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## *Specialists in Strategic, Enterprise and Project Risk Management*

Successful Programme & Project Management  
Singapore, 23-24 August 2001

### **RISK ANALYSIS FOR PROJECT CAPITAL EVALUATION**

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This document contains slides from a conference presentation in Singapore in 2001 concerned with the incorporation of risk and uncertainty in the capital evaluation process for large projects and assets. (The presentation did not include all the slides that appear here.)

A basic assumption behind the presentation is that conference participants were familiar with basic capital evaluation techniques, including discounted cash flow approaches.

A similar presentation was made to a conference in Sydney later in the year.

Capital Asset Management & Investment Evaluation  
Sydney, 27-28 November 2001

### **FRAMEWORK FOR INVESTMENT EVALUATION INCORPORATING RISK & UNCERTAINTY**

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## **1 Outline**

- Introduction
- Capital cost variability
- Practical complications
- Including additional risks
- Owner's costs in an incentive contract
- Evaluating an investment
- Common pitfalls
- Conclusions

## 2 Introduction

<b>RISKS &amp; OPPORTUNITIES</b>
<p><b>RISK &amp; OPPORTUNITY</b> Risks &amp; opportunities arise as the consequences of uncertainty – Aspects: Likelihood Impact</p> <p><b>RISK MANAGEMENT</b> Culture, processes and structures directed towards the effective management of potential opportunities &amp; adverse effects</p> <p><small>© Broadleaf Capital International Pty Ltd, 2001 <span style="float: right;">Page 6</span></small></p>

### RISK

Risk arises as a consequence of uncertainty. We commonly think of risk as negative: the exposure to the possibility of economic or financial loss or gain, physical damage, injury or delay as a consequence of the uncertainty associated with pursuing a particular course of action. However, the consequences of uncertainty can also be positive (opportunities), and the same techniques apply to exploiting opportunities as to reducing risks. In the context of capital evaluation, the most important impact of uncertainty is variability in the main elements of the project cash flow model.

<b>RISK MANAGEMENT IS IMPORTANT</b>
<ul style="list-style-type: none"> <li>➤ Risk is unavoidable in the modern organisational environment</li> <li>➤ Increasingly, risk taking is necessary to achieve targets . . .</li> <li>➤ <b>. . . but it must be managed</b></li> </ul> <p><small>© Broadleaf Capital International Pty Ltd, 2001 <span style="float: right;">Page 7</span></small></p>

<b>WHY BOTHER ABOUT RISK IN MAJOR PROJECTS?</b>
<ul style="list-style-type: none"> <li>➤ Large size &amp; capital outlays <ul style="list-style-type: none"> <li>– potentially very large losses or delays</li> </ul> </li> <li>➤ Unbalanced cash flows, high initial spending</li> <li>➤ Many participants &amp; stakeholders</li> <li>➤ Inherent complexity &amp; risk</li> <li>➤ Stringent approvals &amp; licensing conditions</li> </ul> <p><small>© Broadleaf Capital International Pty Ltd, 2001 <span style="float: right;">Page 8</span></small></p>

### Benefits of risk management

The experience of many organisations suggests a structured risk management approach provides many important benefits. The main direct benefits are:

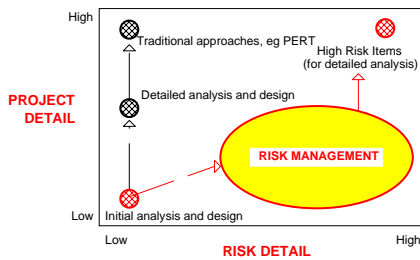
- Better and more definite perceptions of risks, their effects and their interactions;
- Better design and planning to prevent or avoid risks;
- Better contingency planning and selection of responses to those risks that do occur to reduce their impacts;
- Following from these aspects, better decision making, leading to an overall reduction in risk exposure.

Additional benefits include:

- Sensitivity testing of assumptions in business plans and development scenarios;
- Documentation and integration of corporate knowledge that usually remains the preserve of individual minds;
- Insight, knowledge and confidence for better decision making and improved risk management

Of these benefits, it is the reduction in project risk exposure that provides corporate management with the bottom-line justification for undertaking risk analysis studies.

