Practical Project Risk Management [1]

Net Present Value Risk Modelling: A brief guide [2]

Martin Hopkinson

Purposes

Net Present Value (NPV) risk analysis is a useful means of analyzing overall project risk during the earlier phases of a project. It can be used to:

1. Help decide whether or not to continue the project e.g. at major gate reviews.
2. Validate the project business case from a risk perspective.
3. Quantify the implications of time profiling uncertainties that affect costs and benefits.
4. Support choices between mutually exclusive options when designing the project solution.
5. Identify which sources of uncertainty have the most influence on the project's outcome.

A key advantage is that, by requiring the risk management process to take into account risk to both the project's delivery and its benefits, the analysis clarifies the risk implications of trade-offs between the two.

The NPV Formula

$$NPV = \sum_{t=0}^{n} C_t / (1 + D)^n$$

C_t = the net cash flow over a period of time (typically 1 year),
t = the period of time during which that cash flow takes place,
D = discount rate (%), real terms rate of loss in the value of cash,
n = the number of time periods over which NPV is calculated

Techniques

Simple NPV risk models can sometimes be developed deterministically e.g. using a calculator. In most cases, however, a spreadsheet model will need to be developed for Monte Carlo simulation. Typically, the spreadsheet will include a breakdown of project costs and benefits listed vertically with accounting periods (usually years) arranged horizontally. Factors driving costs and benefits, together with uncertainty in their timing as driven by key milestones are represented using probability density functions i.e. the input risk estimates.

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[1] This series of articles is by Martin Hopkinson, author of the books "*The Project Risk Maturity Model"* and *"Net Present Value and Risk Modelling for Projects"* and contributing author for Association for Project Management (APM) guides such as *Directing Change* and *Sponsoring Change.* These articles are based on a set of short risk management guides previously available on his company website, now retired. See Martin's author profile at the end of this article.

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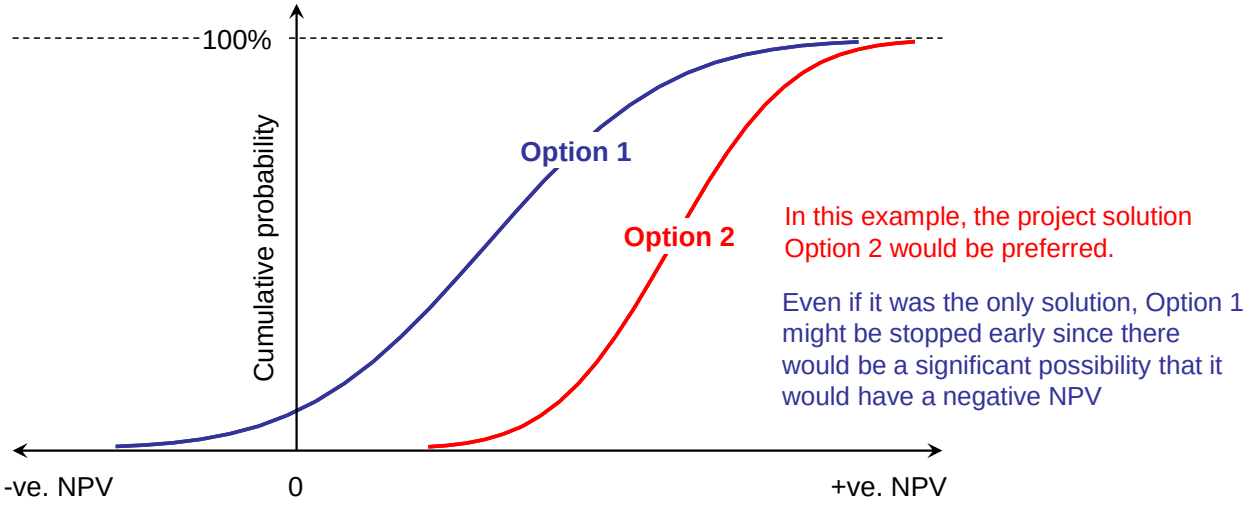
Annual and cumulative cash flow and NPV values can be calculated in the spreadsheet by subtracting overall costs from benefits and applying the NPV formula to the resultant net values. A Monte Carlo simulation can then be used to calculate how these outputs are driven by the risk inputs, typically displaying the results in S-curve format.

Example NPV Risk Analysis Results

Note that, in contrast to S-curve formats typically used for cost or schedule risk analysis results, the better outcomes in a cumulative probability NPV S-curve are to be found at the upper right hand end (high NPV outcomes are preferred).



An important Limitation of NPV Risk Modelling

The NPV approach requires the project's benefits to be modelled in economic terms (i.e. as a cash value). In some cases this is too difficult to do meaningfully. In particular, this might not be an appropriate technique to assess some projects sponsored by governments and charities.

Common Faults

1. Failure to develop the level of detail in the NPV risk model iteratively in a top-down manner e.g. by using a detailed deterministic NPV risk model as the starting basis.
2. Including a risk adjustment in the risk model discount rate – double counting for risk.
3. Failure to use robust risk estimating techniques when developing risk input estimates – quantitative risk modelling is critically dependent upon the quality of the input data.
4. Using NPV risk analysis to make choices between projects in a portfolio – although this is common practice. Strictly speaking, decisions made using NPV models are only valid when they involve mutually exclusive choices.

About the Author

Martin Hopkinson

United Kingdom

Martin Hopkinson, recently retired as the Director of Risk Management Capability Limited in the UK, and has 30 years' experience as a project manager and project risk management consultant. His experience has been gained across a wide variety of industries and engineering disciplines and includes multibillion-pound projects and programmes. He was the lead author on Tools and Techniques for the Association for Project Management's (APM) guide to risk management (*The PRAM Guide*) and led the group that produced the APM guide *Prioritising Project Risks.*

Martin's first book, *The Project Risk Maturity Model*, concerns the risk management process. His contributions to Association for Project Management (APM) guides such as *Directing Change* and *Sponsoring Change* reflect his belief in the importance of project governance and business case development.

In his second book *Net Present Value and Risk Modelling for Projects* he brought these subjects together by showing how NPV and risk modelling techniques can be used to optimise projects and support project approval decisions. (To learn more about the book, click here.)