

# Risk Management



## Risk Identification & Qualitative Risk Analysis

**Peter Bishop C.P.Eng**  
**2017**

# Risk Management Context

---

## Why manage risks?

### Commercial reasons:

- Statutory and legal requirements;
- Market and revenue management;
- Cost management ;
- Protection of reputation ;
- Business improvement (profitability);

### Environmental reasons:

- Statutory and legal compliance;
- Enhancement of reputation;

### Social reasons:

- Statutory and legal compliance;
- Achieve “Employer of choice” status;
- Health & safety management;
- Community liveability enhancement;



# Risk Management Context

---

## In what situations will you have to manage risks?

### Personal:

- Statutory and legal obligations as a professional”;
- Financial management;
- Reputation and career advancement;



### Business Organisations:

- Statutory and legal requirements;
- Market assessment and revenue projections;
- Reputation and business credibility requirements;



### Government Organisations:

- Statutory and legal requirements;
- Budget control;
- Political direction and support;
- Reputation and stakeholder support;



# Risk Management Context

**Where are you likely to participate in risk management?**

## **As an employee:**

- Planner;
- Designer;
- Project Engineer;
- Auditor;

## **As a manager:**

- Responsible for safety of employees;
- Responsible for a project, or sections of a project;
- Responsible for auditing a project or an operation;

## **As a business owner:**

- Responsible for statutory and legal compliance;
- Responsible for commercial success;
- Responsible for customer satisfaction;



# Risk Management Context

## Where are you likely to participate in risk management?

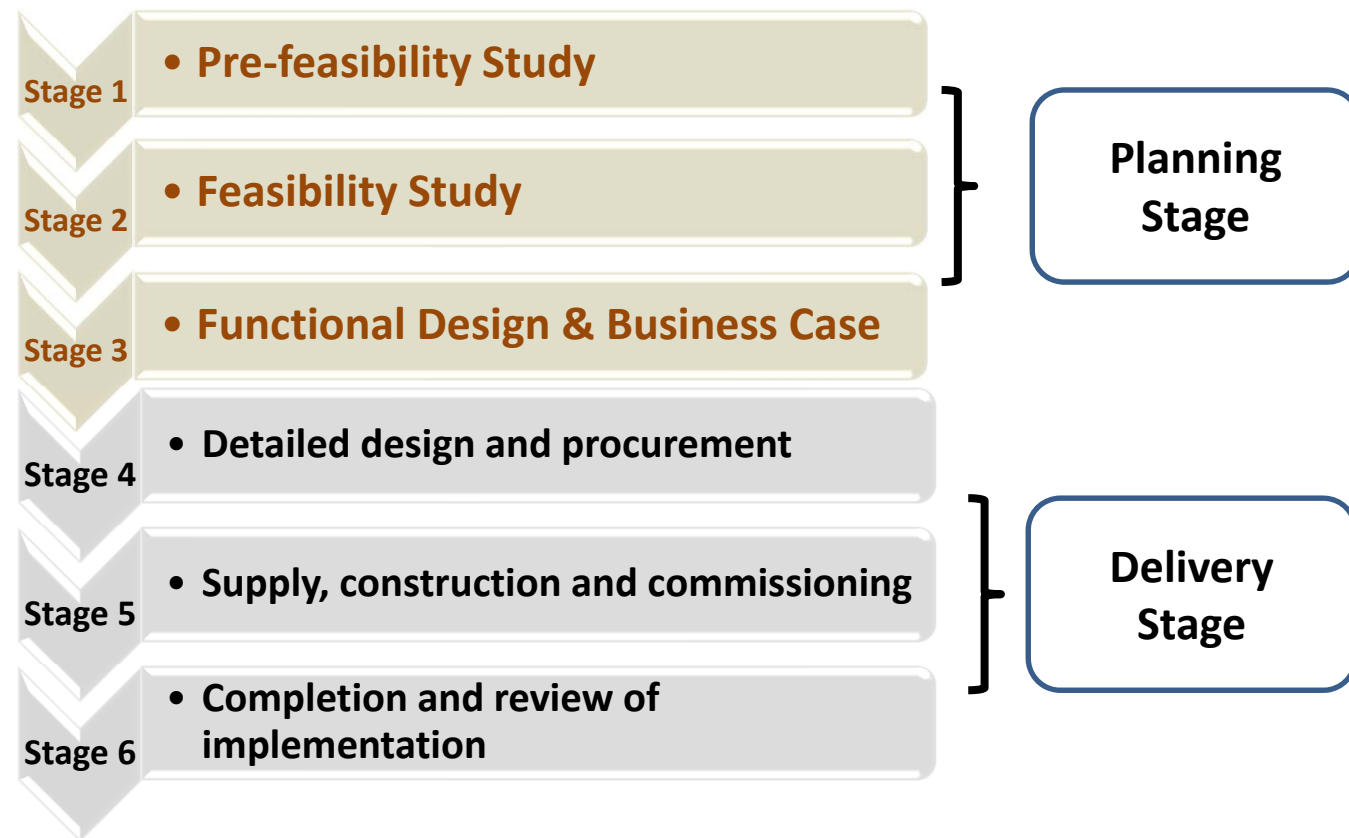
- A qualitative risk analysis process is commonly used in all industries & technical disciplines.
- It is also used for all aspects of project management:
  - Planning;
  - Procurement;
  - Design;
  - Construction;
  - Maintenance;
  - Operations;