## RISK MANAGEMENT PROVIDES A DIFFERENT FOCUS



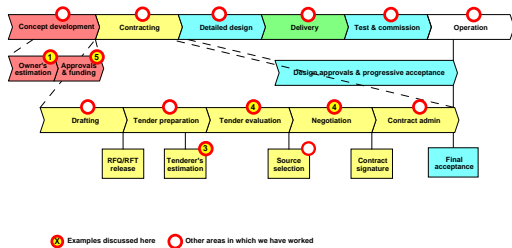
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Risk management often has a different focus from traditional management tools and techniques.

Risk management does not always require a mass of detail about the project or business activity (and for activities at the early concept or pre-feasibility stages there may not be much information anyway). It is often better to devote scarce management resources to examining risks more closely. For the risky areas, additional detail can be added as required.

## APPLICATIONS AT DIFFERENT STAGES OF PROJECTS



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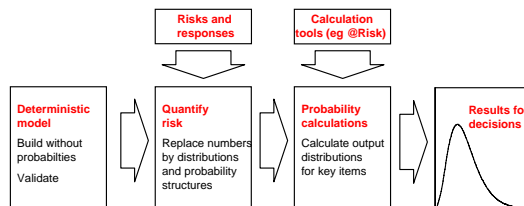
## WHY USE QUANTITATIVE RISK ANALYSIS?

- Evaluating the realism of estimates
- Assessing the return on investment
- ‘Selling’ a procurement proposal for funding
- Setting targets or accepting commitments
- Choosing between alternative investments
- Choosing between technologies with different risk profiles

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## QUANTITATIVE RISK ANALYSIS PROCESS



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This process can be applied to almost anything that can be represented in a spreadsheet model.

Examples include:

Capital cost estimates

Operating revenue and expense estimates

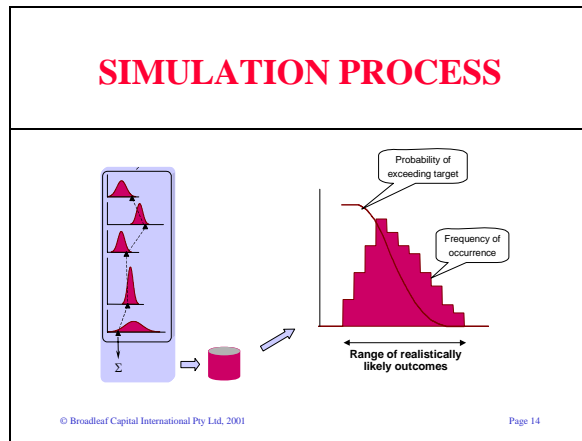
Capital evaluation of a minerals processing project

Review of the budgets for the Sydney 2000

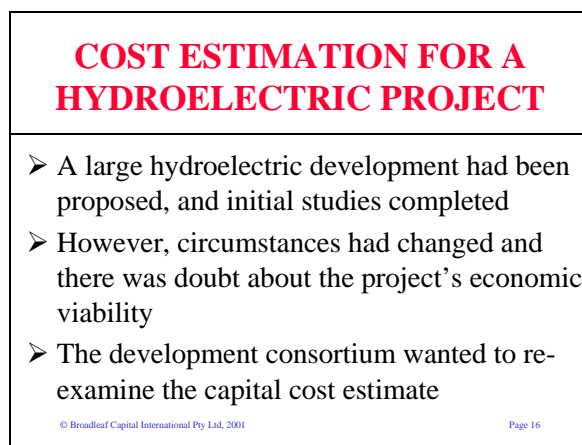
Olympic Games

Analysing the risk to the company associated with an infrastructure investment and assessing a suitable price to place on a financial and operating guarantee

Estimating toxin ingestion from eating fish caught in a polluted river



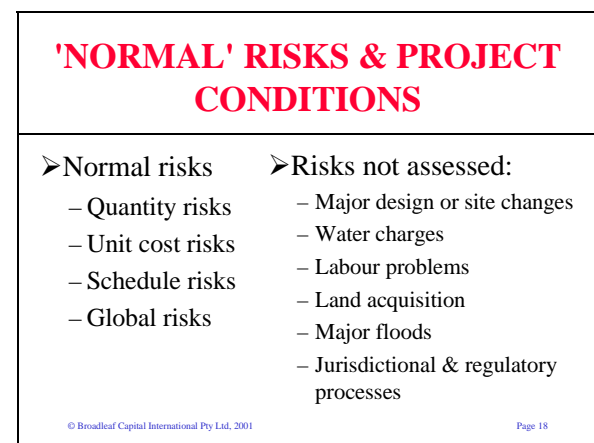
### 3 Capital Cost Variability



A large hydroelectric development had been proposed for an area in northern Alberta with known hydro potential, and detailed preliminary studies had been completed.

