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Risk Assessment of the Niagara Tunnel Project

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Overview

- Qualitative Risk Analysis
- Quantitative Risk Analysis
- Case Study – Niagara Tunnel Project

Finding the Right Approach

- Qualitative versus quantitative risk analysis
- Establishing correct approach for the specific challenge
- Risk management tools for infrastructure projects

Qualitative Risk Analysis

- Identify potential hazards facing the project
- For each hazard
  - rate likelihood of occurrence (1 to 5)
  - rate consequences (1 to 5) by category
  - identify existing mitigation measures
  - identify further mitigation measures
- Sort hazards into priority order
- Review and monitor throughout project

Qualitative Risk Analysis

- Identifies broad spectrum of hazards
- Focuses on what, who, and how of risk mitigation
- Used to prioritize risks

Qualitative Risk Analysis

- High level qualitative risk register
  - Basis for developing individual risk registers
  - Focuses on managing risks
  - Top risks reported to top management
- Risk Subregisters
  - Developed from high level risk register
  - Focus for detailed, real-time risk management
  - Roll up into high level risk register

Qualitative Risk Analysis

- Recognized approach for tunnel projects
- Usually a prerequisite for obtaining insurance for tunnel construction
- “Code of Practice for Risk Management of Tunnel Works”, prepared for the Association of British Insurers (ABI) and the British Tunnelling Society (BTS)

Qualitative Risk Analysis

Strengths

- Tool for identifying and managing risks during a project or operation
- Focuses on prevention and responsibility rather than impacts

Limitations

- Does not provide useful information for project costing and budgeting

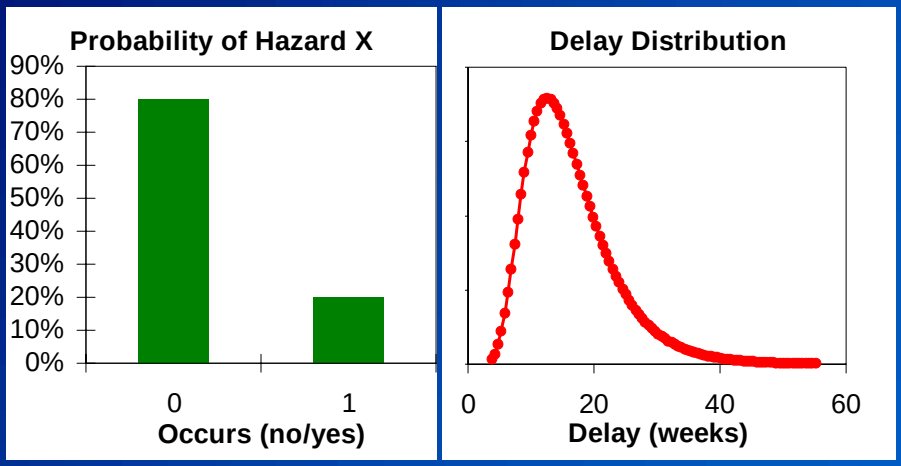
Quantitative Risk Analysis (RISQUE)

- *Risk Identification and Strategy using QUantitative Evaluation* (RISQUE)
- Methods pioneered by Adrian Bowden of URS Business Risk Strategies
- Used to establish realistic estimates to cover the cost of unforeseen events
- Used to model uncertainty in all cost estimates
- Can be based on any unit

Quantitative Risk Analysis (RISQUE)

- Establish a list of risks (risk register)
- For each hazard
  - estimate a probability of occurrence
  - identify consequence(s)
- Use Monte Carlo methods to combine

Quantitative Risk Analysis (RISQUE)



Quantitative Risk Analysis (RISQUE)

- Risk Cost determined by two methods:
  - Chance method – straight probabilistic approach
  - Threshold method – includes full cost of risks above a set threshold

Quantitative Risk Analysis (RISQUE) Probabilistic Costing

- Use to establish "unexpected events" portion of project contingency or reserve
- Establish a total "risk-inclusive" bid price
  - Analyze bids for construction
  - Compare different construction methods
- Able to integrate multiple variables in one analysis

Quantitative Risk Analysis (RISQUE) Probabilistic Costing

- Combined Probability Distribution of project cost and delay uncertainties
  - Combine hazards using Monte Carlo simulation
  - 80th percentile of resulting distribution typically used for project estimate