Seawater  
Desalination Plant

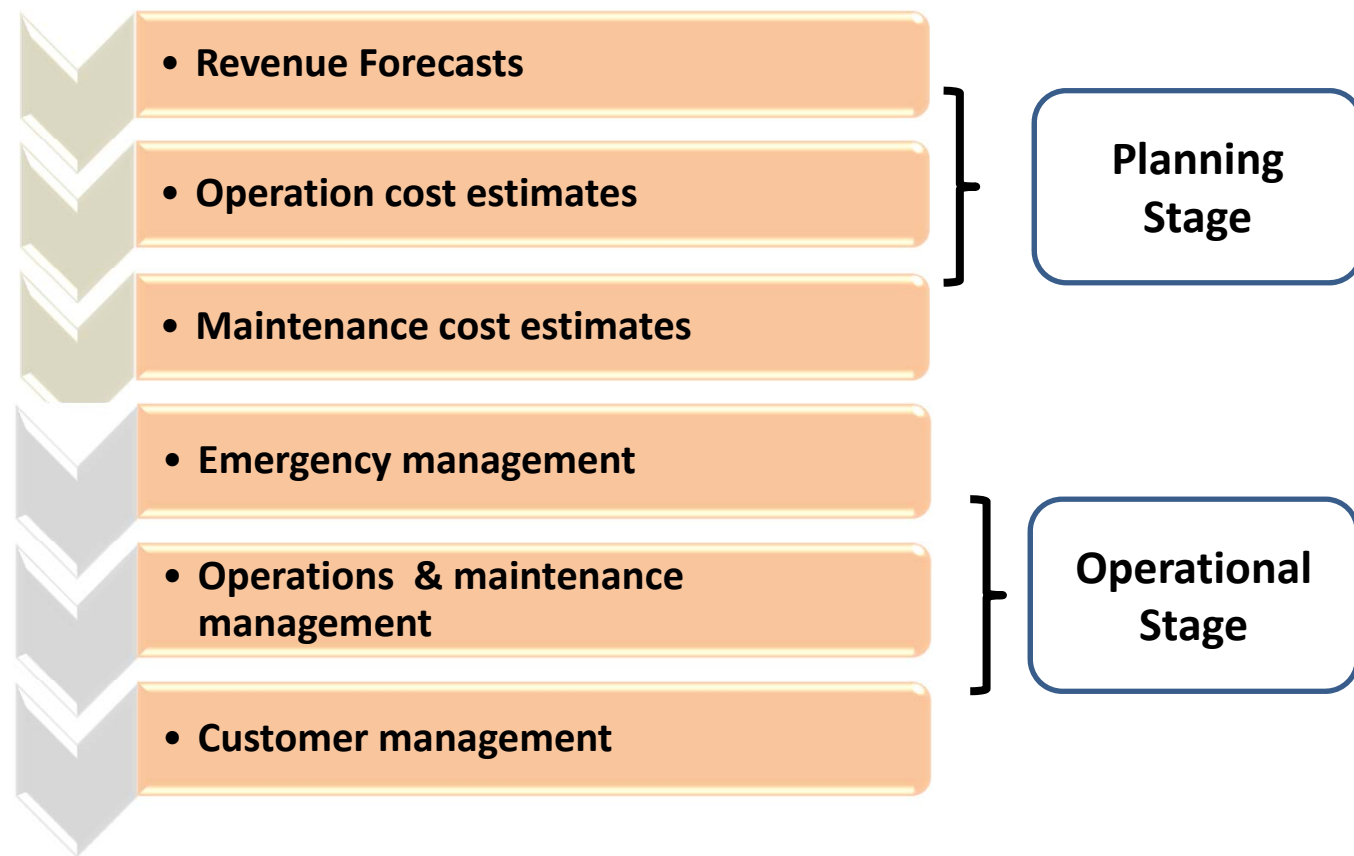
# Risk Management Context

Where are you likely to participate in risk management in the delivery of capital works ?



# Risk Management Context

Where are you likely to participate in risk management in the operational stage of projects?



