

Human Decision Making and Project Risk for Capital Investment Projects

Context: Some Limitations of Human Decision-Making

There has been the development of a body of knowledge in the last 50 years, which has identified significant limitations to human decision-making ability at various levels, summarised as follows:

| Level of Analysis | Key Issues | Theoretical Perspectives |
|-------------------|--|---|
| Individual | Limits to information-processing ability. Biases (heuristics). | Information-processing theories. Cognitive Psychology. |
| Group | Effects of group dynamics on individuals' perceptions, attitudes and behaviours. | Groupthink, group polarization and group cohesiveness. |
| Organisational | Effects of conflicts, power and politics. | Theories of organisational conflict, power, politics and decision-making. |

Figure 1: Levels of Decision Making

Source: Based on Huczynski & Buchanan (2001)

Classical decision theory, which is based on the rational economic model of maximisation of subjective expected utility, (as indicated in Figure-A2), is now accepted as “not providing an accurate account of how people typically make decisions”, (Huczynski & Buchanan, 2001).

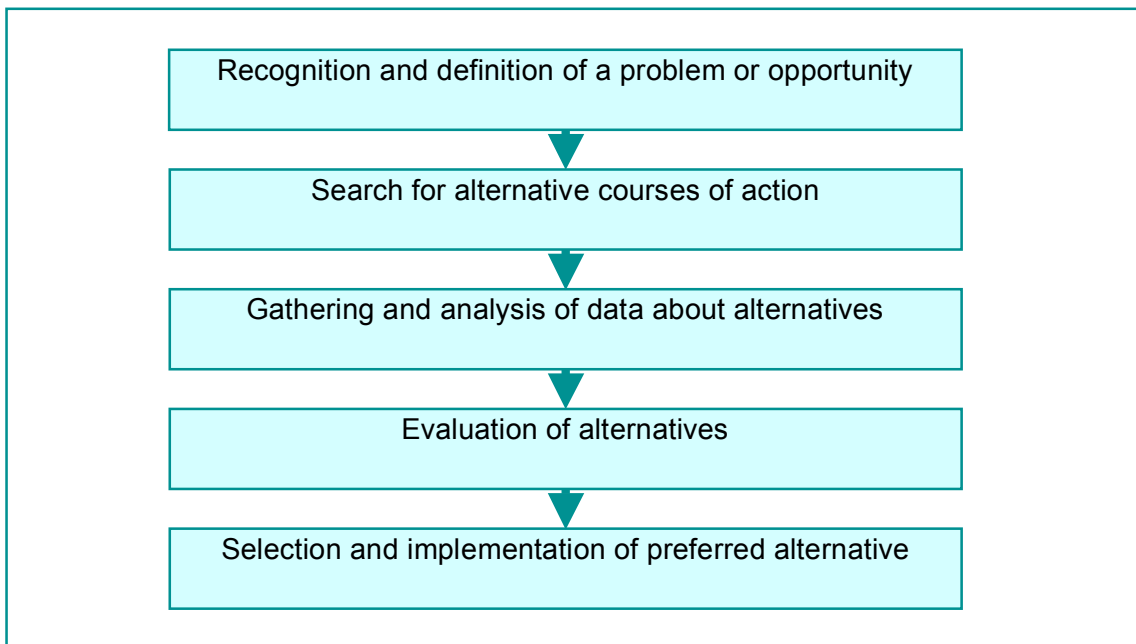


Figure 2: Levels of Decision Making

Source: Huczynski & Buchanan, (2001)

There are a number of alternative descriptive theories, of which some of the main ones are:

Behaviour theory, (March and Simon in a series of papers from the 1960's) shows that people make decisions within the limits of "bounded rationality", recognising that the definition of any problem and generation of alternatives will be incomplete. This leads to the concept of "satisficing": people evaluate one option at a time and accept the first option that meets certain minimum requirements, which therefore may lead to acceptance of a non-optimal option.

Prospect theory (Kahneman and Tversky, 1979) describes how people make choices in situations of uncertainty, and identifies a framing effect. Trivial changes to the way a decision problem is presented, emphasising either potential gains or losses, leads to reversals of preference. Decision makers have been shown to be risk-averse in their choice between options when gains are highlighted and risk-seeking when losses are highlighted.

