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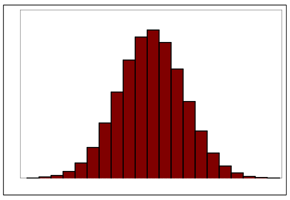
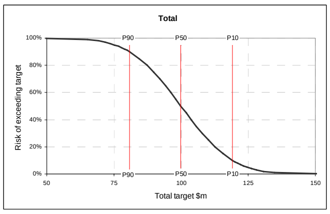
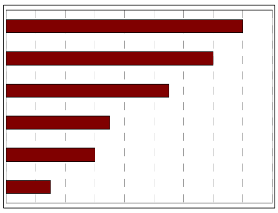
Specialists in Strategic, Enterprise and Project Risk Management

TUTORIAL NOTES: PROJECT RANGE ANALYSIS







1 Introduction

Project range analysis explores the uncertainty in financial, schedule and other quantitative features of a project. It uses estimates of the uncertainty in components of the project to evaluate the overall uncertainty in the project's forecast outcomes.

A range analysis serves two main purposes:

- The aggregate uncertainty forecast provides a basis for setting targets, contingencies and commitments; and,
- The process of examining uncertainty in the components of a project and comparing them with estimates derived by other means – like parametric analysis or industry experience – yields insights that contribute to the realism and integrity of the project concept and the base estimate and schedule.

An increasing number of businesses and public sector bodies are using range analysis as part of their governance and decision making processes. Range analysis supports capital allocation and approvals activities and it can be integrated with the reviews that precede the allocation of funds for studies and project execution.

Range analysis contributes to the independent peer review and value improving practices required to demonstrate diligent decision making on large, risky or sensitive projects so long as it is:

- Based on a sound process;
- Delivered with skilled independent facilitation;
- Documented to record the process, the discussion and the results; and,
- Followed through with actions to capitalise on the insights it yields.

While the computer models used to process the numbers in such analyses are often the centre of attention, the process within which the models are used is at least as important if not more so. The differences between good and poor range analyses are rarely confined to flaws in the technical modelling. They almost always arise in the preparation, planning and facilitation of the process and the interpretation of the outputs.

Broadleaf's personnel have worked in this field for decades. We have refined our methods on a very wide range of projects. Sectors in which we have applied these processes include resources and minerals processing, upstream oil and gas, major infrastructure and property investment, IT and strategic Government procurements.

Our approach is designed to ensure high integrity outcomes, while minimising the burden of the process on a project team who must be closely involved but usually have many other demands on their time.