# Risk Management Context

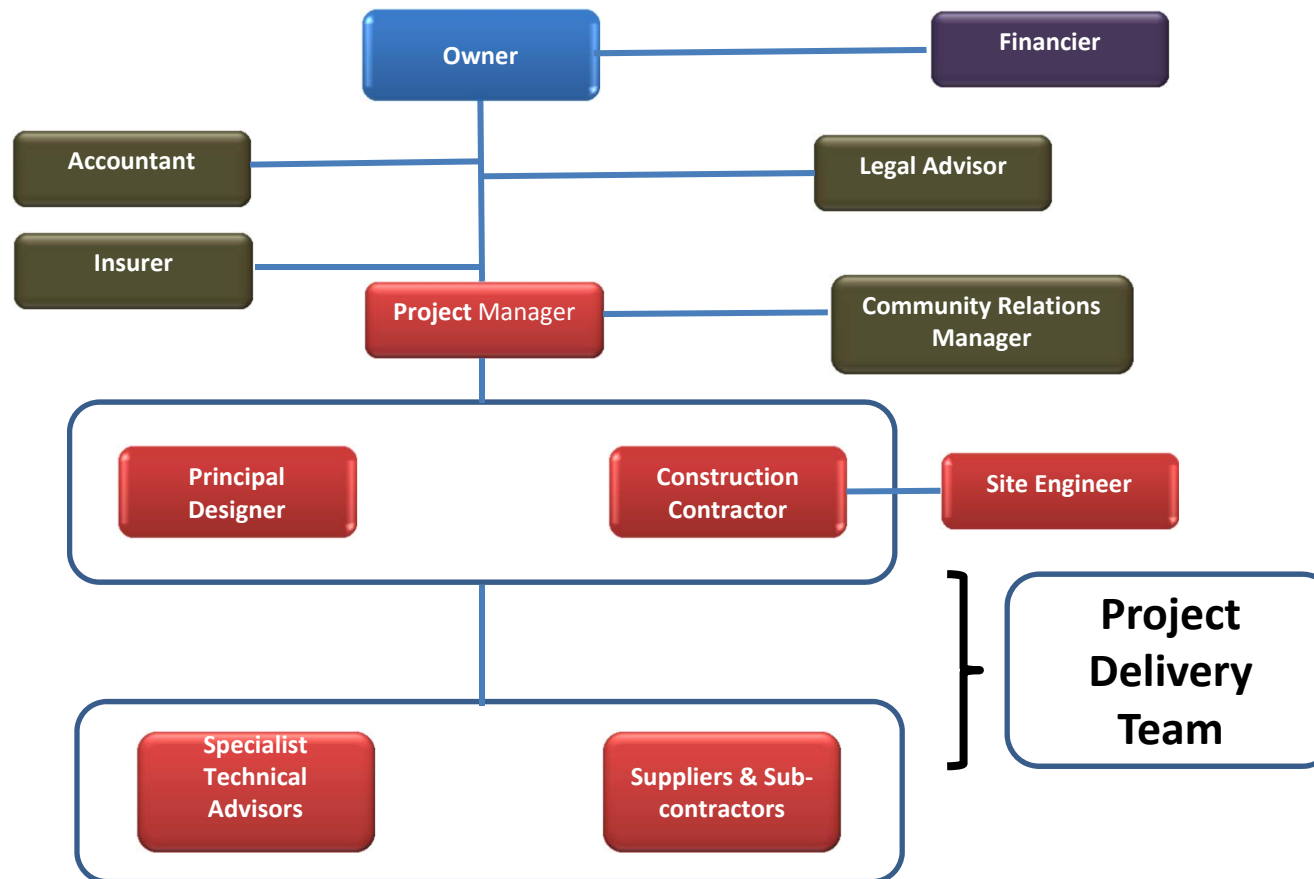
**Whose risks am I managing?**





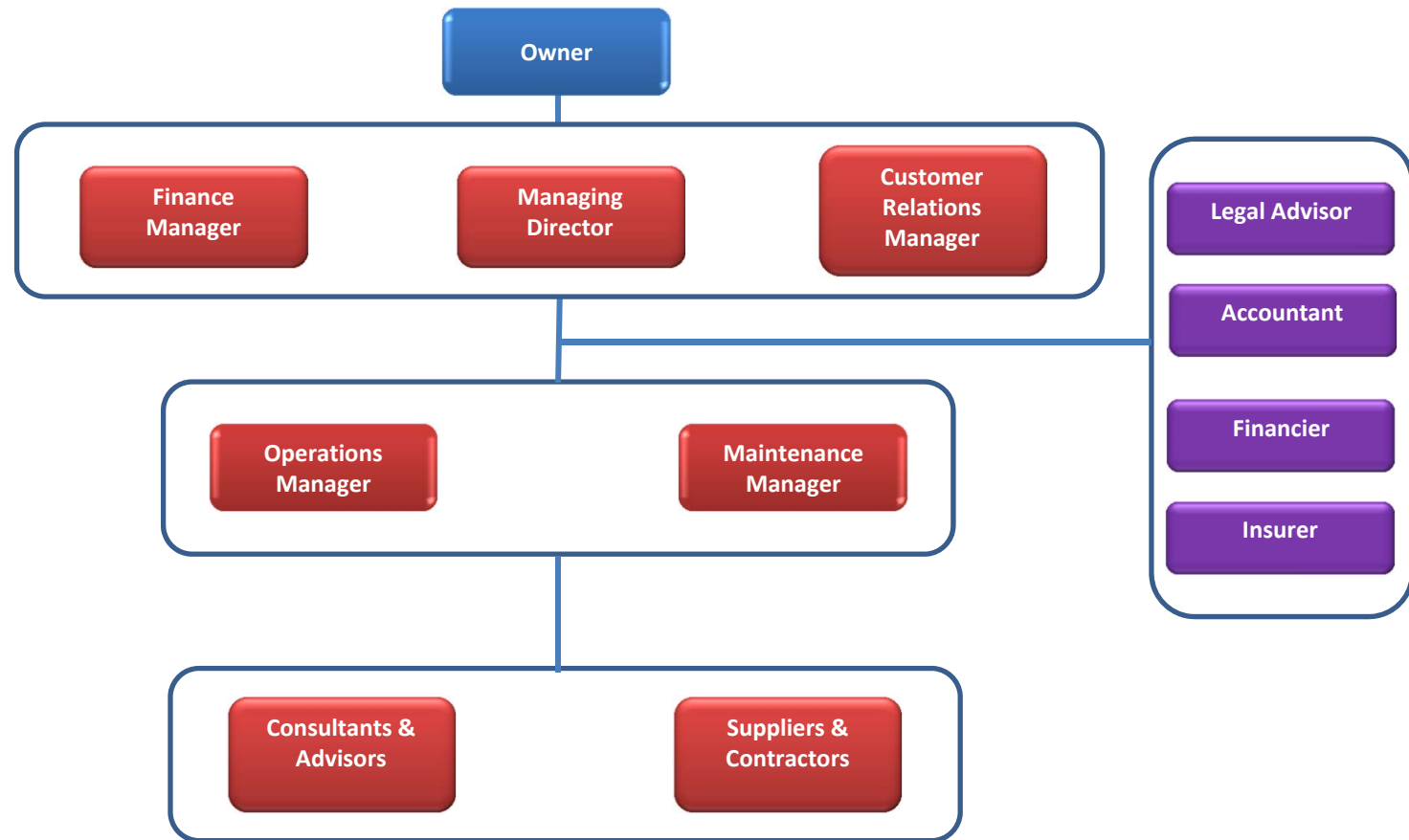
# Risk Management Context

Whose risks are you managing in the delivery of capital works ?



# Risk Management Context

Whose risks are you managing in the operation stage of projects?



# Risk Management Context

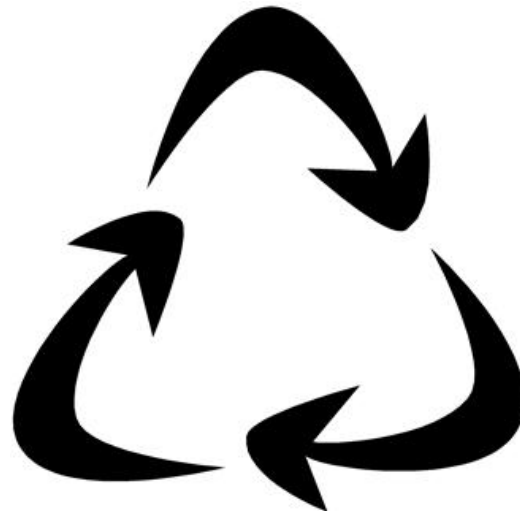
---

## How is risk management handled in large corporations or government organisations?

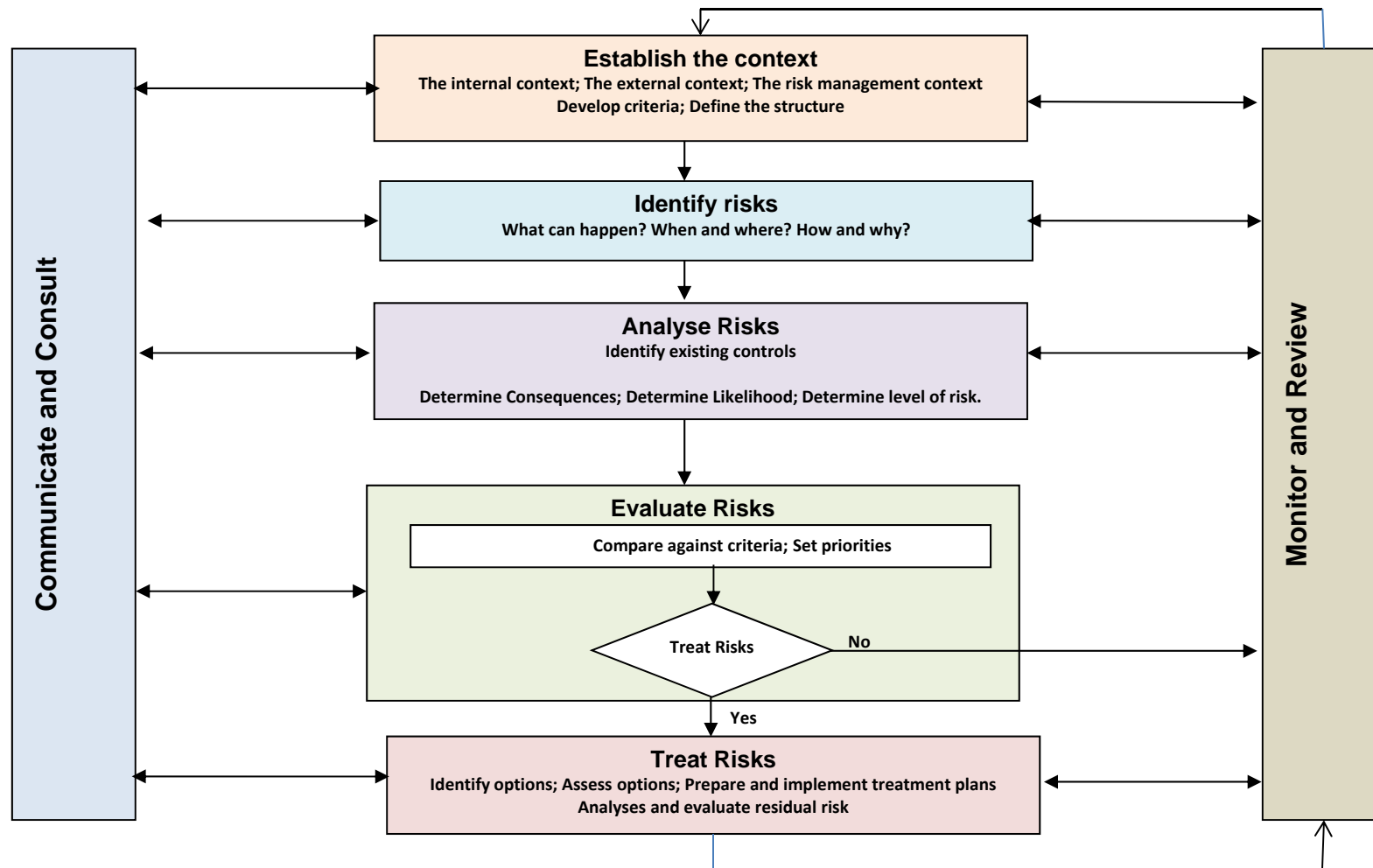
- A structured approach is normal;
- The categories of risk to be managed will be identified, such as:
  - Natural;
  - Political;
  - Legislative;
  - Operational;
  - Man-made;
- A documented framework is used to identify key business risks & provide a common approach across all operating divisions. Typical contents are:
  - Legislative & regulatory context;
  - Organisational context;
  - Committees (eg. Audit Committee);
  - Corporate policies;
  - Requirements for improvement Plans;
  - Manuals & Guidelines (general & specific such as HACCP);
  - Procedures & instructions (compliance & assurance);
  - Records such as a Risk Register & Audit Reports;
  - Risk management & insurance specialist support;