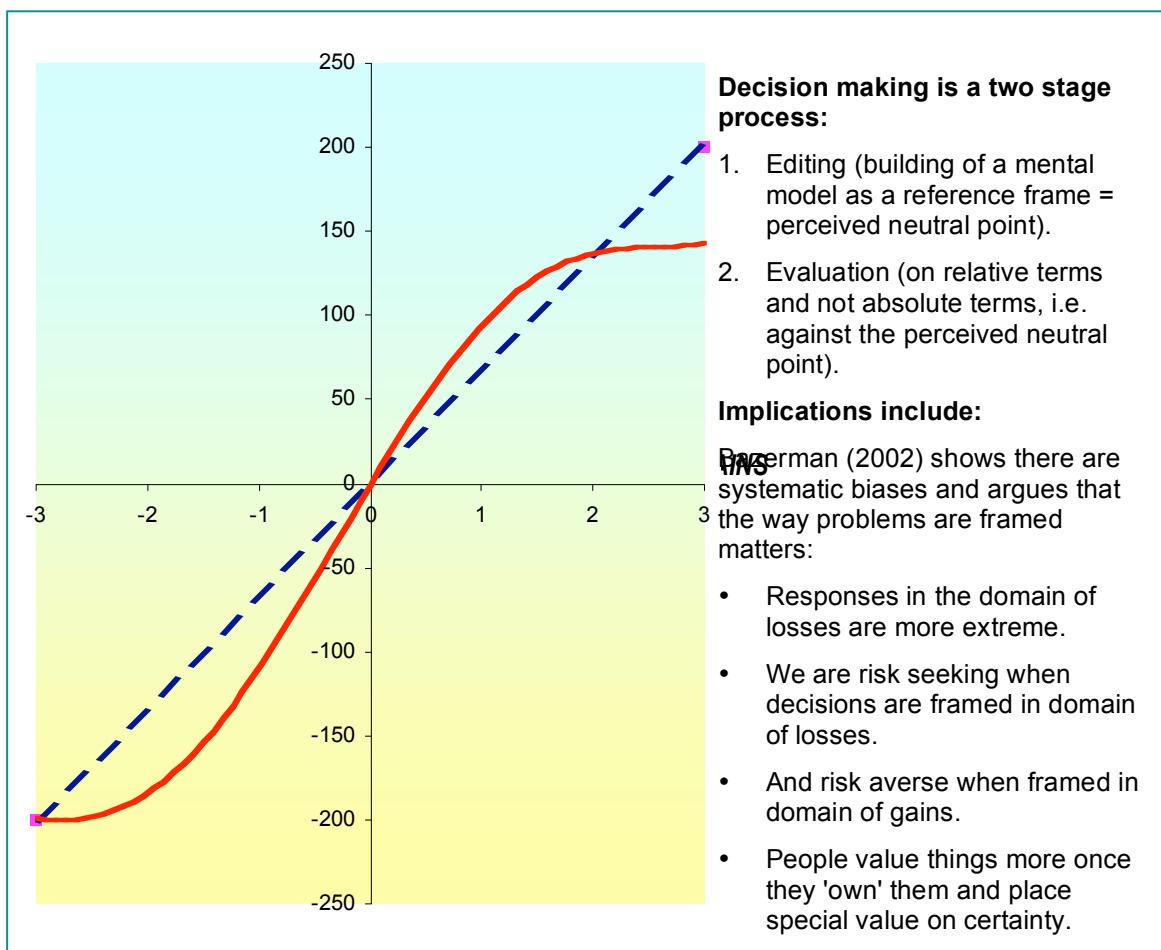


Figure 2: Prospect Theory

Source: Based on Kahneman and Tversky (1979) and Bazerman (2002)

Group polarisation and “groupthink” (Janis 1982), is a phenomenon where groups or teams develop high degrees of cohesiveness. Whilst cohesiveness is generally a positive thing, it can lead to negative consequences. This occurs when members’ strivings for unanimity override a realistic appraisal of alternatives, or override expression of contradictory views.

The judgement heuristics and biases model, which is based on the concept that people use judgement shortcuts, or rules-of-thumb called heuristics, to reduce the information processing demands of decision-making. Whilst these help people deal with complexity, they have been shown to result in a number of biases in situations where individuals inappropriately apply a heuristic. A large number of heuristics have been identified in a series of papers by Kahneman and Tversky (1971, 1972, 1973, 1974, 1979, 1981, 1983, 1984, 1992); some of the main ones are summarized in Figure A3.

| Heuristic | Bias |
|--------------------------|--|
| Representativeness | A predisposition to base judgements of probability on the basis of things which are familiar, and ignore other relevant information. |
| Anchorage and adjustment | A predisposition to make a judgement by starting from an initial value (anchor) and then making insufficient adjustments from that anchor to reflect other significant factors. Different starting points yield different answers. |
| Availability | A predisposition to base judgements on probability on the basis of information that is readily available. Hence an event that is vividly remembered is considered more likely to occur than a bland memory. |
| Overconfidence | A predisposition to be overly confident in judgements when answering moderately to extremely difficult questions |
| Escalation of commitment | A predisposition to continue in a commitment to a course of action, and to ignore evidence indicating failings in the chosen course. |

