Risk Management

Sharif Project Management

Session 10.1
"We have done a Monte Carlo simulation of your performance in 5 years. You're fired."
Project Risk

- An uncertain event or condition that, if it occurs, has a positive or negative impact on a project objective.

- External: unpredictable
- External: predictable
- Internal: non-technical
- Internal: technical
- Legal

- Business risks
- Insurable (pure) risk
  - Direct property damage
  - Indirect consequential loss
  - Legal liability
  - Personnel
# Risk Continuum

## Scope of Risk Management

<table>
<thead>
<tr>
<th>Unknown Unknowns</th>
<th>Known Unknowns</th>
<th>Knowns</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Information</td>
<td>Partial Information</td>
<td>Complete Information</td>
</tr>
<tr>
<td>Enter New Markets</td>
<td>Feasibility Studies</td>
<td>Closeout Reports</td>
</tr>
</tbody>
</table>
Financial Risks

- Up-front funding and payback period based upon number of planes sold
  - Mitigation strategies
    - Funding by life cycle phase
    - Continuous financial risk management
    - Sharing risks with subcontractors
    - Risk reevaluation based upon sales commitments
Market Risks

- Forecasting customers’ expectations on cost, configuration, and amenities based upon a 30-40 year life of a plane
  - Mitigation strategies
    - Close customer contact and input
    - Willingness to custom-design per customer
    - Development of a baseline design that allows for customization
Because of the long lifetime for a plane, we must forecast technology and its impact on cost, safety, reliability and maintainability. Mitigation strategies include:

- A structured change management process
- Use of proven technology rather than high risk technology
- Parallel product improvement and new product development processes
Production Risks

- Coordination of manufacturing and assembly of a large number of subcontractors without impacting cost, schedule, quality or safety

  - Mitigation strategies
    - Close working relationships with subcontractors
    - A structured change management process
    - Lessons learned from other new projects
    - Use of learning curves
Risk Types at Boeing

- Financial risks
- Market risks
- Technical risks
- Production risks
Definition of Risk

\[ \text{Risk}_{\text{event}} = f(\text{Likelihood}, \text{Impact}) \]

- Likelihood is the probability of occurrence
- Impact is the amount at stake
Components of Risk

- Risk Event
- Risk Probability
- Impact
- Timing
- Tolerance
Variation through the Project Life Cycle?

- Risk Event Probability?
- Amount at Stake?
- Cost to make Changes?

Time along project life cycle
### Rating Impacts for a Risk

#### Evaluating Impact of a Risk on Major Project Objectives

(ordinal scale or cardinal, non-linear scale)

<table>
<thead>
<tr>
<th>Project Objective</th>
<th>Very Low .05</th>
<th>Low .1</th>
<th>Moderate .2</th>
<th>High .4</th>
<th>Very High .8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Insignificant Cost Increase</td>
<td>&lt;5% Cost Increase</td>
<td>5–10% Cost Increase</td>
<td>10–20% Cost Increase</td>
<td>&gt;20% Cost Increase</td>
</tr>
<tr>
<td>Schedule</td>
<td>Insignificant Schedule Slippage</td>
<td>Schedule Slippage &lt;5%</td>
<td>Overall Project Slippage 5–10%</td>
<td>Overall Project Slippage 10–20%</td>
<td>Overall Project Schedule Slips &gt;20%</td>
</tr>
<tr>
<td>Scope</td>
<td>Scope Decrease Barely Noticeable</td>
<td>Minor Areas of Scope Are Affected</td>
<td>Major Areas of Scope Are Affected</td>
<td>Scope Reduction Unacceptable to the Client</td>
<td>Project End Item Is Effectively Useless</td>
</tr>
<tr>
<td>Quality</td>
<td>Quality Degradation Barely Noticeable</td>
<td>Only Very Demanding Applications Are Affected</td>
<td>Quality Reduction Requires Client Approval</td>
<td>Quality Reduction Unacceptable to the Client</td>
<td>Project End Item Is Effectively Unusable</td>
</tr>
</tbody>
</table>

The impacts on project objectives can be assessed on a scale from Very Low to Very High or on a numerical scale. The numerical (cardinal) scale shown here is non-linear, indicating that the organization wishes specifically to avoid risks with high and very-high impact.

**Figure 11–2.** Rating Impacts for a Risk
EXTRACT FROM "PROJECT RISK PROFILE", IBM

Identify the relative likelihood (Low - Medium - High) and relative impact (Low - Medium - High) from each of 123 sources of risk. The result is a "Project Risk Matrix". One extract page is shown below.