# Risk Management Process

**Is there a process I can follow that is suitable for any project organisation or project situation?**



# Typical Risk Analysis Process



# Risk Analysis Process

---

Obtain corporate information to understand corporate risk profile and management profile in context and nominate whose risks are being considered

Using a workshop methodology, identify hazards & associated risks and rate their likelihood & consequence

Using a workshop, analyse existing controls, develop new controls & assess their effectiveness by reviewing the likelihood & consequence rating

Based on the residual risk rating, develop an action plan for ongoing management of the residual risk

Use a risk register to record the process and to track the risks during the ongoing implementation of the project(s)

# Risk Analysis Process

---

*Understand the corporate and project risk context  
as your starting point for the qualitative risk analysis.*

- Many organisations have a risk management policy, identified priority risk categories and corresponding risk management strategies defined in a corporate framework document;
- Many organisations have a risk management manual and refer to the Australian Standard as the guide. (AS/NZS ISO31000:2009, Risk Management – Principles & Guidelines);
- See Australian Government Fact Sheet which provides a guide for Government Departments : [COV\\_216905\\_Risk\\_Management\\_Fact\\_Sheet\\_FA3\\_23082010\\_0.pdf](#)
- The overarching risk profile and the key business risks to the organisation will be described in corporate documentation;



# Risk Analysis Process

---

## Identify the Hazards and Risks?

The risk identification process can be simply broken down to answering the following questions:

- *What can happen that could affect the project or activity that I am involved in?*
- *When and where could it occur?*
- *How and why could it occur?*

Usually, this task is best facilitated in a workshop environment involving a range of diverse participants who can offer differing perspectives.





# Risk Analysis Process

---

## What is the difference between a hazard and a risk?

- **Hazard:** An event, situation or state that may give rise to a risk.
- **Risk:** The chance of something happening that will have an impact on an organisation or person's ability to achieve business or personal objectives.
- **Control Measure:** An action taken to reduce the frequency and/or the severity of a risk.

# Risk Analysis Process – Case Study

## Example of risk identification: A Forest Fire

Action	Hazard?	Risk?	Control measure?
Fire load (trees, grass , stored combustibles)			
High winds			
Sufficient trained fire fighters			
High temperatures			
Low humidity			
Adequate water supply for fire fighting			
Lightning strikes			



# Risk Analysis Process – Case Study

## Example of risk identification: A Forest Fire

Action	Hazard?	Risk?	Control measure?
Fire load (trees, grass , stored combustibles)	✓		
High winds	✓		
Sufficient trained fire fighters			✓
High temperatures	✓		
Low humidity	✓		
Adequate water supply for fire fighting			✓
Lightning strikes	✓		



# Risk Analysis Process – Case Study

## Example of risk identification: A Forest Fire

Action	Hazard?	Risk?	Control Measure?
Adequate insurance cover			
Assets nearby			
Community evacuation plan			
People nearby			
Fire breaks in forests & around communities			
Aerial fire fighting capability			
Good communications system			



# Risk Analysis Process – Case Study

## Example of risk identification: A Forest Fire

Action	Hazard?	Risk?	Control Measure?
Adequate insurance cover			✓
Assets nearby	✓		
Community evacuation plan			✓
People nearby	✓		
Fire breaks in forests & around communities			✓
Aerial fire fighting capability			✓
Good communications system			✓



# Risk Analysis Process – Case Study

## Example of risk identification: A Forest Fire

What are the risks to be managed?	What are risk control measures?
Big fire load + low humidity + high temperature + high wind. ( this is Scenario 1)	
Scenario 1 + lightning strikes	
Scenario 1 + a fire is ignited (this Scenario 2)	
Scenario 2 + near assets (Scenario 3)	
Scenario 2 + near people (Scenario 4)	
Scenario 3 or 4 + aerial equipment at another concurrent fire.	
Scenario 3 or 4 and communications system breaks down	



# Risk Analysis Process – Case Study

## Example of risk identification: A Forest Fire

What are the risks to be managed?	What are risk control measures?
Big fire load + low humidity + high temperature + high wind. (this is Scenario 1)	Remove hazard (pro-active) Implement pre-planning actions (pro-active) Implement fire risk warning system & mobilise resources
Scenario 1 + lightning strikes	Implement fire risk warning system & mobilise resources (pro-active)
Scenario 1 + a fire is ignited (this Scenario 2)	Implement fire risk warning system & activate resources (re-active)
Scenario 2 + near assets (Scenario 3)	Focus resources + notify asset owners (re-active)
Scenario 2 + near people (Scenario 4)	Focus resources + focus warnings (reactive)
Scenario 3 or 4 + aerial equipment at another concurrent fire.	Conduct risk analysis & possibly revise resource allocation.