Quantitative Risk Analysis (RISQUE) Strengths of Probabilistic Costing

Strengths

- Provides a well-supported contingency amount for project budget purposes
- Supports benefit/cost analysis of options (e.g. different construction methods)
- Can be useful in analysis of bids

Limitations

- Does not handle risks with very low probability (<5%)

Quantitative Risk Analysis (RISQUE) Threshold Method

- Establish "risk threshold" for the project
  - Amount of impact acceptable in any given year without setting aside any special reserves
- Rank hazards by risk quotient
- Total Risk Cost is the sum of occurrence costs (not risk quotients) of risks that are higher than the "risk threshold" limit

Quantitative Risk Analysis (RISQUE) Threshold Method

- Establish amount of money Corporation is prepared to spend on risk mitigation
  - Use benefit / cost analysis to establish how to spend this money to best reduce Total Risk Cost

Quantitative Risk Analysis (RISQUE) Threshold Method

Strengths

- Analyzes and manages ongoing risk
- Provides an estimate of Total Risk Cost that does not underestimate impacts
- Analyzes where risk mitigation budget should be spent to best advantage
- Includes high risk events, regardless of likelihood

Limitations

- Not suitable for estimating project contingencies or cumulative delay

Case Study 1
Niagara Tunnel Project

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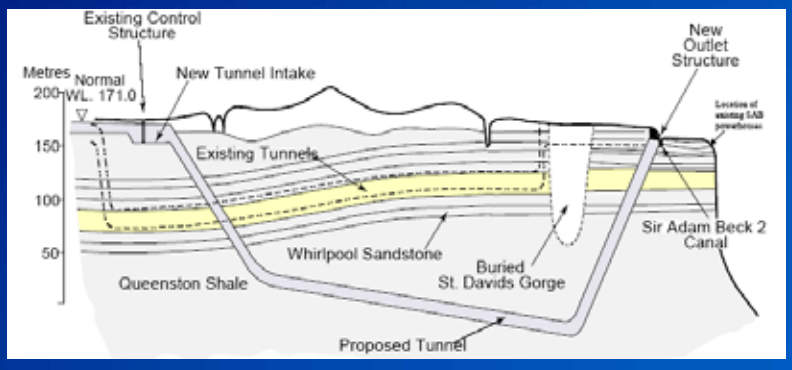
Niagara Tunnel Project



Case Study 1
Niagara Tunnel Project

- Qualitative Risk Assessment
  - Basis for detailed risk register
  - Managing the project
  - Insurance requirements
- "Chance Method" Risk Assessment
  - Project budgeting

Case Study 1
Niagara Tunnel Project
Expert Panel

- Consultant Team
  - Risk Analysis consultant
  - Technical consultants
- Expert Panel
  - OPG project team staff
  - OPG internal Risk Analysis group
  - preliminary design/oversight consultants

Case Study 1 – Niagara Tunnel Project Subregisters

- Approvals and permitting
- Stakeholder issues
- Planning and conceptual design
- Financial and contractual
- Logistics and access
- Final design and construction
- Environmental issues
- Safety and security

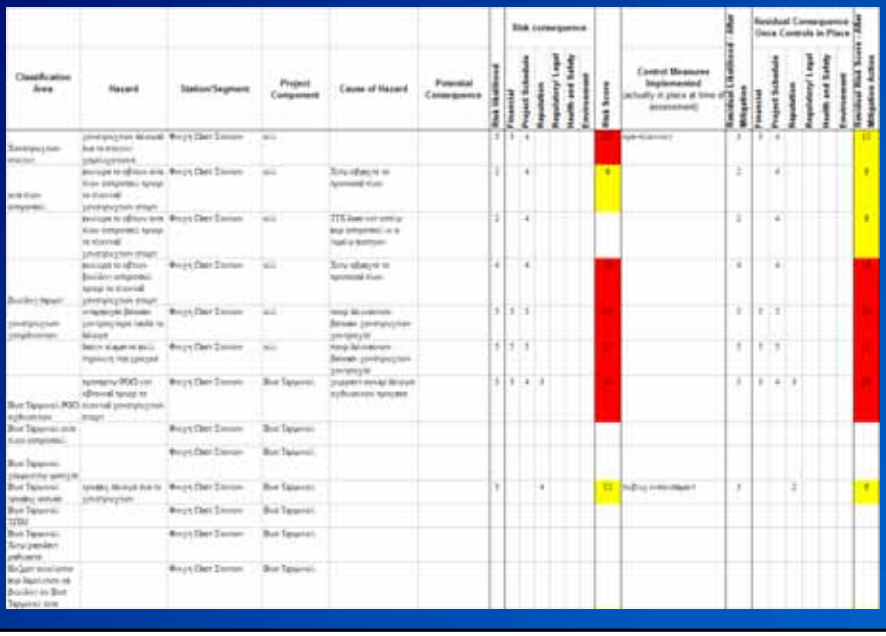
Case Study 1 – Niagara Tunnel Project Consequence Categories