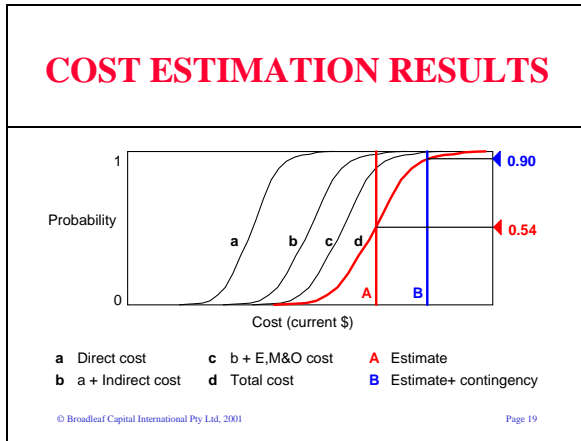
However, there was some doubt about the economic viability of the project, because the energy environment had become less certain: Predicted regional energy demand was reduced due to general economic recession; World oil and gas prices were unstable; The general pattern of future regional energy production was unclear.

The development consortium saw a need for re-examining the capital costs. In particular, it was felt by the utilities involved that the original estimates may have been optimistic, and that the contingency allowance may have been too small.



If delays occur, or if a likelihood of schedule over-run was detected, additional resources would be used to maintain the schedule if possible.

Global risks applied to all construction activities.



Note that contingency in this context refers to the uncertainty relating to known activities, not the loose ends and detailed bits and pieces that were not estimated

## 4 Practical Complications

### UNCERTAIN COMPONENTS

- Uncertain quantities
  - Range
  - Likelihood within range (distribution)
- Uncertain events
  - Outcomes and their values
  - Likelihoods

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### UNCERTAIN QUANTITIES

- Range
- + most likely value
- + shape
- Model or observations

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### UNCERTAIN EVENTS

- Simple
  - Yes/No
  - Probability and value
- Multiple
  - List of outcomes
  - Probability tree
  - Probability and value (min, likely, max) of each

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### EXAMPLE: SITE ALLOWANCE CONTINGENCY

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This example is from a different case, an irrigation scheme in rural New South Wales, but the principles of using a probability tree to represent possible discrete future outcomes is quite general in application.

Software like @Risk can include structures of this kind in the spreadsheet model.

## COST & SCHEDULE LINKAGES

- Schedule used to distribute capital cost spending profile through time
- Fixed & variable cost elements

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### 5 Including Additional Risks

## TUNNEL 1 WORK PACKAGE

- Assumptions
  - Build the portals first
  - Work from each end with two road headers
  - Services must be relocated at the eastern end
  - A vent shaft is to be driven

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## ACTIVITY DIAGRAM

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## THREE-POINT ESTIMATES

Item:		Ref:	
Risks	Responses	Assumptions	
Optimistic	Pessimistic	Likely	
Compiler:	Date:	Reviewer:	Date:

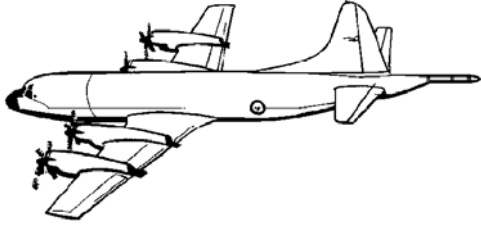
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## COMPLICATING THE MODEL!

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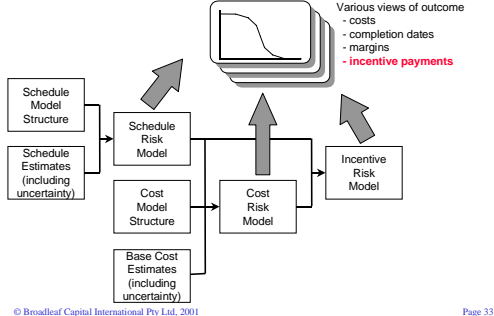
## 6 Owner's Costs in an Incentive Contract

### TENDER RISK EVALUATION: INCENTIVE CONTRACT



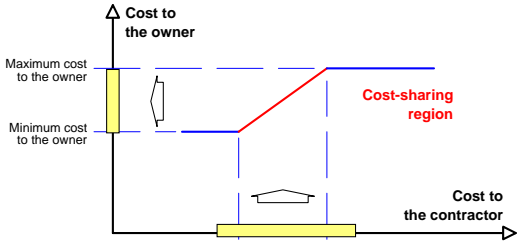
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### EXAMPLE: INCENTIVE MODEL



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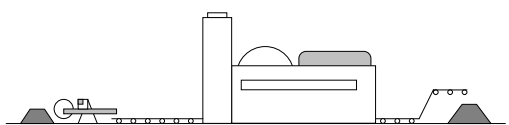
### INCENTIVE CONTRACT: WHAT WILL IT COST?