# Risk Analysis Process – Case Study

## Example of risk identification: A Forest Fire

What are the risks to be managed?	What are risk control measures?
Scenario 2 + fire fighters elsewhere or too exhausted	
Scenario 3 or 4 + water supply runs out.	
Scenario 4 + community not aware of evacuation plan.	
Scenario 3 or 4 and wind changes direction during fire.	
Scenario 3 or 4 and communications system breaks down	





# Risk Analysis Process – Case Study

## Example of risk identification: A Forest Fire

What are the risks to be managed?	What are risk control measures?
Scenario 2 + fire fighters elsewhere or too exhausted	Mobilise pre-planned alternative resources
Scenario 3 or 4 + water supply runs out.	Monitor supply to know timing & revert to pre-planned containment techniques or alternative supply
Scenario 4 + community not aware of evacuation plan.	Macro & micro advisory systems + message escalation.
Scenario 3 or 4 and wind changes direction during fire.	Risk analysis with pre-planned actions and best possible meteorological monitoring & forecasting.
Scenario 3 or 4 and communications system breaks down	Risk analysis and pre-planned redundancy + multiple communications methods.



# Risk Analysis Process

---

## Determine the Likelihood Rating of Each Risk

### Purpose:

The analysis of risks requires an objective assessment of their frequency of occurring, based on historical events and some assessment of what has changed and may occur into the future.

**The following table is used to rate the likelihood of different risks occurring for a civil asset with say 100 year effective life:**

#	Rating	Description	Probability	Frequency – Civil Asset
5	Almost Certain	Risk will occur within the period	0.99	1 per year
4	Likely	Risk likely to occur within the period	0.98 - 0.50	1 in 1 to 4 years
3	Possible	Risk may occur within the period	0.49 - 0.20	1 in 5 to 19 years
2	Unlikely	Risk not likely to occur within the period	0.19 - 0.05	1 in 20 to 49 years
1	Rare	Risk will only occur in exceptional circumstances	0.04 - 0.02	1 in 50 years or greater

*Note: A more detailed quantitative analysis techniques can be used to determine the likelihood more accurately (see Lecture 2)*

# Risk Analysis Process

---

## Determine the Likelihood Rating of Each Risk

The frequency estimate will vary depending on the period under review for the given project & situation.

The 'period under review' is dependant on what is the context of the risk analysis:

Context	Period Under Review
An asset	Life of the asset class
A project construction cycle	Life of the project
A seasonal hazard	
A peak operation period	
An emergency situation	

# Risk Analysis Process

---

## Determine the Likelihood Rating of Each Risk

The frequency estimate will vary depending on the period under review for the given project & situation.

The 'period under review' is dependant on what is the context of the risk analysis:

Context	Period Under Review
An asset	Life of the asset class
A project construction cycle	Life of the project
A seasonal hazard	Say 4 months
A peak operation period	Varies: Say 8 hours
An emergency situation	Varies: Allow from 1hr to 1 week.

# Risk Analysis Process

---

## Determine the Consequence Rating

- The consequence of a risk actually occurring can be quantified in commercial terms (\$), environmental terms( such as contamination of a wetlands), or social terms (loss of amenity).
- Monetising all consequences is useful for combining a total impact. However, some consequences are difficult to monetise. (such as loss of a species)
- A qualitative assessment scale for analysis of consequences is shown below

	Consequence	Description
1	Insignificant	Almost no impact on the project
2	Minor	Small impact on the project that can easily be fixed
3	Moderate	Medium impact on the project that can be fixed with some effort
4	Major	Major impact on the project that will be difficult to fix
5	Catastrophic	Disastrous impact on the project that will be almost impossible to fix

# Risk Analysis Process

## Determine the Risk Priority or Risk Rating

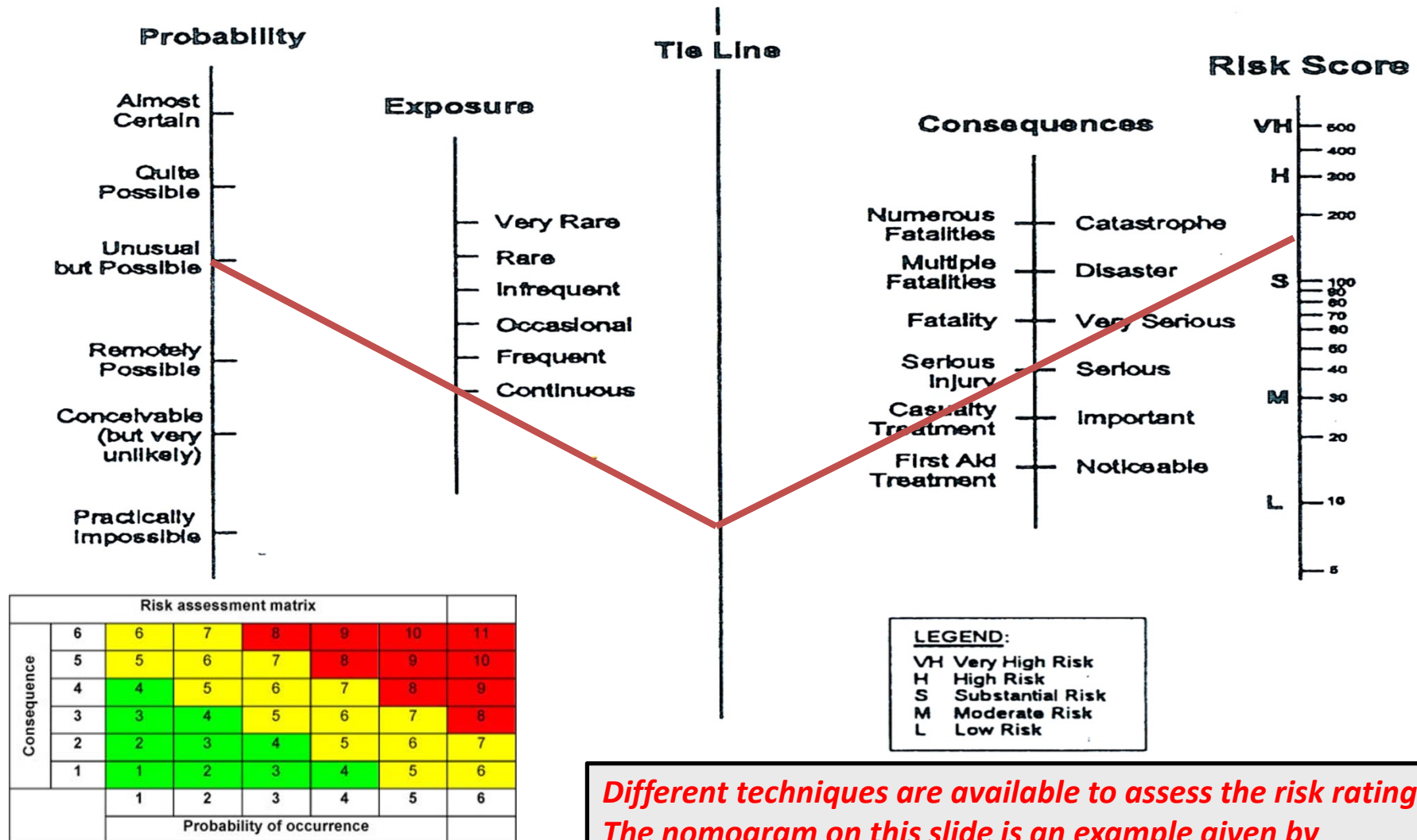
The likelihood and consequences of a risk occurring are used to determine the risk rating of either low, medium, high or extreme. The matrix below can be used to provide a visual method of categorising risks based on their risk rating.

