Risk Analysis and Management for Projects

Chris Lewin

20 February 2012

Looking ahead

- "We may daily observe that no strange accident doth at any time happen, but it is by some means foreshowed or foretold."

- John Hayward, *The Life and Raigne of King Henry IIII*, published in 1599

Actuaries and Civil Engineers

- How co-operation came about
- Voluntarily working together
- Synergies – both are engineers
- Terminology differences, however
- Publication of RAMP in 1998, 2002, 2005
- STRATrisk Guide 2006
- Work on operational risk, 2008
- Now working towards ERM

This talk

- What we mean by “risk” and “uncertainty”
- What is RAMP?
- How does RAMP work?
- Risks in large infrastructure projects
- Uses for RAMP

Risk and Uncertainty

- Risk – possibility of outcomes different from expected (threats and opportunities), allowing for uncertainty

- Uncertainty – lack of sufficient knowledge about risk - includes:
  - Unknown threats and opportunities which may emerge
  - Hidden connections and interactions between risks
  - The possibility that outcomes now perceived as threats may turn out to be opportunities, and vice versa
  - The possibility that the probability or impact of some risks may turn out to be very much greater than currently perceived
  - Unexpected human reactions

- Enterprise Risk
  - Strategic (big risks)
  - Project (risks in change projects)
  - Operational (“business as usual” risks)

Components of Enterprise Risk

Project risks

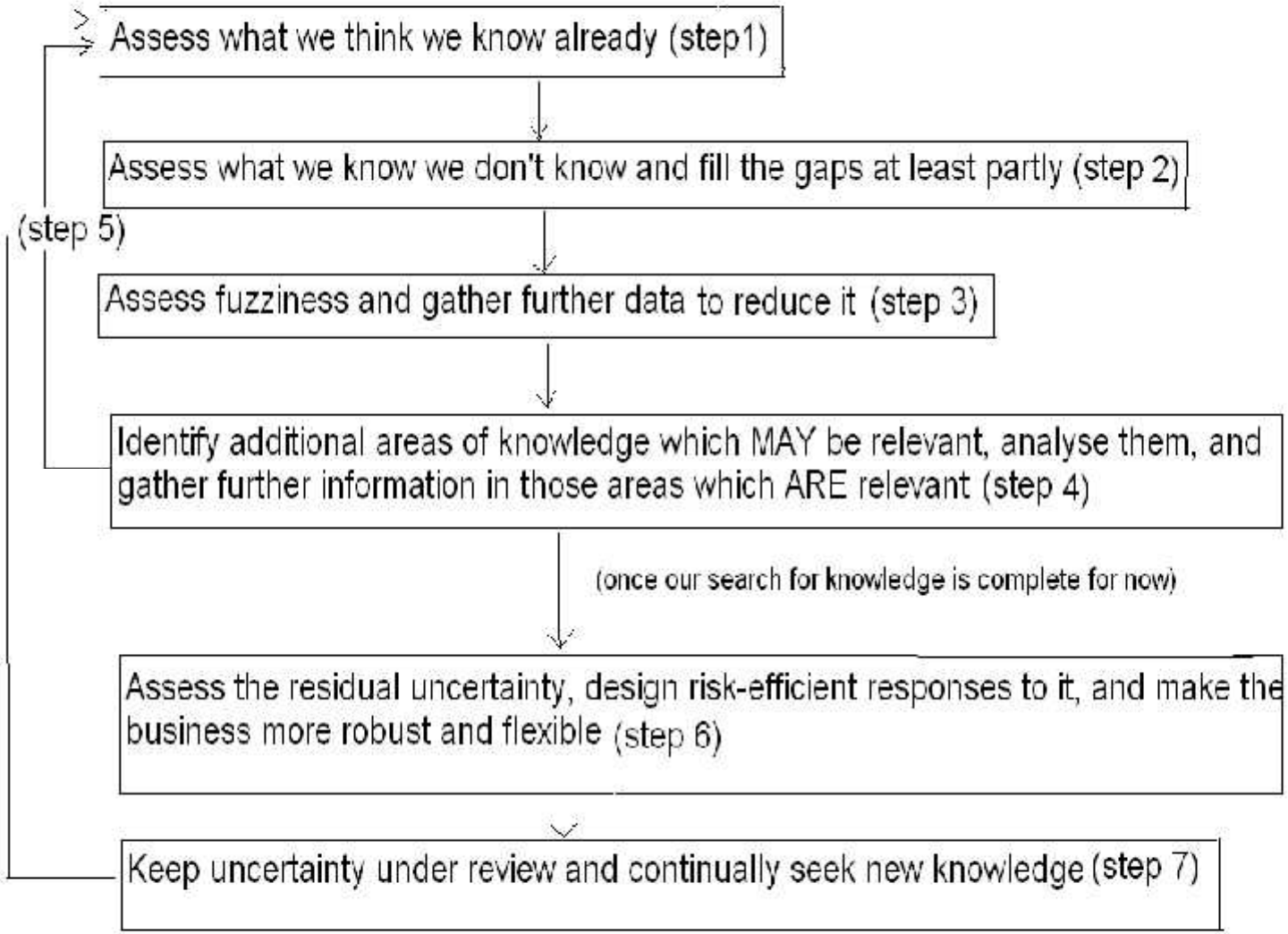
How they can be managed

What is RAMP?