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## 7 Evaluating an Investment

### CAPITAL EVALUATION FOR A MINERALS PROJECT



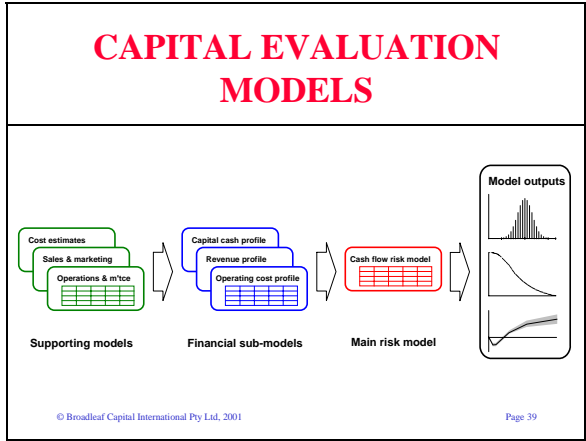
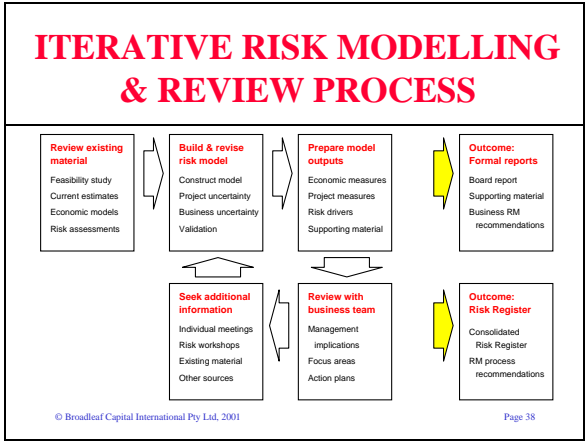
- Is the investment worthwhile?
- Will it provide a suitable rate of return?

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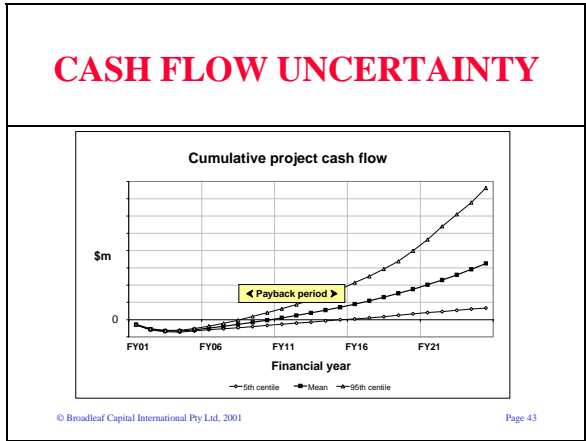
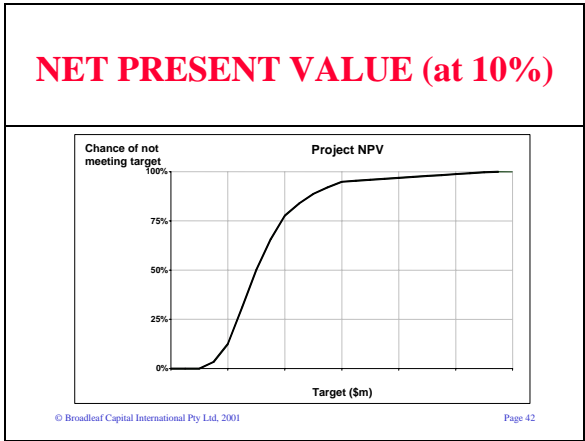
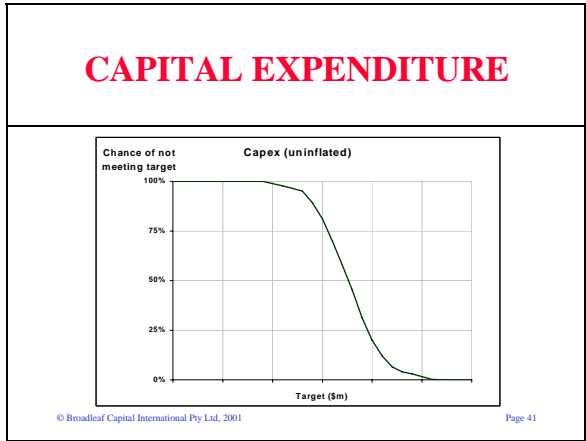
### RECENT EXAMPLES