To determine the risk rating, the Likelihood rating is added (+) to the Consequence rating. The addition of the two numbers produces a continuum number that is a number from 2 through to 10.

**Risk Rating Matrix**

	Likelihood				
Consequence	1	2	3	4	5
5	Medium	Medium	High	Extreme	Extreme
4	Medium	Medium	Medium	High	Extreme
3	Low	Medium	Medium	Medium	High
2	Low	Low	Medium	Medium	Medium
1	Low	Low	Low	Medium	Medium

# Example Risk Score Calculation



*Different techniques are available to assess the risk rating. The nomogram on this slide is an example given by Dr Birloni for a worker safety situation.*

# Risk Analysis Process

<https://mediumrisk.com/blog/what-is-a-risk-matrix-and-how-do-you-use-it/>

“It is often relevant to create risk matrices that are specific to your purpose and organisation, instead of relying on generic risk matrices like the examples shown in this post. However, a lot of details go into creating a good risk matrix. You have to make the right choices to get a correct result when assessing the risk. If you are creating a risk matrix for assessing risk to persons, you should really consider involving a risk management expert.”

<https://www.business.qld.gov.au/business/running/risk-management/risk-management-plan-business-impact-analysis>

<http://www.acera.unimelb.edu.au/>

[\*\*2014 Risk Assessment Example and Template - City of ...\*\*](#)

<https://www.geelongaustralia.com.au/.../8cbc48484619721-2014%20Ris...> [Cached](#)

2014 EVENT **RISK ASSESSMENT TEMPLATE.**

<http://searchdisasterrecovery.techtarget.com/Risk-assessments-in-disaster-recovery-planning-A-free-IT-risk-assessment-template-and-guide>

*Different techniques are available to assess the risk rating.  
Valuable reading is available on the web sites shown  
above.*



# Risk Analysis Process

---

## The Hierarchy of Risk Control Measures:

When reviewing the effectiveness of the current risk control measures , further measures can be introduced if necessary to reduce the frequency or consequences.

The following shows a hierarchy of control measures in order of effectiveness.

Eliminate or avoid the hazard or issue that is creating the risk	✓✓✓✓✓
Control the risk to an acceptable level & manage	✓✓✓✓
Transfer the risk to another party who can better manage the risk	✓✓✓
Accept the risk and manage it closely	✓

# Risk Analysis Process

---

## The Hierarchy of Risk Control Measures:

When reviewing the effectiveness of the current risk control measures , further measures can be introduced if necessary to reduce the frequency or consequences.

ISO 31000:2009 gives a list on how to deal with risk:

- Avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk
- Accepting or increasing the risk in order to pursue an opportunity
- Removing the risk source
- Changing the likelihood
- Changing the consequences
- Sharing the risk with another party or parties (including contracts and risk financing)
- Retaining the risk by informed decision

# Risk Analysis Process

---

## Effectiveness of Risk Control Measures:

Level	Descriptor	Guidance for Risk Control Rating
1	Excellent	The system is effective in mitigating the risk. Systems and processes exist to manage the risk and management accountability is assigned. The systems and processes are well documented and understood by staff. Regular monitoring and review indicates high compliance with the process.
2	Good	Systems and processes exist which manage the risk. Some improvement opportunities have been identified but not yet actioned. Formal documentation exists for key systems and processes in place to manage the risk that is reasonably understood by staff.
3	Fair	Systems and processes exist which partially mitigates the risk. Some formal documentation exists and staff have a basic understanding of systems and processes in place to manage the risk.
4	Poor	The system and process for managing the risk has been subject to major change or is in the process of being implemented and its effectiveness cannot be confirmed. Some informal documentation exists, however staff are not aware or do not understand systems or processes to manage the risk.
5	Unsatisfactory	No system or process exists to manage the risk.

