

# Engineering Risk Analysis

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# 1. Introduction

## Risk Analysis

→ objective of risk analysis is to improve the predictability of a project (used to manage commercial, technical and reputational risks)

→ is an ongoing process and not just the design and construction phases (e.g. strengthening of West Gate Bridge due to residual design deficiencies, increased loading, non-compliance with current standards)

1. **Uncertainty** → state of having limited knowledge where it's impossible to exactly describe the existing state or future outcome
2. **Risk** → effect of uncertainty on objectives (can be positive – have upside)
3. **Project** → organised undertaking or a special unit of work

## Project Risks

1. **Environmental** → air quality, noise and vibrations, erosion control, flora and fauna mgt, soil water mgt, cultural heritage mgt (e.g. EastLink Wetland System captures and reats 100% of road surface water run-off and trees removed have been replaced over time)  
→ pre-cast concrete panels and acrylic used as **noise barriers**  
→ **Air quality monitoring** conducted on EastLink to meet standards mandated by the Victorian Environmental Protection Authority (EPA)
2. **Political** → possibility of an unexpected politically-motivated event affecting the outcome of an investment (e.g. investment restrictions, operating restrictions, political stability, terrorism)
3. **Financial**
4. **Legal**
5. **Cultural**
6. **Quality**
7. **Stakeholders**
8. **Safety**

## Engineering Risks

→ the project's success depends on the project dynamics, if the project's risks are not sufficiently managed, the project can go beyond the timeframe, over budget and be of lesser quality than planned for

1. **Time** → baseline schedule, expected and actual time
2. **Cost** → base cost, delay, adjustment, overrun
3. **Quality** → scope, technical standards, benefits

### *Federation Square*

→ was costly (4 x over budget) and over the expected timeframe but considered to be of high quality

- Reactive response to emerging issues
- Sustained cost and time escalation
- Cash flow issues (not enough cash at a given time to pay contractors)

## Australian/New Zealand Risk Management Standard

1. *Establish the context* → involves the external (business, social, regulatory, cultural, competitive, financial, political) and internal environment (internal stakeholders, capabilities, capital, employees) and the purpose of the risk management activity
2. *Identify the risks* → what can happen and how/why, when/where could it happen and what are the consequences (who is affected)
3. *Analyse the risks* → develop an understanding of the risk and the consequences and likelihood, qualitative analysis is typically used as a general indication before quantitative analysis is conducted
  - *Qualitative analysis* → potential magnitude, likelihood and consequence of the risk is qualitatively analysed (risk grid can be used to analyse these factors simultaneously)
  - *Quantitative analysis* → numerical values used to analyse the consequence and analysis, can be conducted with statistical theory (sampling, confidence intervals, hypothesis testing, Monte-Carlo simulation, linear regressions)

4. *Evaluate the risks* → decisions made based on the outcome of the risk analysis  
→ risks ranked in terms of likelihood, possible cost and consequence to determine treatment priorities and where attention is needed most
5. *Treat the risks* → assess risk treatment options and prepare and implement treatment plans with consideration of priorities and resources
6. *Monitoring and review* → monitor activities and processes to determine effectiveness of measures taken to treat risk (data evaluation, audit, compliance measurement)

## 2. Qualitative Risk Analysis

Qualitative risk analysis is commonly used in all industries & technical disciplines and used for all aspects of project management (planning, procurement, design, construction, maintenance, operations).

### Managing risks

#### *Why manage risks*

1. **Commercial reasons** → statutory and legal requirements, market and revenue management, cost management, reputation, business improvement (profitability)
2. **Environmental reasons** → statutory and legal compliance, enhancement of reputation
3. **Social reasons** → statutory and legal compliance (access for disabled), 'employer of choice' status, health & safety management, community liveability enhancement (Melbourne's tourism – 'most liveable city')

#### *In what situations might we manage risks*

1. **Personal** → financial management, reputation and career advancement, statutory and legal obligations as a professional
2. **Business organisations** → statutory and legal requirements, market assessment and revenue projections, reputation and business credibility requirements
3. **Government organisation** → statutory and legal requirements, budget control, political direction and support, reputation and stakeholder support

#### *Where are we likely to participate in risk management*

1. **Employee** → planner, designer, project engineer, auditor
2. **Manager** → safety of employees, project or sections of a project
3. **Business owner** → statutory and legal compliance, commercial success, customer satisfaction (making sure products are delivered in time, are of sufficient quality, overall customer experience)

### Risk analysis process - structured approach to risk management

A systematic process that is ongoing and requires ongoing communication and consultation with stakeholders and a consultative team (ensure risks are identified effectively)

→ the Australian Standards provide principles and generic guidelines on risk management

1. *Establish the Context* → Understand the corporate risk profile and project risk context and the risk owner under consideration (who is responsible for the risk)  
→ AS/NZ code outlines a suitable process that can be followed for project organisations/situations  
→ many organisations have their own risk management policies and procedures, identified priority risk categories and corresponding risk management strategies.
2. *Identify Risks* → Identify the hazards and risks (What can happen that could affect the project, when and where would it occur, how and why could it occur)  
→ context of the risk is important in identifying risks and hazards (time period under consideration will depend on the context of the risk analysis, e.g. project life cycle, effective life of asset, peak operation period, emergency situations)  
**Hazard** is an event or situation that may give rise to a risk  
**Risk** is the chance of something happening that will have an impact on an organisation's or person's ability to achieve business or personal objectives  
**Control Measure** → an action taken to reduce the frequency and/or severity of a risk