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Specialists in Strategic and Project Risk Management

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Broadleaf Risk Management for National Critical Infrastructure

**Risk Management for
National Critical Infrastructure**

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Broadleaf Risk Management for National Critical Infrastructure

Summary

National critical infrastructure
Risk management and the risk manager
Risk identification: 'random' failures and deliberate disruption
Risk analysis and risk evaluation
Implications for the risk manager

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National critical infrastructure is defined as

... those physical facilities and those information technologies and communications networks which would, if destroyed, degraded or rendered unavailable for an extended period, impact on the social or economic well-being of the nation or affect Australia's ability to conduct national defence or ensure national security

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The criticality of infrastructure is assessed in terms of ...

The impact or consequences of a failure of an asset or a disruption to services
The duration of the failure (the recovery time to restore services)
The presence of other sources of supply (the degree of redundancy within the sector)

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These factors are closely inter-related.

Note that recovery time is not always the same as repair time, particularly if there are other sources of supply.

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Role of the risk manager in relation to critical infrastructure is to assist in ...

- Identifying and ranking critical infrastructure
- Identifying threats and vulnerabilities
- Identifying risks and the consequences of failure
- Developing effective risk treatments, including disaster recovery plans

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These condense to a set of questions common to most risk management:

- Where should we be focussing our attention?
- What are the specific risks we should address?
- How should we deal with each major risk, either to reduce its probability or consequences, or to recover from it should it occur?

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The recommended risk management process is AS/NZS 4360

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The Australian and New Zealand Standard on Risk Management, AS/NZS 4360:1999 is the recommended approach across most areas of Australian Government. (Why: because it is simple and it works.) This will promote common approaches and better communication.

For security-related assessments, this becomes part of an integrated intelligence cycle.

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The Standard AS/NZS 4360 provides a common framework for risk management

- A common understanding of the processes and its components
- Shared definitions of risks and risk levels
- A basis for common information collection, analysis and cooperation between agencies
- A common framework for risk treatment
- A basis for scenario planning and training

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Risk identification: what kinds of risks are relevant? We need to distinguish between ...

- 'Random' failures
 - Failures due to intrinsic characteristics of the asset or its operations and maintenance regime
 - Failures due to natural events
- Deliberate disruption
 - Failures associated with malicious acts

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It is important to distinguish between these kinds of risks because they involve different forms of :

- Thinking and structuring;
- Data availability, information analysis and quantification;
- Modelling and risk analysis;
- Treatment actions.

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Risk analysis determines the characteristics of potential risk events in terms of ...

The consequences or impacts of risk events on important criteria

The probabilities that these levels of consequences will arise should each risk event occur

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Consequences of risks to critical infrastructure

National

- Social well-being: inability to conduct the socially accepted way of life, fear, uncertainty
- Economic well-being: effect > 0.01% of GDP
- Defence and national security

Local

Asset-specific

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Consequences are often defined more specifically in terms of effects on ...

- People and the community
- Physical assets and the economy
- The environment and natural resources
- Classified material
- Intangibles (eg. national security)

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The degree of overall consequence depends on several factors

Asset vulnerability (capacity, redundancy, single points of failure, interdependencies)

The intensity of the effect (how big)

The spatial distribution of the effect (the area that may be affected)

Temporal factors (warning time, time of occurrence, duration, frequency)

Response options (what can be done to recover, and how quickly)

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Most of these consequences are difficult to measure. Economic well being might be expressed in dollars, but quantification is difficult. It may be easier to quantify asset damage and repair costs at the asset level, but it is still a large task.

Other consequences must use other measures.

Note: Australian GDP is approximately AUD 730 billion per annum, so 0.01% of GDP is AUD 73 million. (see <http://www.rba.gov.au/Statistics/Bulletin/G10hist.xls>)

Effects are often defined in terms of simple ordinal scales (e.g. from Insignificant to Severe), with descriptors for each point on the scales and a tabular form.

However, before consequences can be rated on scales like these, it is usually necessary to think through all the direct and indirect effects of the initiating events, and often the responses, particularly if there are likely to be secondary risks associated with the responses themselves.

This requires thinking about how an event might happen, and possibly developing scenarios to describe the range of outcomes that might arise.



On 14 August 2003, a cascading blackout struck large areas of the north-east USA and southern Canada. For a detailed timeline of the blackout, see http://www.doe.gov/engine/doe/files/dynamic/1282003113351_BlackoutSummary.pdf

New York without lights! Picture source: http://www.jbemmerl.com/usa_2003.htm

Northeast Blackout Likely to Reduce US Earnings by \$6.4 Billion

Patrick L. Anderson, Principal, and Ilhan K. Geckil, Economist

Anderson Economic Group Working Paper 2003-2
http://www.andersoneconomicgroup.com/Publications/articles_pressreleases/blackout_AEGwp2003-2.pdf



The Economist, print edition Aug 21st 2003:
‘Although it was not the work of terrorists, the great blackout is reminding American firms that their defences remain haphazard and inadequate.’
http://www.economist.com/displaystory.cfm?story_id=2009374

This picture, included in the original conference presentation and widely available on the internet, is claimed to be from ISAT Geostar 45, 23:15 14 Aug 2003, reference 003/45/7844. However, there seems to be good evidence that it is a fake!



For comparison, the lower picture is a USA night lights cloud-free composite image taken by the DMSP from Oct. 1, 1994, to March 31, 1995. National Oceanic and Atmospheric Administration (NOAA) processed the data from the Defense Meteorological Satellite. Credit NOAA/DMSP. Source:

<http://www.noaanews.noaa.gov/stories/images/usa-nightlights1994-1995b.jpg>

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Risk analysis for random failures: quantitative models combine ...