# Risk Analysis Process

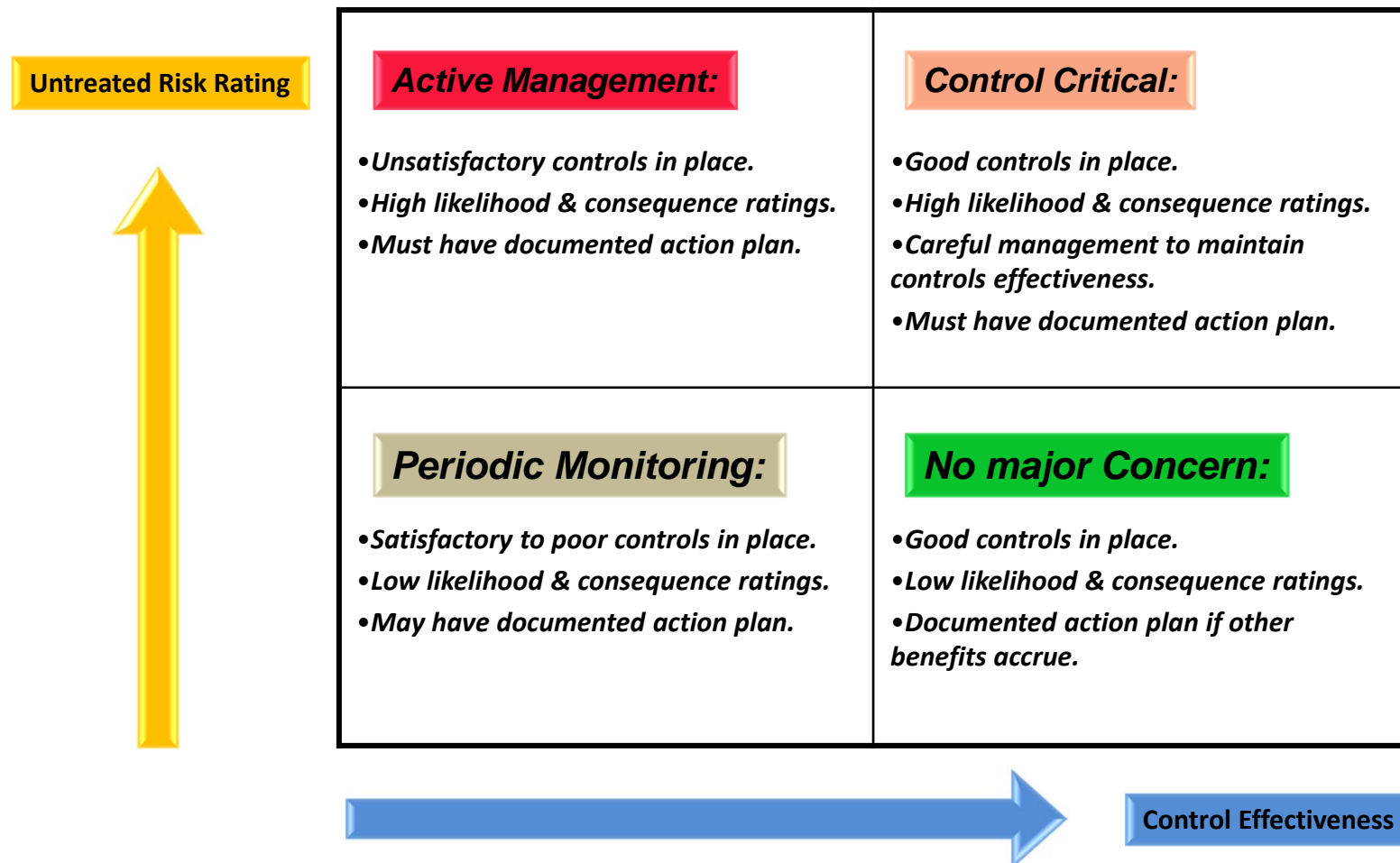
		CONSEQUENCE				
		5 Catastrophic	4 Major	3 Moderate	2 Minor	1 Negligible
L I K E L Y H O O D	5 Almost certain	Extreme (1)	Extreme (1)	Major (2)	Major (2)	Medium (3)
	4 Likely	Extreme (1)	Extreme (1)	Major (2)	Medium (3)	Minor (4)
	3 Possible	Extreme (1)	Major (2)	Major (2)	Medium (3)	Minor (4)
	2 Unlikely	Major (2)	Major (2)	Medium (3)	Minor (4)	Minor (4)
	1 Rare	Medium (3)	Medium (3)	Minor (4)	Minor (4)	Minor (4)

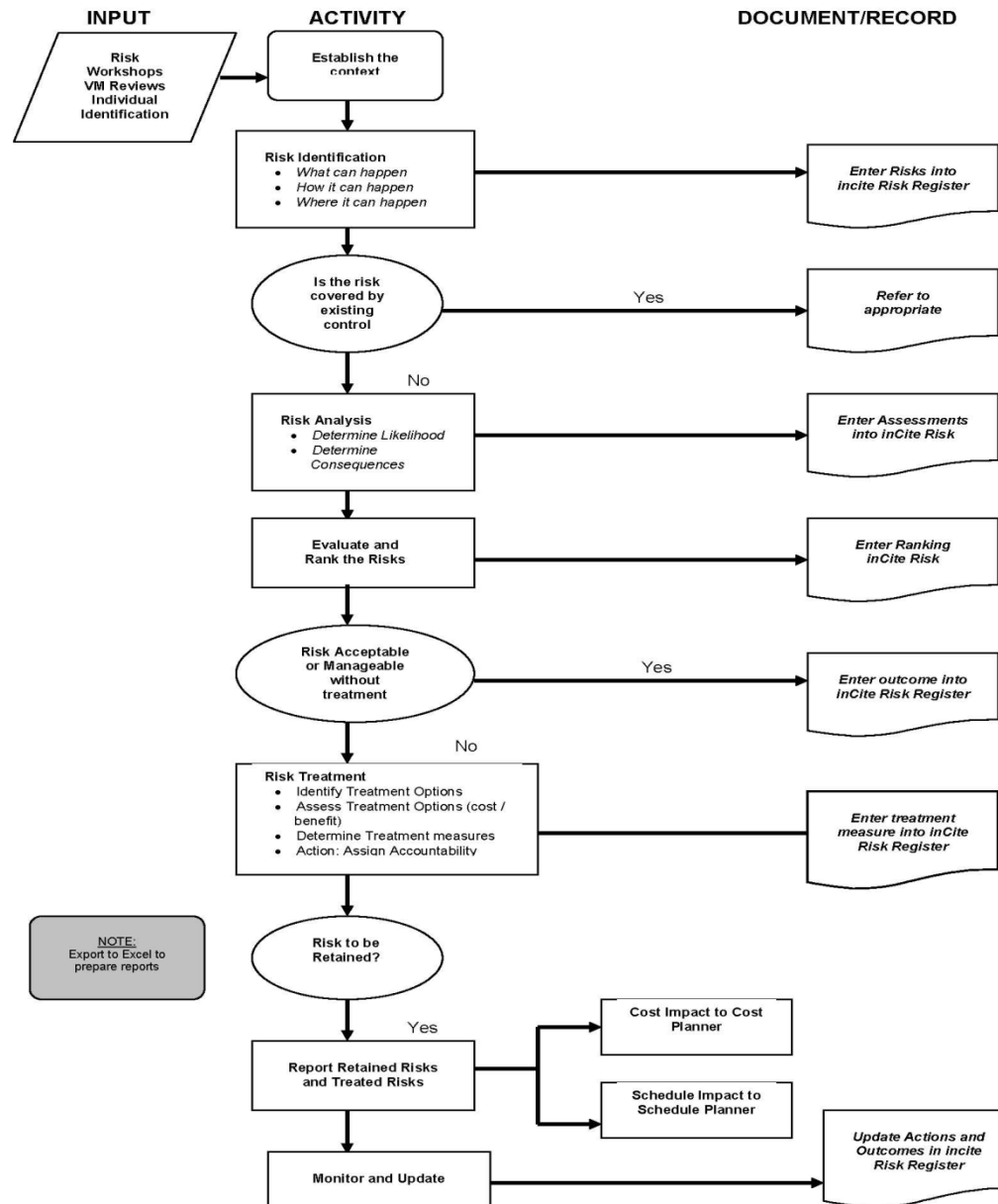
## Definitions:

<b>Extreme</b>	Extreme risks that are likely to arise and have potentially serious consequences requiring urgent attention
<b>Major</b>	Major risks that are likely to arise and have potentially serious consequences requiring urgent attention or investigation
<b>Medium</b>	Medium risks that are likely to arise or have serious consequences requiring attention
<b>Minor</b>	Minor risks and low consequences that may be managed by routine procedures

# Risk Analysis Process

## Final Assessment of Residual Risks:





An example of a risk analysis process applied to the determination of a cost contingency allowance for a construction project.