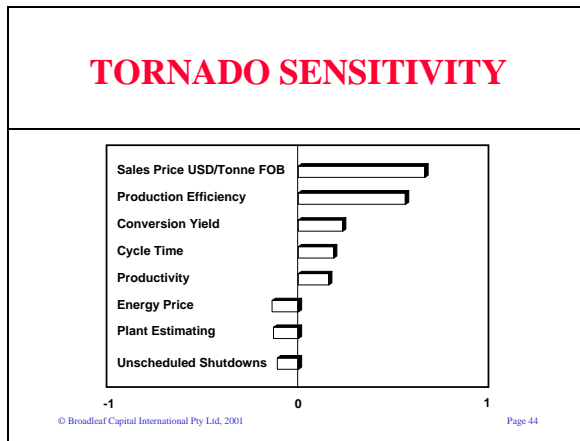
- Australia, magnesium
- Indonesia, nickel
- New Caledonia, nickel
- Australia, alumina
- Australia, gold
- Australia, steel

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- ### OUTCOMES FROM THE EVALUATION MODEL
- Project measures:
    - Financial: NPV, IRR & payback period
    - Physical: cost per unit of product
    - Time: to commissioning, practical completion
  - Enterprise measures:
    - Shareholder NPV & IRR (after tax and depreciation)
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## 8 Common Pitfalls

Traps for the unwary:

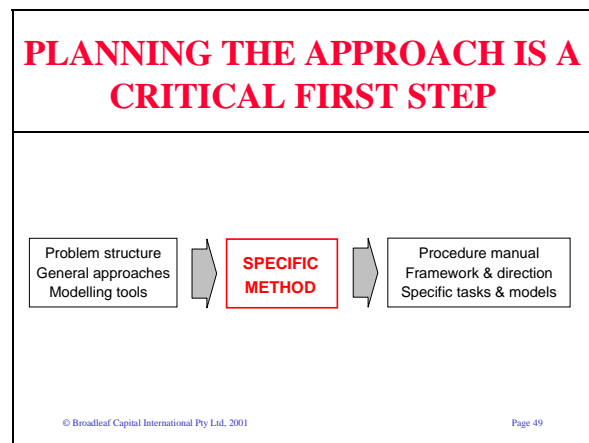
- Poor modelling practice (not specific to risk models)
  - Poor analysis
  - Inadequate validation
- Inappropriate levels of detail
  - ... in the model
  - ... in the analysis of risks and uncertainty
- Wrong focus
- **Correlations omitted**

## 9 Summary

## CONCLUSIONS

- Quantitative risk analysis software is very flexible
  - Any fool can use it!
- The difficulties lie in the project
- Some are technical, but some are linked to policies & attitudes to risk-taking

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## REQUIREMENTS FOR SUCCESS

- Good method design
- Good management of the process
- Specialist expertise
- Flexible software
- **Senior management commitment**

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## BALANCING COSTS & BENEFITS

Risk management helps you decide between ...

- Good and bad management
- **Good and bad luck !**

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Key message:

**RISK MANAGEMENT IS A MAJOR DRIVER OF GOOD PROJECT OUTCOMES**

## 10 About Broadleaf

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### BROADLEAF'S RISK MANAGEMENT SERVICES

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

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## FURTHER INFORMATION

**Dale F Cooper: Applying Risk Management Techniques to Complex Procurement**  
Purchasing Australia, Australian Government Publishing Service, Canberra, 1997. ISBN 0 642 26803 7.

**Stephen Grey: Practical Risk Assessment for Project Management**  
John Wiley & Sons, Chichester, 1995, ISBN 0 471 93979 X

**Australian/New Zealand Standard on Risk Management, AS/NZS 4360**  
Standards Australia, Standards New Zealand, 1995

Please contact Dr Cooper for further information

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