Training, Documentation and Support
Risk Factors: Likelihood (L,M,H) Impact (L,M,H)
- No-one is responsible for user training
- No one is responsible for documentation
- No one is responsible for support or help desk
- Users are not available for training

User Expectation
Risk Factors: Likelihood (L,M,H) Impact (L,M,H)
- Is being installed in an area of the company where Information Technology is not valued
- Have unrealistically high expectations
- Have unrealistically low expectations

User Impact
Risk Factors: Likelihood (L,M,H) Impact (L,M,H)
- Is being delivered to than one user community, for example, department or function
- Is being delivered to users illiterate in Information Technology
- Is being delivered to a large diverse user base with varying needs
- Involves users learning new skills or ways of working
- Is being delivered to users who do not understand the Implications on their work
- Involves reorganization of the company
- Has users who will not agree to changes in working patterns required by new system
- Is being delivered to users who do not realize extent of training required to use solution
RISK MANAGEMENT
Basic Concept

- Risk management focuses on:
  - Known unknowns
  - Proactive management

The alternative to proactive management is reactive management, also called crisis management.

This requires significantly more resources and takes longer for problems to surface.
Risk Management Plan

The systematic processes of identifying, analyzing & responding to project risks

A formal approach to the process as opposed to an intuitive one.

- Define objectives
- Identify Risk
- Quantify Risk
- Develop Response
- Risk Control
Risk Management Processes PMBOK

- Risk planning
- Risk assessment
  - Risk identification
  - Risk analysis/quantification
- Risk handling
- Risk monitoring
Risk management

- Risk management focuses on the future
- Risk and information are inversely related

Historically, we focused our attentions on schedule and cost risk management.

Today, our primary emphasis is on technological risk management:
  - Can we design it and build it?
  - What is the risk of obsolescence?
Why bother with Risk Management?

Arguments AGAINST

Arguments FOR
<table>
<thead>
<tr>
<th>Knowledge Area</th>
<th>Initiating</th>
<th>Planning</th>
<th>Executing</th>
<th>Controlling</th>
<th>Closing</th>
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<tr>
<td>4. Project Integration Management</td>
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<td>4.1 Project Plan Development</td>
<td>4.2 Project Plan Execution</td>
<td>4.3 Integrated Change Control</td>
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<td>5. Project Scope Management</td>
<td>5.1 Initiation</td>
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<td>6. Project Time Management</td>
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<td>5.2 Scope Planning</td>
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<tr>
<td>7. Project Cost Management</td>
<td></td>
<td>5.3 Scope Definition</td>
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<td></td>
<td>5.4 Scope Verification</td>
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<tr>
<td>8. Project Quality Management</td>
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<td>6.1 Activity Definition</td>
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<td>5.5 Scope Change Control</td>
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<td>10. Project Communications Management</td>
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<td>6.3 Activity Duration Estimating</td>
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<tr>
<td>11. Project Risk Management</td>
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<td>6.4 Schedule Development</td>
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<td>7.1 Resource Planning</td>
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<td>7.4 Cost Control</td>
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<td>7.2 Cost Estimating</td>
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<td>7.3 Cost Budgeting</td>
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<td>8.1 Quality Planning</td>
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<td>8.3 Quality Control</td>
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<td>9.3 Team Development</td>
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<td>9.2 Staff Acquisition</td>
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<td>10.1 Communications Planning</td>
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<td>10.3 Performance Reporting</td>
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<td>10.2 Information Distribution</td>
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<tr>
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<td></td>
<td>10.3 Performance Reporting</td>
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<td>10.4 Administrative Closure</td>
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<td>11.6 Risk Monitoring and Control</td>
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<td>11.2 Risk Identification</td>
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<tr>
<td></td>
<td></td>
<td>11.3 Qualitative Risk Analysis</td>
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<tr>
<td></td>
<td></td>
<td>11.4 Quantitative Risk Analysis</td>
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<tr>
<td></td>
<td></td>
<td>11.5 Risk Response Planning</td>
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<td>12.1 Procurement Planning</td>
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<td>12.6 Contract Closeout</td>
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<td>12.2 Solicitation Planning</td>
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<td></td>
<td></td>
<td>12.3 Solicitation Planning</td>
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</tbody>
</table>

**Figure 3-9.** Mapping of Project Management Processes to the Process Groups and Knowledge Areas
Decision-Making Categories

- Complete uncertainty
- Relative uncertainty (partial information)
- Complete certainty