- The probability that a failure occurs (often modelled as a random process)
- The extent of loss if there is a failure (the distribution of costs per day if there is a failure)
- The time taken to restore the service (the number of days taken to respond to and repair the failure)

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Analysis of random failures and their consequences is well known and relatively common. It is usually quantitative, and often complex.

For an example at the asset level, see Chapman, C.B., D.F. Cooper and A.B. Cammaert (1984) Model and situation specific OR methods: risk engineering reliability analysis of an LNG facility. J Operational Research Society 35(1): 27-35. (This paper was awarded the President's Medal of the Operational Research Society.)

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For security assessments, risk (or threat) probabilities are usually disaggregated

```

    graph TD
      TP[Threat probability] --- SA[Subject attributes]
      TP --- A[&]
      TP --- AA[Asset attributes]
    
```

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Note that the ampersand ‘&’ is used to denote a process for combining subject and asset attributes, without specifying the detailed method. In some areas, attributes are ranked on ordinal scales, and simple matrix structures are used to combine them to generate an estimate or indicator of threat probability, again on an ordinal scale.

Similar processes are often used in the examples that follow, as in many cases any more precise form of quantification is difficult or fruitless, given the imprecise and subjective nature of the data.

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Disaggregation of subject probabilities: attributes of a potentially hostile entity

```

    graph TD
      SA[Subject attributes] --- I[Intent]
      SA --- C[Capability]
      I --- D[Desire]
      I --- CO[Confidence]
      C --- R[Resources]
      C --- K[Knowledge]
    
```

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Each of the four components can be disaggregated further if appropriate.

- Desire: commitment, previous activities, world and local political events or issues, attractiveness of target ...
- Confidence: confidence in ability, perception of security weaknesses ...
- Resources: people, equipment, finance, local support ...
- Knowledge: asset, security situation, expertise, training ...

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Disaggregation of asset probabilities: attributes of an attractive target

```

    graph TD
      AA[Asset attributes] --- S[Symbolic]
      AA --- P[Physical]
      AA --- B[Behavioural]
    
```

Symbolic & **Physical** & **Behavioural**

- Symbolic**: Strong national, religious, cultural or political characteristics
- Physical**: Material characteristics of assets and their vulnerability (size, location, itinerary, level of protection)
- Behavioural**: Personal characteristics, actions, utterances

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The behavioural attributes are more relevant to people who might be targeted than to physical assets. (A facetious thought – are politicians critical national assets?)

The asset characteristics often serve to modify the assessments of subject characteristics – the two aspects of subject and asset analysis should be integrated.

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Controls may reduce the probability and consequences of a disruptive act and the level of risk

For example:

- Security force investigation (reduces confidence, resources)
- Increased physical security (confidence, knowledge, asset attributes)
- System redundancy (consequences)
- ...

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Risk analysis: simple matrix approaches are often sufficient

	Consequences				
	Insig	Minor	Moderate	Major	Severe
Likelihood	E	D	C	B	A
A Almost certain	Low		High		Extreme
B Likely	Medium			High	
C Possible	Low		High		
D Unlikely	Low		High		
E Rare	Low		High		

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Levels of risk are often defined in terms of the need to take action

Extreme

- Immediate action is required, at high Government level

High

- Asset owners and operators must take action, regulators are probably involved

Medium

- Action is required to reduce risk at the asset level

Low

- Routine procedures are often sufficient

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Implications for the risk manager: the perceived levels of threat are increasing

- There will be more work to do, more urgently
- Regulatory requirements are becoming more stringent
- Potential liabilities are increasing as litigation becomes a more common response to the occurrence of an incident, however caused
- Insurance premiums are rising as a result

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Implications for the risk manager: increased need to communicate and coordinate

- Many of the conceivable threats involve assets that are part of integrated systems
- Multiple agencies would be involved in responding to a major incident
- There will be increasing needs for integrated assessments and coordinated responses

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Insurance must be managed here as in any other area of risk. Good risk management is a tool for premium reduction if you can demonstrate its effectiveness.

In Australia, Infrastructure Assurance Advisory Groups and a Critical Infrastructure Advisory Council are being established to facilitate coordination and integration.

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Implications for the risk manager: greater engagement with stakeholders

- Most critical infrastructure involves many stakeholders, either as owners, operators, neighbours or users
- Public perceptions and community responses may be critical to success if an incident occurs
- Good stakeholder communications skills will be vital

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Relationships with neighbours, planning authorities, regulators, emergency services, ... are all important.

We worked with an oil refinery to assess the risks associated with planning regulations in the nearby residential areas. That involved a range of matters, from monitoring complaints (particularly about odours and emissions) through to evacuation plans at the other extreme.

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**Implications for the risk manager:
integration with 'routine' risk management**

Many of the processes and procedures for critical infrastructure should be part of routine risk management within an asset-based organisation, at least for inherent failures and natural events

Wider systemic matters may need to be included for assessing the consequences of incidents to some critical assets

Security assessments may require new sources of information and wider consultation

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If you are working with national critical infrastructure, your risk management processes will be substantially the same as those you employ in your normal corporate activities, although they might need to be a bit wider than those used in other circumstances – and that is an interesting challenge!

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Broadleaf's risk management services

- Quantitative risk & financial modelling
- Risk assessment for private financing options
- Strategic & policy risk management
- Project & procurement risk management
- Risk assessment workshop facilitation
- Risk management plans & implementation
- Risk management procedures review
- Risk management training

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