Figure 3: Summary of the Main Heuristics and Associated Biases

Source: Various: Kahneman & Tversky (various dates), also summarized in Bazerman (2002)

Although some of the heuristics research has been criticised (eg Gigerenzer 2002) there is strong evidence that human decision-making is often less than ideal, which have potentially disastrous consequences for organisations. Some examples are as follows:

- The Challenger space shuttle disaster has been attributed in a presidential commission to “flawed decision making and the negative symptoms of groupthink” (Esser and Lindoefer, 1989)
- The Scottish Parliament building, which has cost ten times the initial budget and taken three times longer to complete than originally estimated, (FT, 16.9.04), in part due to overconfidence in the initial estimates.
- The collapse of Barings Bank, due to the escalation of commitment in trading by one of its dealers.

Improved Decision Making

There is therefore a compelling case to be made for development and implementation of improved decision-making processes at all levels (individual, group and organisational). Bazerman (2002) attempts to summarize the

contemporary thinking on the question of how to improve the decision-making process. He outlines five complementary strategies:

- Acquiring experience and expertise;
- De-biasing judgement;
- Taking an outsider's view;
- Adjusting intuitive predictions.

Hodgkinson, et al (1999 and 2002) have replicated an elaborate strategic decision problem in a field setting with senior managers. This demonstrated that senior managers fail to avoid the framing bias and therefore the acquisition of experience by itself may not be sufficient. However, a second part of their research demonstrated that when cognitive mapping techniques were applied prior to choice, there was a significant reduction in the framing bias. They conclude that "cognitive mapping prior to choice improves the quality of the decision taken".

There are a number of other techniques which have been demonstrated by Bazerman (2002) to improve decision making, which include the following:

- Decision conferencing (facilitated decision workshops);
- Multi Criteria Decision Analysis (MCDA);
- Scenario Planning;
- Decision Trees;
- Dialectical Enquiry;
- Devil's advocacy;
- Using statistical models.

Therefore an approach that combines facilitated workshops, with the building of statistical models together with some of the other techniques should facilitate greater robustness in decision making.

Decision Making in the Context of Risk Management for Projects

Capital works projects typically involve complex decision-making, multiple stakeholders, with a need to make value tradeoffs, and which are likely to come under scrutiny following contract award.

Risk management needs to be at the heart therefore of the development of the project business case.

The HM Treasury Green Book (2003) sets out the UK Government’s policies for the appraisal and evaluation of public sector procurement projects. This document claims to “take account of the wider social costs and benefits of proposals, and the need to ensure the proper use of public resources”. It sets out an appraisal process as follows:

| Stage | Activity | Comment |
|-------|--|--|
| 1 | Identify and value the costs of each option. | Standard NPV cost-benefit appraisal |
| 2 | Identify and value the benefits of each option. | |
| 3 | Adjust for the timing of the incidence of costs and benefits by discounting them to obtain their present values. | |
| 4 | Adjust for material differences in tax between options. | |
| 5 | Adjust for risk and optimism to provide the Base Case. | Optimism bias adjustment is a new requirement and recognises for the first time in public sector procurement the impact of heuristics. |
| 6 | Consider unvalued impacts using weighting and scoring techniques if appropriate. | Recognises the need to measure non-monetary benefits and costs, which points towards the use of MCDA. |

Figure 3 Appraisal Procedure

Source: HM Treasury Green Book (2003), comments by Author

The Green Book was revised (2003) and calls for the first time for adjustments to be made for optimism bias, stating; “There is a demonstrated, systematic, tendency for project appraisers to be overly optimistic appraisers tend to overstate benefits and understate timings and costs, both capital and operational.”

In an attempt to provide a consistent methodology for making appropriate levels of adjustment, HM Treasury commissioned Mott MacDonald to undertake a study of the outcome of large public sector procurement projects in the UK over the last 20 years. This resulted in the HM Treasury Guidance document (2002) “Review of Large Public Procurement in the UK”, which provides an analysis based on historical projects of the percentage difference between estimates at appraisal stage against the final outcomes. The summary shows the average optimism bias as follows:

| Optimism Bias (%) | | | |
|-------------------|---------------|-------------------|--------------------|
| Works duration | Capital Costs | Operational costs | Benefits shortfall |
| 17% | 47% | 41% | 2% |

Figure 3: Average Optimism Bias, Construction Budget Estimates

Source: Mott MacDonald: Review of Large Public Procurement in the UK (2002)

As a consequence, the Green Book now recommends that adjustments be made to the estimated capital cost of projects in accordance with “the best empirical evidence”. The Mott MacDonald document provides further detailed guidance on appropriate levels of adjustment, based on factors such as complexity of the project. This approach appears to have much to commend it, adopting a process similar to that recommended by Bazerman (2002), (i.e. to adjust intuitive predictions based on outside information), as a method of improving decision-making.