# Risk Management Process

---

## Documenting the Risk Analysis Process Using a Risk Register

**The business Risk Register is a common tool in corporate risk management Systems:**

- It can be used to filter risks, track progress, document action plans;
- It is useful for risk owners, auditors, managers, directors;
- It can be tailored to a reader's particular need for detail;
- Each business group within an organisation can have its own risk register, linked upwards to corporate policy level risks;
- The "top 10" risks can be highlighted in the Register for ongoing management.
- Control measures can be classified as "Proactive" (affect the likelihood of an event occurring), or "Reactive" (affect the level or duration of consequences) and monitoring can be tailored for each risk.
- **The Risk Register is supported by a report with workshop notes, analysis files, photos, diagrams & material that validates the summary in the Risk Register.**

# Typical Risk Register **Example**

Business Risk No	Date Risk Updated	Context / Hazard	Business Risk	Team	Responsible Name	Corporate Risks	Control Measure	Control Effectiveness	Likelihood (A)	Consequences (B)			Total Consequence (B)	Risk Rating (A+B)	Risk Rating Matrix Classification	Risk Management Classification
										Social	Environmental	Financial				
A001	27/3/14	Manual Handling	Back Injury	MelbUni	Student A	Risk of inadequate health, safety and security of people, property and environment	<ul style="list-style-type: none"> <li>- Manual handling training</li> <li>- Standard operating Procedures</li> <li>- Task Risk Assessments</li> </ul>	3	?	?	?	?	?	?	?	?

- Control Critical or
- Active Management or
- Periodic Monitoring or
- No major concern



# Risk Analysis Process

---

**Use the resources around you to undertake the risk analysis process**

- People with particular knowledge & previous relevant experience;
- Corporate policy, guidelines and manuals (context);
- Records of previous events or incidents (such as historical records, insurance reports, legal or governmental enquiries);
- Reports about the planning & implementation of similar projects;
- Outputs from brain-storming workshops using people with a wide range of expertise & experience.



# Risk Analysis Process

---

## Other resources available to undertake the risk analysis process

Standards Australia AS/NZS ISO 31000 & other codes



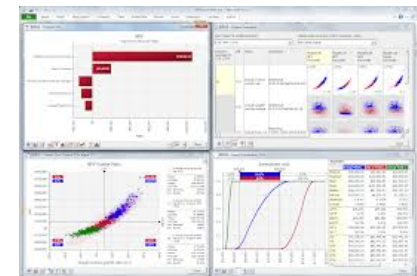
Proprietary software packages for quantified risk analysis such as the “Palisade” products:

<http://www.palisade.com/>

These allow you to analyse risks using quantitative techniques and to rank the top 10 risks on a probability basis (A Tornado diagram)



**@RISK**  
*Advanced Risk Analysis for Spreadsheets*



# Risk Analysis Conclusion

---

I wish I had  
done a risk  
analysis before I  
started this  
project !!!



# Case Study

Use up available water to generate hydro-electricity while the price is high.

Sell hydro power at high price

Undersea power cable to mainland

Import power at lower price when needed

Hydro Power needs rainfall.

“Moth-balled” stand-by power at high price



# Case Study

Use up available water to generate hydro-electricity while the price is high.

**Should we sell hydro power for a high price?**

- What is the primary risk ?
- We might run short of power

**What are the hazards in this project decision?**

- Rainfall availability to restore the water resource
- Back-up power source if required.
- Infrastructure failure

Friday 4 March 2006  
The Australian Financial Review | www.afr.com **AFR**

## Hydro Tasmania faces questions over crisis

Ben Potter

Companies that use a lot of electricity want to know why Hydro Tasmania, the state-owned electricity monopoly, sold power to Victoria last year only months before shortages hit the island.

Extremely low spring rainfall and the failure of the Basslink undersea transmission cable to Victoria in December have pitched the state into an energy crisis without an end date that will cost tens of millions of dollars a month to fix.

There was a Bureau of Meteorology El Nino warning current when Hydro sold large volumes of power to Victoria via Basslink from May to September last year, and rainfall was below average from late May.

"One has got to ask the question, 'if there was an El Nino warning and low inflows [into Hydro's dams], why were they exporting?'" an official with a large energy user said.

He also asked why Hydro didn't crank up the Bell Bay No. 3 gas plant - which was used only at times of peak demand last year - until January.

Hydro spokeswoman Samantha Meyer said although hydro storage was low on average at the start of winter, inflows were near or above budgeted levels and some small dams had either to spill water or generate power - with the surplus exported to Victoria.

She said the rapid onset and severity of the unfavourable spring weather was "not predicted by anyone".

Legal battles over who pays for the electricity crisis will dog Tasmania for years, Mier White of Gonsu Energy Consulting said on Wednesday.

The Tasmanian government - which budgeted for a \$157 million deficit this year before the crisis - will have to make do without its annual cash injection from Hydro, which has poured about \$650 million into Treasury coffers in the past four years.

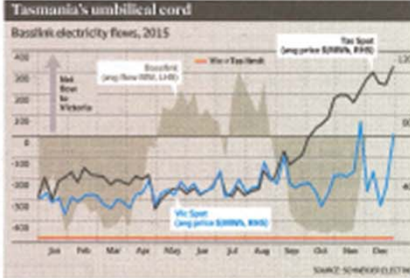
"There is no question that managing the current challenge comes at a cost," Ms Meyer said. "There is likely to be an operating loss this financial year."

Basslink sent huge volumes of

Hydro sold large volumes of power to Victoria despite an El Nino warning.

**Tasmania's umbilical cord**

**Basslink electricity flow, 2015**



cheap Victorian power to Tasmania from October - when the dry set in - until 20 December, when Basslink faded.

Since then Hydro has made up the difference with power from Bell Bay No. 3, an older gas plant with an estimated cost of generation of nearly \$100 a megawatt hour, and re-commissioned the Tamar Valley combined cycle gas turbine, with a cost of about \$90 a megawatt hour.

Major users such as Rio Tinto's Bell Bay Aluminium, South32's Teneco manganese smelter and Norske Skog's newsprint mill have shed about 100 megawatts of capacity between them at Hydro's request, data from Schneider Electric shows. Nyrstar, which operates a zinc smelter near Hobart, is in discussions with Hydro about load shedding.

Hydro is importing 200 one-megawatt diesel generators to make up the shortfall with an upfront cost of \$44 million and a monthly operating cost of about \$22 million at full tilt.

The energy they produce will cost an estimated \$185 to \$250 per megawatt hour.

► Features p37



# Case Study

Use up available water to generate hydro-electricity while the price is high.

## What happened?

- Expected rainfall failed
- Undersea cable failed.
- Stand-by power units not ready.
- Industry forced to reduce output to conserve power.

## What would you have done?

- Risk Analysis
- Low probability/ high consequences
- So ???

