Management

**« Specialized »**

- Development and Implementation of Project Selection and Delivery Models (PSDM)
- Development and Implementation of Project Management Systems (Procedures)
- Development and Management of Operations Readiness Plans (ORP)
- Commissioning and Start-up Management
- Development and Implementation of Project Governance Structure
- Review and Audit of Project Controls
- Project Finance Modeling Assistance
- Management (or support) of Owners activities
- Procurement and Logistics Management
- Plant shut-down Management
- Portfolio Management
- «VIPs»
- Claims Analysis
- Bankable Studies
A few of our valued clients
Megaproject Failure Rate: 56%

Defining Megaproject Success and Failure

- We deem a project to be a failure if one or more of the following occurred:
  - Costs grew 25% +
  - Schedule Slipped 25% +
  - Overspent (Absolute Measure) 25% +
  - Severe and Continuing Operational Problems (1 year or more) Yes

- Of the projects that failed (56 percent):
  - 42 percent failed on one criterion
  - 32 percent failed on two criteria
  - 21 percent failed on three criteria
  - 5 percent failed on all criteria
Figure 4. Changes in Risk Levels Before and After Mitigation

Figure 4. Qualitative risk analysis performed across twelve separate projects documented within The History of Project Management yielded a pattern. The level of risk management maturity appeared to diminish over time until Magellan’s Voyage, at which point it began to radically improve, to higher levels than previously seen.
Modern Risk Management

- AS/NZS 4360:1995
- AS/NZS 4360:2004
- ISO 31000:xxxx
- PMI, AACEi standards
## AACEi Risk Practices

<table>
<thead>
<tr>
<th>Document Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>41R-08</td>
<td>Risk Analysis and Contingency Determination Using Range Estimating</td>
</tr>
<tr>
<td>42R-08</td>
<td>Risk Analysis and Contingency Determination using Parametric Estimating</td>
</tr>
<tr>
<td>44R-08</td>
<td>Risk Analysis and Contingency Determination Using Expected Value</td>
</tr>
<tr>
<td>57R-09</td>
<td>Integrated Cost and Schedule Risk Analysis Using Monte Carlo Simulation of a CPM Model</td>
</tr>
<tr>
<td>62R-11</td>
<td>Risk Assessment: Identification and Qualitative Analysis</td>
</tr>
<tr>
<td>63R-11</td>
<td>Risk Treatment (expectations, requirements, and practices for risk treatment)</td>
</tr>
<tr>
<td>64R-11</td>
<td>CPM Schedule Risk Modeling and Analysis: Special Considerations</td>
</tr>
<tr>
<td>65R-11</td>
<td>Integrated Cost and Schedule Risk Analysis and Contingency Determination Using Expected Value</td>
</tr>
<tr>
<td>66R-11</td>
<td>Selecting Probability Distribution Functions for use in Cost and Schedule Risk Simulation Models</td>
</tr>
<tr>
<td>72R-11</td>
<td>Developing a Project Risk Management Plan</td>
</tr>
</tbody>
</table>
Must use risk management process

- Risk management process ≠ risk register
- Ed Merrow quotes:
  - “Monte Carlo simulation results in a thin gloss of scientific verisimilitude on pure BS”
  - “The use of Monte Carlo simulation has no relationship to the success of megaprojects…”
  - “Monte Carlo simulation actually does harm; it is not merely worthless”
  - “Probabilistic schedule assessment does work”
- Be very careful with Monte Carlo cost risk simulation
  - Cost estimates overrun most often because the scope changed or was not completely defined (central value issue, not distribution)
  - Distributions often not based on first principles or history
  - Orthogonality (independence) requirement often violated
  - I am not saying don’t use it, but be very careful how you use it
Iterate

- This is a consistent weakness I observe
- During each *monthly* iteration, look at triggers and leading indicators for changes
- What new risks have materialized?
- What risks have increased or decreased in probability or consequences?
- Doesn’t need to be long or bureaucratic (software can make this much less painful)
Risk Management Process – Iterate!

- **Identify Risk**: Statement of risk, List of risks (risk register)
- **Analyze Risk**: Risk evaluation, Risk Classification, Risk prioritization
- **Control**: Risk decisions
- **Tracking**: Risk status report, Risk mitigation plans
- **Response Planning**: Risk Mitigation plans, Risk Acceptance Rationale, Risk Tracking Requirements

Iterate!!
Use Appropriate Risk Treatment

- Owners with limited/no megaproject experience often try to transfer all risks without understanding risk premium
- Party with greatest influence/control over risk should own it

Figure 8. Maturity Levels Associated With Different Risk Strategies

Figure 8. Four different ways of approaching a project risk and the level of maturity required to manage each approach. Built from information contained within A Guide to the Project Management Body of Knowledge, 4th Edition by the Project Management Institute (2008).
“What if” Planning