The Mott MacDonald study concludes that, “the most important contributing factors to optimism was the inadequacy of the business case and not addressing the needs of stakeholders.”

Risk Management

This all points to the need for robust risk analysis and management tools.

The traditional approach to risk management measures risk as a product of likelihood and severity. Such an approach has significant limitations, including the following:

- Fails to identify the monetary monetary value (cost) of the risk.
- Risk is measured on many different scales, with each practitioner using his/her preferred variation on the theme, but with no relation to a universal norm.. Whilst the descriptions are generally self explanatory, the measures could mean different things to different people.
- Fails to recognise the inter-relationships between risks.
- Often fails to address the biases outlined above

A statistical based cost estimating approach recognises that all construction projects have inherent risk. Rather than single point estimates business plans and Capex approvals, such an approach recognises that project funding needs to be made for the following:

- Base cost (no contingencies, or risk allowance)
- Expected cost. This equates to the expected out-turn cost of the project, with appropriate allowance for risk and uncertainty
- An upper bound confidence level (often taken at the 95% confidence level). This equates to a near worst-case scenario.

These are illustrated in the following diagram, that illustrates the uncertainty in project funding requirements.



Figure 3 A Typical Statistical Spread of Likely Outcomes

Once established the risk adjusted costs can be pro-actively managed through the programme, converging at practical completion, as illustrated in the following diagram:

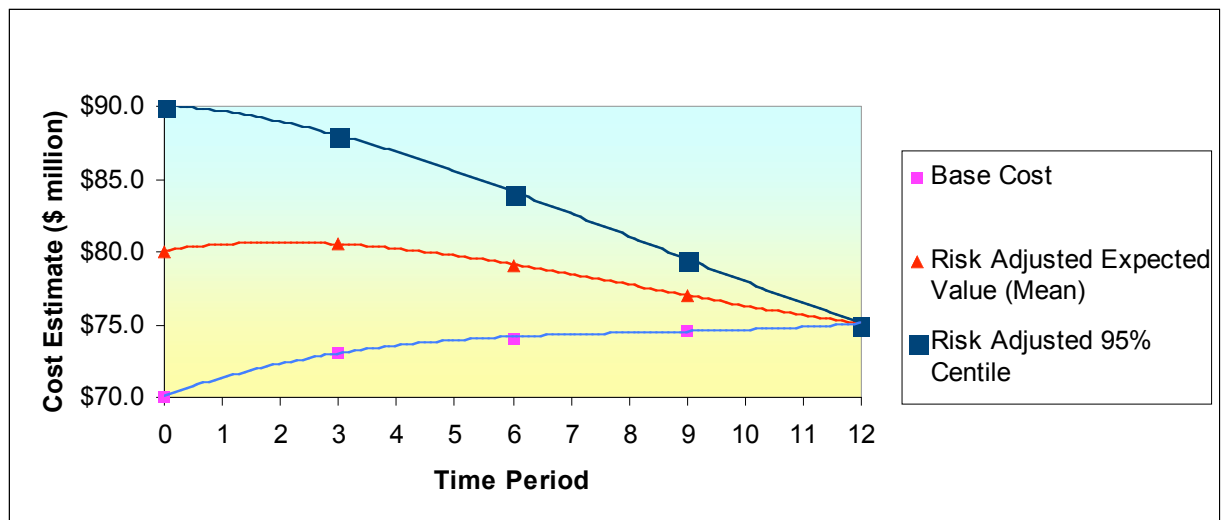


Figure 3 Risk Reduction against Time

The statistical methodology with estimated monetary values offers the following :

- Make applications for Capex funding with an appropriate level of contingency;
- Provides a simple methodology of assigning dollar values to decision options;
- Enables modelling of both threats and opportunities;
- Facilitates a measure of Value for Money of risk apportionment and transfer under the terms of the procurement contract;
- Enables tracking of the progress in risk reduction from concept, through design and tender to contract, as levels of uncertainty reduced and risks were closed out;
- Allows interaction between different risks to be accounted for. Correlation can “discover” effects or outcomes that could potentially be missed by traditional techniques.

The key benefit is that risks are measured in monetary values, which enables true comparisons to be made between options. The risk adjusted estimate can also be developed into a whole of life net present value risk adjusted estimate, which provides a means to compare options on a like for like basis to determine best value.

However there is no panacea in project risk management. Much depends on the skills of the risk practitioner.

Hence the challenge for the industry is to continue to develop and adopt transparent and robust methodologies for quantifying and managing risk, that address the limitations inherent in human decision making.