2 Approach

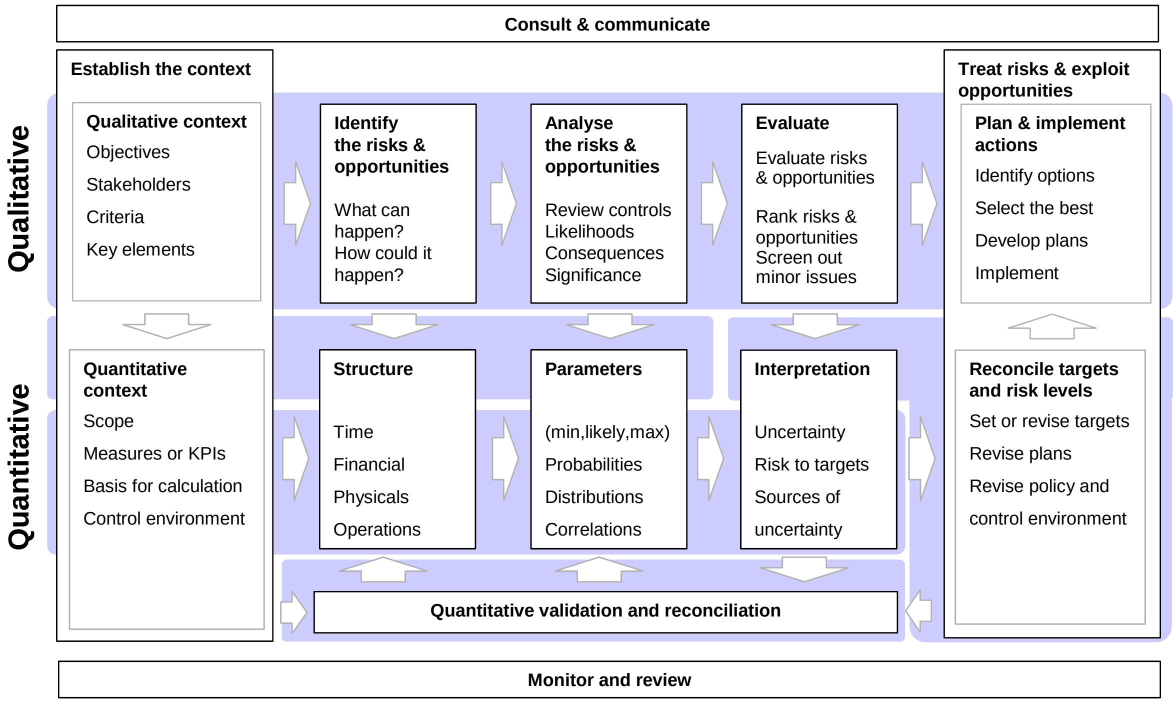
2.1 Method

The technical aspects of range analysis are usually based on Monte Carlo simulation modelling. This is a proven means of integrating and aggregating many uncertain values contributing to the cost, schedule and other quantitative features of a project.

To prepare and use Monte Carlo simulation models, it is necessary to understand the sources of uncertainty affecting a project. A model must represent these uncertainties realistically and link them to the aggregate project forecast; the cost, schedule, NPV or other measure.

Broadleaf's approach to risk management is based on the Standard AS/NZS 4360:2004. We have extended the core concepts of the Standard to encompass quantitative risk analysis and link it to the processes by which risks are understood and managed. This is illustrated in Figure 1, where the top row represents the core Standard concepts, the bottom row outlines the modelling exercise and the shaded areas in the background indicate the scope of the major stages of the process.

Figure 1: Risk modelling based on AS/NZS 4360:2004



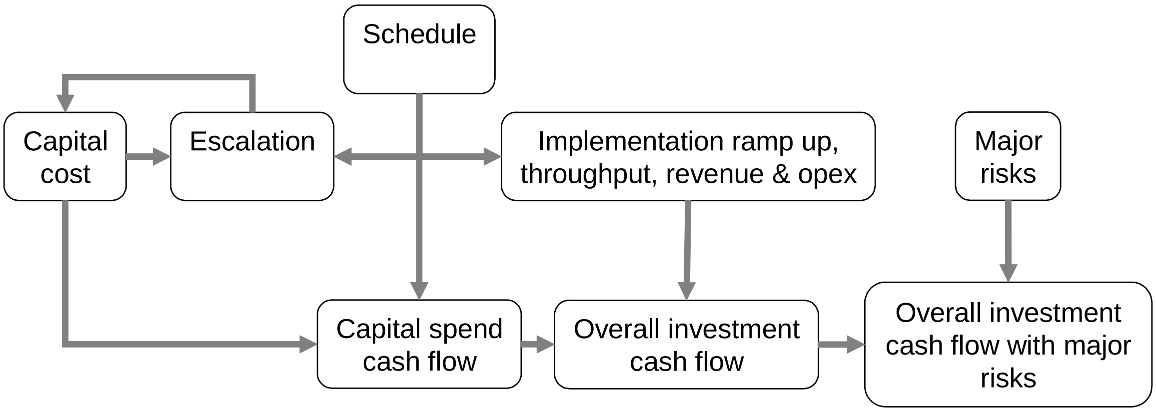
2.2 Models and Tools

Financial modelling is usually carried out in Excel using an add-in to provide Monte Carlo simulation capability. Broadleaf generally uses the @Risk add-in for financial and related modelling. Simple schedule modelling can also be undertaken in Excel with @Risk, allowing close integration of schedule cash flow drivers with financial models.

There are several schedule modelling tools but the one most closely aligned with Prima Vera, the dominant planning tool for major projects, is Pertmaster. For large or complex schedule analyses, where direct interaction with Prima Vera is required or where the stakeholders benefit from the presentation of material in a form similar to that of Prima Vera, we use Pertmaster for schedule modelling.

The complexity of models varies depending on the nature of a project, how far it stretches into the future and the types of uncertainty affecting it. A typical set of model components for a large project and the relationships between them are shown in Figure 2.