- Traditional approach:
  - Identify potential risks
  - Capture in risk register
  - Assign someone to each risk (typically a junior person)
  - Check risk management off of “must do to get $$ list”
  - Move on to “more important” tasks

- Ask Integrated Project Team (project risks) and Steering Team (strategic risks) how they will respond to hypothetical but realistic scenarios:
  - What if detailed engineering progress is not on track to meet the (politically sensitive) start of construction date?
  - For a location sensitive project, what if the primary location is suddenly unavailable (Trinidad example)?
Standardized Frameworks Help

- Consider a complete risk breakdown structure to organize risks and to prompt thinking about areas that are sometimes missed.
- Strongly consider a standardized probability and consequences matrix that allows all risks (project and strategic) to use the same scale and be captured in one unified project risk register.
5. Risk Breakdown Structure
<table>
<thead>
<tr>
<th>Rating</th>
<th>Judgement</th>
<th>Frequency</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Almost certain or Frequent</td>
<td>Expected to occur</td>
<td>Very High, may occur at least several times per year</td>
</tr>
<tr>
<td>4</td>
<td>Likely or Probable</td>
<td>More likely to occur than not occur.</td>
<td>High, may occur about once a year</td>
</tr>
<tr>
<td>3</td>
<td>Possible or Occasional</td>
<td>As likely to occur as not to occur.</td>
<td>Possible, may occur at least once in a one to ten year period</td>
</tr>
<tr>
<td>2</td>
<td>Unlikely or Remote</td>
<td>Not impossible, more likely not to occur than to occur.</td>
<td>Not impossible, likely to occur during the next ten to twenty five years</td>
</tr>
<tr>
<td>1</td>
<td>Rare or Improbable</td>
<td>Very unlikely to occur.</td>
<td>Very low, very unlikely during the next twenty five years</td>
</tr>
<tr>
<td>Rating</td>
<td>Health &amp; Safety</td>
<td>Environment</td>
<td>Regulatory</td>
</tr>
<tr>
<td>--------</td>
<td>----------------</td>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>5 CRITICAL</td>
<td>Fatality of staff, contractor or the public</td>
<td>Long term environmental damage (5 years or longer), requiring &gt;$5 million to study or correct or in penalties</td>
<td>Regulatory intervention and prosecution possible</td>
</tr>
<tr>
<td>4 MAJOR</td>
<td>Serious injury or occupational illness (non-recoverable) or permanent major disabilities (acute or chronic)</td>
<td>Medium-term (1-5 yr) environmental damage, requiring $1 to 5 million to study or correct</td>
<td>Breach of licenses, legislation, regulation or corporate mandatory standards</td>
</tr>
<tr>
<td>3 MODERATE</td>
<td>Lost time or restricted duties injury or occupational illness (recoverable)</td>
<td>Short-term (&lt;1 yr) environmental damage, requiring up to $1 million to correct</td>
<td>Breach of standards, guidelines or impending legislation. Subject raised as corporate concern through audit findings or voluntary agreements</td>
</tr>
<tr>
<td>2 MINOR</td>
<td>Medical Treatment or First Aid Injury No lost time or occupational illness</td>
<td>Environmental damage, requiring up to $250,000 to study or correct</td>
<td>Breach of internal procedures or guidelines</td>
</tr>
<tr>
<td>1 INSIGNIFICANT</td>
<td>No Injury</td>
<td>Negligible environmental impact, managed within operating budgets</td>
<td>No breach of licenses, standards, guidelines or related audit findings</td>
</tr>
</tbody>
</table>
Opportunities (Positive Risks)

• Use the same level of systematic capture, assignment, strategy and tracking as for negative risks
• Decide which ones (probability x consequence) are worth investing time and resources to go after
• Sometime pursuit of an opportunity requires a significant project change and approval of key stakeholders
• Must identify and decide to pursue before end of FEL 2 to avoid high risk FEL 3 scope changes
• Good article this topic in Dec. 2012 Project Management Journal: “Challenging Classic Project Management: Turning Project Uncertainties into Business Opportunities”
Operations Readiness

- This is frequently a weakness in megaprojects particularly for greenfield
- New region/country amplifies the issues
- Integrated Project Team (is supposed to) have systems, discipline, project controls tracking, etc.
- Operations are often left on their own
- Global Best Practice is full integration of Operations into Project Development and Execution System (PDS)
Industrial Project Delivery Model
## Project Life Cycle and ORP Evolution Process