- A framework for managing project risks and uncertainty
- It attaches financial values to risk
- It assists in making choices about competing projects
- It helps when deciding whether to spend money on risk mitigation
- From the outset RAMP considers risks throughout project lifetime
- Disaster risks are highlighted - not buried in a model
- Focuses attention on need for special care at planning/design stage
- Recommended by HM Treasury and senior management of OGC

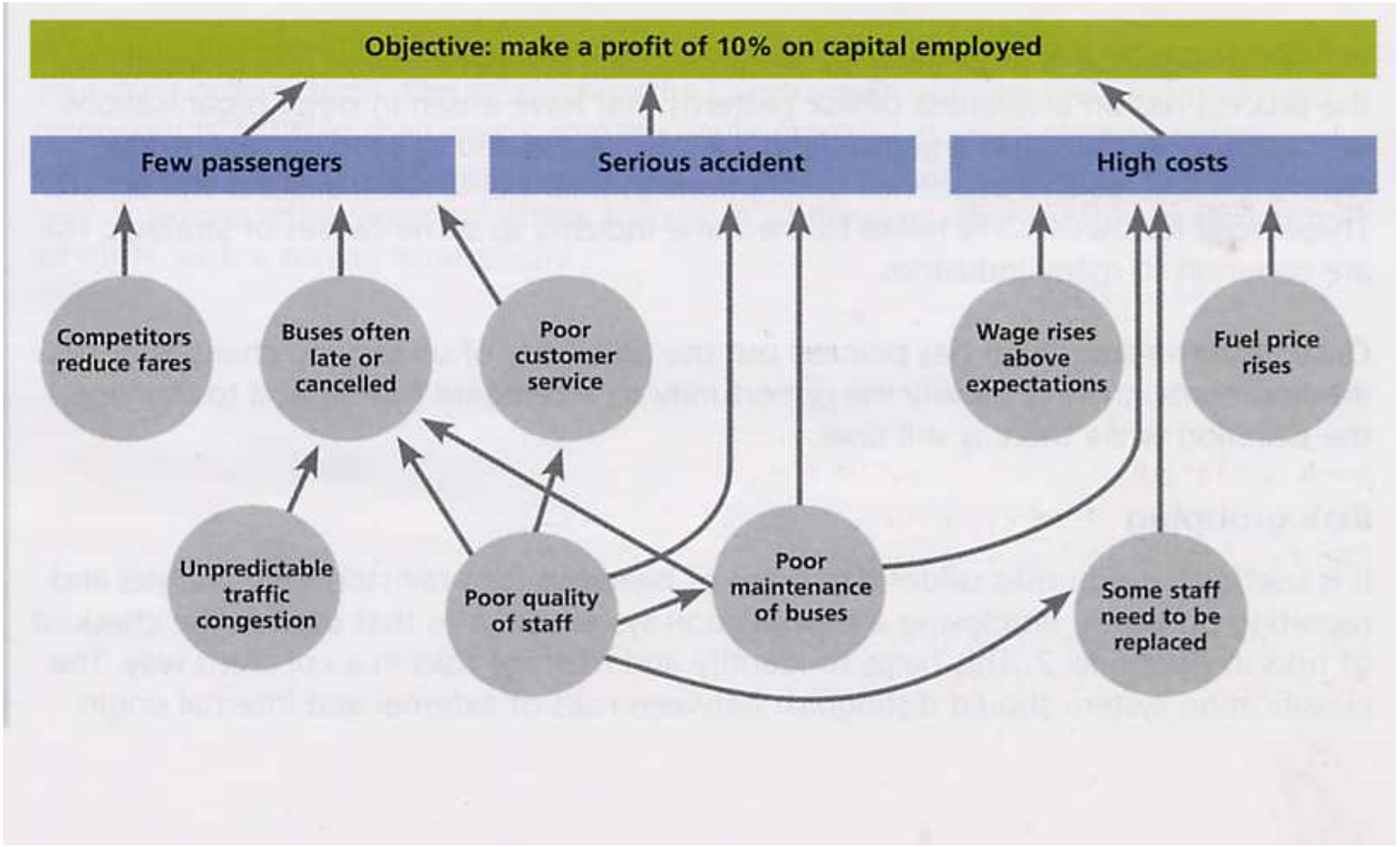
Summary of RAMP

- Covers both threats and opportunities
- Methodology – iterative process, risk identification, analysis, responses, residual risks, decision processes, follow through to risk control.
- Used with financial models to provide range of possible NPV outcomes for different scenarios
- Looks at underlying causes of risk
- Considers uncertainty, not just foreseeable risks
- Considers whether to spend money on risk mitigation
- Focuses on assumptions and bias as sources of risk