Tolerance For Risk

- Risk avoider
- Risk neutral
- Risk lover
Developing and Using Payoff Tables

Establishing the procedure to follow

Construct the Payoff table

Decision-making under certainty

Maximin Approach
Maximax Approach
Minimax regret Approach
Insufficient Reason Approach

Decision-making under complete uncertainty

Expected Monetary Value (EMV) Approach
Expected Opportunity Loss (EOL) Approach
Expected Value of Perfect Information (EVPI) Approach

Decision-making under risk
FIVE STEPS TO DEVELOP PAYOFF TABLE

- List all the alternatives.
- List the future consequences of each alternative.
- Identify the payoffs associated with each combination.
- Assess the degree of certainty that these combinations will materialize.
- Decide on a decision criterion.
Developing Contingency Plans
Problem-Solving

Idea Generation:
Brainstorming
Risk Quantification

STAGE I  STAGE II  GUIDANCE  WARHEAD

PROGRAM SUMMARY

DESIGN

TEST

MANU.

COST

LEGEND

HIGH

MEDIUM

LOW
Risk Handling

- Assumption (retention)
- Avoidance
- Control (mitigation)
- Transfer
Future Risks

Customer’s Knowledge

Inexperienced

Experienced

Simple

Complex

Contract Type

INCREASING RISKS
How Much Risk is Acceptable?

- High tolerance for risk
- Medium tolerance for risk
- Low tolerance for risk
Degrees of Downstream Risk

Low Risk

R&D

Manufacturing

Marketing

Time
Degrees of Downstream Risk

Moderate Risk

- R&D
- Information Exchange
- Manufacturing
- Marketing

Time
Degrees of Downstream Risk

High Risk

R&D

Manufacturing

Marketing

Time
## Prioritization of Risks

<table>
<thead>
<tr>
<th></th>
<th>Schedule</th>
<th>Cost</th>
<th>Technical Performance or Quality</th>
</tr>
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<tbody>
<tr>
<td><strong>First (Highest) Priority</strong></td>
<td>![Checkmark]</td>
<td></td>
<td></td>
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<tr>
<td><strong>Second Priority</strong></td>
<td></td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td><strong>Third Priority</strong></td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
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</table>
### Risk Intensity

<table>
<thead>
<tr>
<th>Product Changes</th>
<th>Radical Breakthrough</th>
<th>Next Generation</th>
<th>Addition to Family</th>
<th>Add-ons &amp; Enhancements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market</td>
<td>• High</td>
<td>• High</td>
<td>• Medium</td>
<td>• Medium</td>
</tr>
<tr>
<td>Technical</td>
<td>• High</td>
<td>• High</td>
<td>• Medium</td>
<td>• Medium</td>
</tr>
<tr>
<td>Timing</td>
<td>• High</td>
<td>• High</td>
<td>• Medium</td>
<td>• Medium</td>
</tr>
<tr>
<td>Cost</td>
<td>• Low</td>
<td>• Medium</td>
<td>• Medium</td>
<td>• Low</td>
</tr>
<tr>
<td>Price</td>
<td>• Medium</td>
<td>• Medium</td>
<td>• Low</td>
<td>• Low</td>
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<tr>
<td>Quality</td>
<td>• Medium</td>
<td>• Medium</td>
<td>• Low</td>
<td>• Low</td>
</tr>
</tbody>
</table>
Risk Controls

Schedule Length

Too Long

Appropriate

Too Many Risk Management Filters and Gates

No Risk Plan
Risk Control Measures

Intensity of Controls

Range of Controls

Risk Intensity

Standard Controls

Low

Low

High

Extreme

Risk Intensity
Which Method to Use?

- **Rigid Policies/Procedures**
- **Guidelines**
- **Project Procedural Documentation**

- **Assumption**
- **Reduction**
- **Transfer**
- **Avoidance**

**Tolerance for Risk**
- High
- Low
The Risk-Reward Matrix
Mitigation Strategies Available

- Technical Risk Assessment and Forecasting
- Financial Risk Assessment
- Schedule Risk Assessment
- Market Risk Assessment and Forecasting
- Contract/Market Strategy

Numerous Opportunities for Tradeoffs Resulting from Risk Analyses

Limited 40
Interacting Risks

Specification Limit
On Characteristic B

Product Feature A

Desirable

Undesirable

Product Feature B

Undesirable
Desirable
Risk Planning

Customer Expectations

Actual Performance

Poor Risk Management

Technical Inability

Performance

Time