<table>
<thead>
<tr>
<th>Pre-Feasibility</th>
<th>Feasibility</th>
<th>Execution</th>
<th>Commission &amp; Start-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORP Level 1</td>
<td>ORP Level 2</td>
<td>ORP Level 3</td>
<td>ORP Level 3</td>
</tr>
<tr>
<td>High level Plan</td>
<td>Baseline Plan including manpower deployment and departments’ implementation strategy</td>
<td>Detailed OR Plan by business process, done with department’s personnel</td>
<td>Progressive deployment of Operations resources, and execution of activities and deliverables according to OR detailed Plan</td>
</tr>
</tbody>
</table>

### Preparation
- Align OR and project key milestones
- Identify major categories of OR deliverables
- Draft of organizational structure
- Develop OR master schedule
- Develop preliminary OR and operations budgets
- Identify OR work by Owner and by others

### Implementation
- Develop OR control schedule
- List of business processes by department
- Refine / upgrade ORP documents initiated in ORP Level 1, to satisfy requirements of project funding and IRR calculation
- Develop short-term detailed OR plan
- Develop detailed OR schedule and synchronize with project schedule
- Develop / Implement OR progress monitoring system
- Validate OR budget
- Initiate schedule progress reporting and budget control functions
- Assist Owner’s managers with their ORP implementation

### Enforcement
- OR schedule and progress monitoring
- Maintain OR schedule "evergreen" according to OR progress and project evolution
- OR budget monitoring
- Act as facilitators to managers in their Plan’s implementation / execution and dealings with other departments
- Assistance in development and implementation of procedures for facilities tests, commissioning, start-up and acceptances

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**exp.'s Key Contributions**
Typical ORP Level 1 Deliverables

**ORP Level 1**

- List of major categories of OR deliverables by department
- Preliminary Owner’s organization, roles and responsibilities
- OR master schedule by department (See box below for example)
- List of OR work packages (Owner’s & others)
- Preliminary effort assessment and resources deployment plan
- Preliminary OR budget
- Operations and maintenance philosophy
- Commissioning and start-up strategy/model
- Ramp-up strategy/model

**Example of departments covered by an ORP:**

- Operations Readiness (transitional department)
- Environment, Health and Safety
- Human Resources
- Community Relations
- Finance
- Legal Affairs

- Operations and Maintenance
- Business Management
- Procurement / Outsourcing
- Sales and Marketing
- Information Systems and Technology
- Commissioning
Bankable Quality Projects

• Bank’s engineer will typically want to see the risk register monthly and will expect changes (iteration)
• Risk Management is a pervasive theme with exceptionally high pressure to transfer all risks
• Partnership projects significantly complicate risk management process (not linear with # of partners)
• Consider project from Banker’s perspective (typical Banker’s Checklist slide)
## Sample Banker’s Checklist

<table>
<thead>
<tr>
<th>Check Items</th>
<th>Covered by IM Chapter No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A credit risk rather than an equity risk is involved.</td>
<td>7</td>
</tr>
<tr>
<td>2. A satisfactory feasibility study and financial plan have been prepared.</td>
<td>4 &amp; 7</td>
</tr>
<tr>
<td>3. The cost of product or raw material to be used by the project is assured.</td>
<td>4 &amp; 5</td>
</tr>
<tr>
<td>4. A supply of energy at reasonable cost has been assured.</td>
<td>4 &amp; 5</td>
</tr>
<tr>
<td>5. A market exists for the product to be produced.</td>
<td>3</td>
</tr>
<tr>
<td>6. Transportation is available at reasonable cost to move the product to the market.</td>
<td>5 &amp; 6</td>
</tr>
<tr>
<td>7. Adequate communications are available.</td>
<td>4 &amp; 5</td>
</tr>
<tr>
<td>8. Building materials are available at costs contemplated.</td>
<td>4</td>
</tr>
<tr>
<td>9. The EPCM contractor is experienced and reliable.</td>
<td>4 &amp; 5</td>
</tr>
<tr>
<td>10. The Operations Team is experienced and reliable.</td>
<td>4, 5 &amp; 6</td>
</tr>
<tr>
<td>11. Management personnel are experienced and reliable.</td>
<td>4</td>
</tr>
<tr>
<td>12. Unproven technology is not involved.</td>
<td>4</td>
</tr>
<tr>
<td>13. Contractual agreement among joint venture partners, if any, is satisfactory.</td>
<td>2</td>
</tr>
<tr>
<td>14. A stable and friendly political environment exists; licences and permits are available.</td>
<td>4 &amp; 6</td>
</tr>
<tr>
<td>15. The risk of expropriation has been properly considered</td>
<td>8</td>
</tr>
<tr>
<td>16. Country risk is satisfactory.</td>
<td>8</td>
</tr>
<tr>
<td>17. Sovereign risk is satisfactory.</td>
<td>8</td>
</tr>
<tr>
<td>18. Currency and foreign exchange risks have been addressed.</td>
<td>7</td>
</tr>
<tr>
<td>19. The key promoters have made an adequate equity contribution.</td>
<td>2 &amp; 7</td>
</tr>
<tr>
<td>20. The project has value as collateral.</td>
<td>7</td>
</tr>
<tr>
<td>21. Satisfactory appraisals of resources and assets have been addressed.</td>
<td>4</td>
</tr>
<tr>
<td>22. Adequate insurance coverage is contemplated.</td>
<td>8</td>
</tr>
<tr>
<td>23. Force majeure risk has been addressed.</td>
<td>8</td>
</tr>
<tr>
<td>24. Cost over-run risk has been addressed.</td>
<td>8</td>
</tr>
<tr>
<td>25. Delay risk has been considered.</td>
<td>8</td>
</tr>
<tr>
<td>26. The project will have an adequate ROE, ROI and ROA for the investors.</td>
<td>7</td>
</tr>
<tr>
<td>27. Inflation rate projections are realistic.</td>
<td>7</td>
</tr>
<tr>
<td>28. Interest rate projections are realistic.</td>
<td>7</td>
</tr>
<tr>
<td>29. Environmental Impact has been addressed.</td>
<td>4</td>
</tr>
<tr>
<td>30. Socio-Economic Impact has been addressed.</td>
<td>4</td>
</tr>
</tbody>
</table>
Project Related Documents