An Approach to Uncertainty Management

Concept mapping – a tool for spotting risky areas



Causes of bias in appraisals

- Insufficient care
- Key risks omitted, accidentally or deliberately
- Risk independence wrongly assumed
- Inadequate past experience of disasters
- Cashflows guessed
- Insufficient attention to economic cycle
- New technology risks understated
- Credit taken for benefits which would have been received anyway
- Insufficient account taken of effect on other activities
- Wrong assumptions
- Arithmetical mistakes

Use of RAMP for decisions

- To proceed or not? And which project?
- Identify residual risks after risk responses
- Use investment model to generate probability distribution of NPVs
- Do sensitivity testing
- Add in the assumption risks
- Consider uncertainty, flexibility, bias and political factors. Add intuition.
- Decide

Valuing risk financially

- A 10% chance that the project site will flood, costing £100,000
- Is it worth spending an extra £5,000 to mitigate this risk?
- Would it be worth spending £12,000?
- Or £18,000?

Risk Mitigation Example

Year	Cash flow £000s
1	-1000
2	+300
3	+400
4	+400
5	+400
Total	+500

Scenario analysis

Scen	Event	Prob	Impact
A	None	55%	None
B	Know-how	10%	+£200k yr2
C	Delay	15%	Extra year -£300k
D	Faults	10%	-£100k p.a.
E	C+D	10%	As in C+D

Effects of scenarios

Scen	Net flow » £000	NPV £000	Prob
A	500	292	55%
B	700	481	10%
C	200	-64	15%
D	100	-54	10%
E	-200	-391	10%

Weighted average NPV = £155,000

Risk mitigation

- Contractors will bear the whole cost of extra development costs (as in scenarios C and E) provided contract price increased by £80,000. Should we agree?

Effects of risk mitigation

Scen	Net flow	NPV	Prob
	£000	£000	
A	420	212	55%
B	620	401	10%
C	420	139	15%
D	20	-134	10%
E	20	-188	10%

Weighted average NPV = £145,000

Lower average NPV but reduced risk of a very big loss

Ten tips for project success

- Get full understanding of objectives of all key stakeholders
- Define project's scope, objectives and success criteria thoroughly
- Make design as flexible as possible, involving ultimate users
- Identify and analyse all significant threats and opportunities and plan responses
- Prepare high-quality appraisal, avoiding bias
- Establish good risk-governance and communication system for project
- Draw up project plan and ensure sufficient resources
- Develop contingency plans
- Have a good change control process with cut-off date
- Ensure sufficient funding in place for completion of construction

A framework for assessing large infrastructure projects

taking account of social and environmental risks

Multiple Stakeholders and S&E factors

- Infrastructure projects are associated with a wide range of social and environmental factors + associated risks affecting multiple stakeholders
- Challenge is to identify and engage with broad range of stakeholders
- Definitions of S&E factors will vary with stakeholder and are in constant flux
- Must draw out range of stakeholder interests and values, who values what and how much?

Examples of social/environmental risks

- Woodland destruction benefits owner in cash terms, but locals see it as priceless asset (but under valued so can be exchanged for community centre)
- Water quality deterioration unknown by local community
- Objections might cause re-routing at late stage
- While people in some areas may benefit, others may lose
- Small probability risks but big consequences – nuclear, oil-well leak, dam burst, chemical explosion, flooding underground railway

Multiple Criteria Analysis

- MCA considers all factors and risks, both monetary and non-monetary
- Prioritises good stakeholder management
- Enables objectives, concerns, values and priorities of all stakeholders to be reconciled as far as possible in a transparent way
- Leads to optimisation of project-design and planned risk-management
- Provides framework for project monitoring and evaluation
- Includes cost-benefit analyses

Conclusion

- RAMP - a useful tool for project managers and sponsors
- Civil Engineers played a key role in developing it
- Actuaries can help with financial modelling etc
- Placing financial values on risk helps in making decisions, e.g. which project to choose and whether to mitigate risk
- For large infrastructure projects RAMP can be used within a Multi-Criteria Framework
- RAMP is all about methodically thinking through the project and its context – looking ahead and considering achievement of benefits as well as delivery within time and budget