Estimating Project Risk Reserves

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Topics

- Basic Concepts and Notation
- The Spreadsheet
- Deciding to Accept or Mitigate
- Deciding to Prevent or Track
Definitions

- Definitions
  Risk = an uncertain condition or event that, if it occurs, could have a negative effect on the project, the product, or the process
  Mitigation = actions taken to reduce the impact of a risk

- Example of mitigation
  - Redesign so hardware won’t fail
  - Multi-version programming
  - Contract Terms and Conditions (‘Not my fault!’)
  - Purchase insurance
Goals

- Choose an "optimal" reserve amount (money)
  - Too large ⇒ overpriced
  - Too small ⇒ inadequate resources

- Provide justification for the amount
  - Hard reserve versus soft reserve
  - Documented calculations

- Advice on planning
  - Preventative versus contingent
  - Schedule impacts
Notation

• Basic Quantities

\[ P_B = \text{Probability of occurrence before mitigation} \]
\[ C_B = \text{Cost of occurrence before mitigation} \]
\[ P_A = \text{Probability of occurrence after mitigation} \]
\[ C_A = \text{Cost of occurrence after mitigation} \]
\[ C_M = \text{Cost of mitigation} \]

• Useful Quantities

\[ I_i = \text{Impact} = P_i \cdot C_i \]
\[ \text{RRL} = \text{Risk Reduction Leverage} = \frac{I_B - I_A}{C_M} \]
Handling Insurance

• Definitions:
  \[ C_F = \text{Face Value} \]
  \[ C_D = \text{Deductible amount} \]
  \[ C_I = \text{Cost of policy} \]

• Calculations
  \[ I_B = P_B \times C_B \]
  \[ I_A = P_B \times [C_B - (C_F - C_D)] \]
  \[ RRL = P_B \times (C_F - C_D)/C_I \]
## Risk Analysis Spreadsheet*

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*Based on concepts in [Hwang, 1973] and [Army, 1979].

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Est Proj Risk Res (27Sep02)
# Regions of the Spreadsheet

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Overlapping Risks

• Coupling
  – Mitigating one risk increases the impact of another risk
  – “Buy instead of build” reduces new development risk, but increases COTS volatility risk

• Compounding
  – One occurrence affects several components or tasks
  – The new ICASE tool lacks needed features, and is “buggy”
  – Reference Section 2.5.2 in [Boehm, 1989]
Overlapping Mitigation Actions

• One mitigation action affects multiple risks
  – Example: A high maturity process mitigates risks associated with multiple process areas
  – The concern: allocating $C_M$ to the risks so $RRL_i$ is realistic

• Alternatives
  – Allocate $C_M$ equally to the risks
  – Allocate $C_M$ in proportion to $(I_B - I_A)$
Computing the Appropriate Reserve

• Approach
  – Mitigate only risks with RRL > 1
  – Rank order risks by decreasing RRL

• Definitions:

\[ CMC = \text{Cumulative Mitigation Cost} = \sum_{RRL>1} C_M \]

\[ PTC = \text{Predicted Total Cost} = \sum_{RRL>1} I_A + \sum_{RRL<1} I_B + \sum_{RRL>1} C_M \]
# Sample Risk Analysis

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Est Proj Risk Res (27Sep02)
Predicted Total Cost vs Rank(RRL)
Deferring Mitigation Actions

- Some risks may never occur. (They expire)
- Some risks are almost certain to occur.
- Strategy to expend the risk reserve:
  - Preventative: Do something immediately
  - Contingent: Track the risk. Take action if threshold exceeded.
Choosing the Preventative Mitigation Actions

Mitigate a Task If:

1. $I_B > 0.05 \times \text{(Total Project Cost)}$

or

2. $RRL_i \geq 2$
## Applying the Two Criteria

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**Total Reserve** = $405.5K  
**Planned Tasks** = $227.0K
Addressing Schedule Risk

• Delays may occur due to:
  – Repair or rework
  – Dependence on predecessor tasks
    \( \Rightarrow \) all tasks not affected

• Possible approaches
  – Use a Resource Loaded Network
  – Add a column to spreadsheet for schedule slip (if identifiable)*

• Advice
  – Reduce coupling between tasks
  – Include slack in the branches of the network
  – Include tasks for “large” contingent actions in the network

*Reference Chapter 5 in [McConnell, 1996]
References