- Study Team and Engineering Services Provider Mobilization
- FEL 3 Tech. Doc.
- Strategic Risk Mgmt Plan
- FEL 3 Study Report
- Integrated Project Plan 1st Ed.
- EPCM RFQ Doc.

Operations Readiness Plan (ORP)

- Energy Contract
- ORP – Level 2
- Raw Materials Supply Plan

End Product Value

- Product & Marketing Plan

IRR, Funding & Financing

- Funding Agreement Draft
- Lenders & Partners Financial Requirements - Final

Bankable Documents – 3Bxx

- EPC/M Contract Award
- Bankable Documents

Agreements Signed

Basic Eng. Completed

DRB Members

Decision by DRB

Funds Available

Full Funds

Study by DRB

Funds Appropriation

Extraction failed
Bankable Quality Projects

People

Financing Structure

Partners

Operations Readiness

Enabling Framework & Government

Project Rationale & Economics

Bankable Cost Estimate & Schedule

Balance Of Stage Gate Deliverables
Bankable Quality – True North

People

Enabling Framework & Government

Financing Structure

Project Rationale & Economics

Bankable Cost Estimate & Schedule

Balance Of Stage Gate Deliverables

Operations Readiness
- Bankable Quality – True North

- Strong well staffed Owner’s team
- Supported by a quality engineering service provider (size, balance sheet, recent track record, experienced people)
- Tier 1 EPC/M team utilizing proven systems and procedures
- Minimal risk of changes in team or loss of key personnel (incentives); financial penalties to EPC/M for loss of key people
- Plan and commitment for quality, experienced construction supervision and workforce
- Quantity and quality of team are key to success (“A” team not “C” team). Expect careful scrutiny of key team CV’s for experience both within the industry as well in projects of similar size.
Questions and answers
Qualitative Risk Analysis

• This consists of using the probability and impact matrix tool (PIM) to prioritize and rank the risks contained in the risk register. By doing this, you are able to focus your management time and effort on the most important risk areas. In effect, you are able to apply the 80/20 rule – 20% of the risks will cause 80% of the threats to your project objectives, hence you need to focus on those.

• Each risk would be evaluated for its probability and impact using a numbered ranking system such as low, low to medium, medium, medium to high, and high. Or perhaps using a 1 to 10 scoring system. Each risk will have the numbers for probability multiplied together to get a priority score so that these can be ranked. Other data could be captured for each risk such as urgency or proximity, and the category (for example hardware, software, commercial, design, and so on).
Quantitative Risk Analysis

- As the name might suggest, this is quantifying (assigning a value = quantity) the ranked risks often done in terms of time or cost. There are several tools that help in this. One is by using decision trees to arrive at a monetary amount for each risk (the extra cost incurred or time delay if the risk happened).

- Another tool is expected monetary value analysis. If a risk would incur an extra $1000 and it has a 25% probability, then the risk cost value could be seen as $250. If this was done for all the risks, then simply adding up each risk cost value could be used as a risk budget to help fund the aggregated risks.

- A risk is an uncertain event, that if it did occur, it would have an impact on the project’s objectives. But a risk can be a negative impact threat or a positive impact opportunity. Both have uncertainty which is what makes them both examples of a risk.
Risk Response

“Negative” Risk Responses

• Transfer - Reallocate the risk to others
• Accept - Do not develop mitigation strategies. May develop contingency plan if needed
• Watch - Monitor risk attributes; establish metrics; identify contingency strategy if needed
• Mitigate - Eliminate or reduce likelihood of occurrence or impact; identify contingency plan
• Avoid - Find a way around risk