- Financial
- Project schedule
- Corporate reputation
- Regulatory / legal
- Health and safety
- Environment

Case Study 1 – Niagara Tunnel Project
Illustrative Qualitative Rating Scale

Rating	Time Period
1	1-2 weeks
2	2-4 weeks
3	1-2 months
4	4-6 months
5	1-2 years

Qualitative Risk Analysis



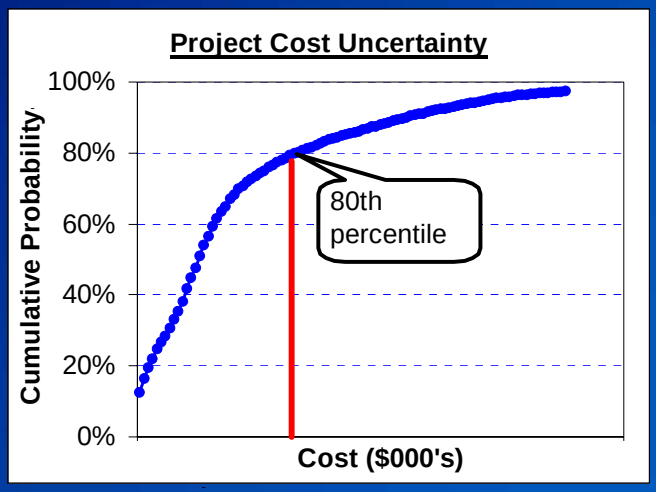
Case Study 1 – Niagara Tunnel Project
Principles for "Chance Method" Analysis

- "Seeded" from qualitative risk register using likelihood ratings and consequence ratings
- Eliminated hazards that had no cost or schedule impact
- Expert Panel reviewed elements and ratings
- Quantitative Risk Register

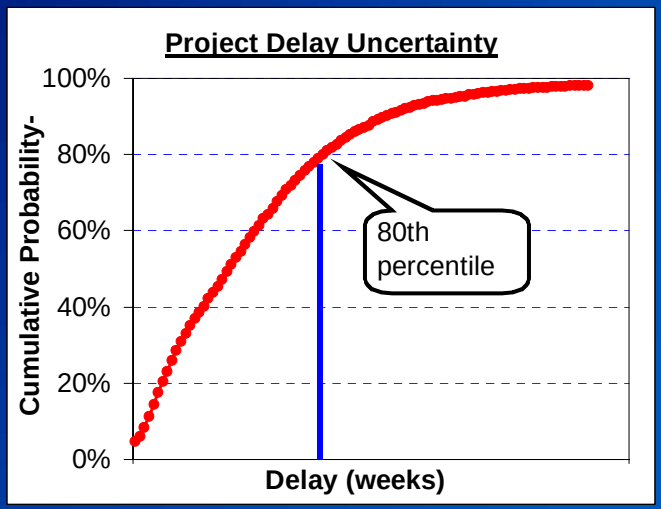
Case Study 1 – Niagara Tunnel Project
"Chance Method" Risk Analysis

- Project delays
  - Directly estimated as critical path delays (net of "float")
- Financial impacts
  - Direct costs
  - Economic losses, including delay impacts

Case Study 1 – Niagara Tunnel Project Financial Impact Estimate



Case Study 1 – Niagara Tunnel Project Delay Impact Estimate



Case Study 1 – Niagara Tunnel Project Results

- Qualitative risk register to be used during construction for regular risk monitoring
- Used “chance method” to help set internal contingencies