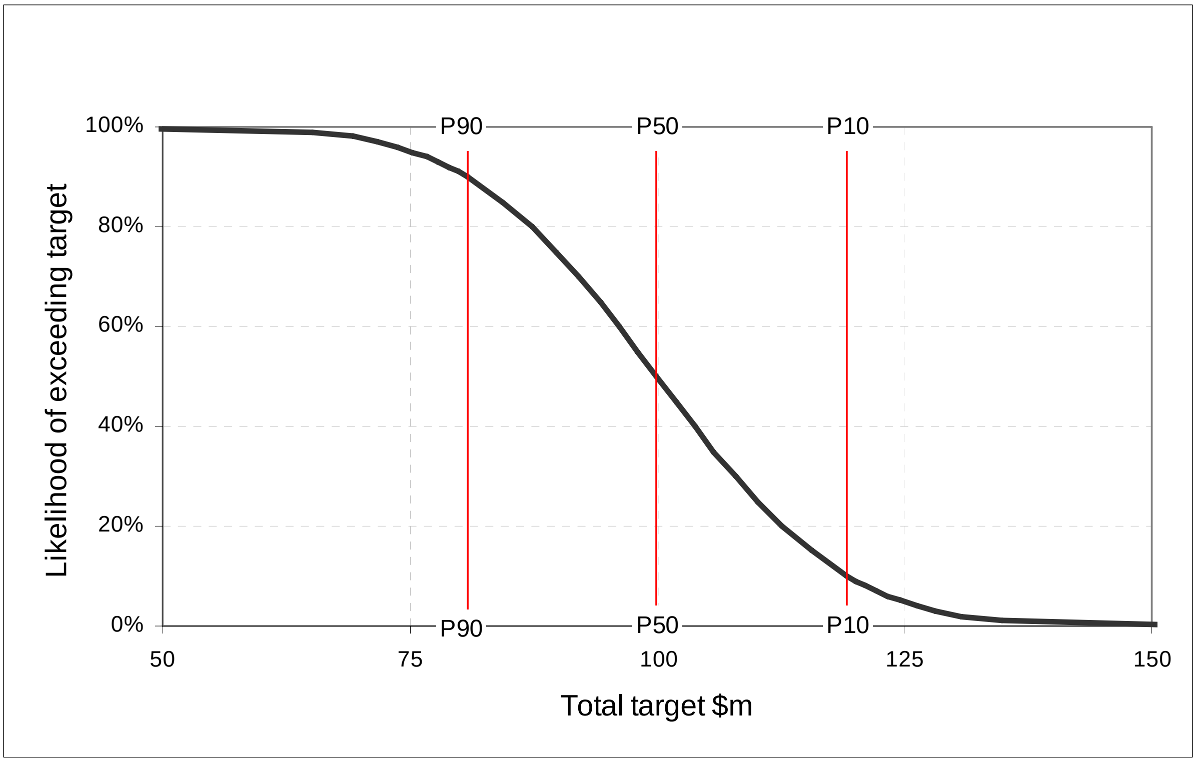
Figure 2: Range analysis models



2.3 Outputs

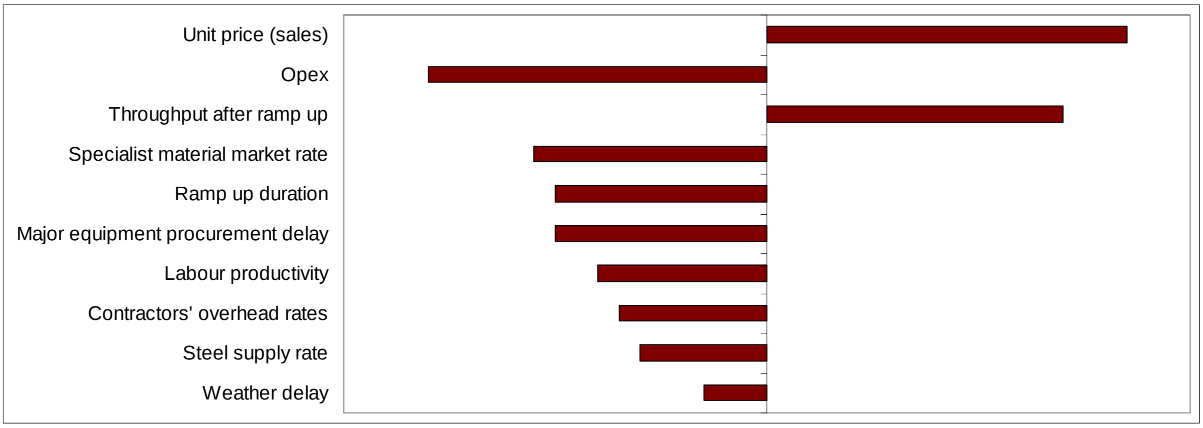
Any model offers opportunities to explore the components and relationships that it represents as well as providing immediate outputs. This is true for range analysis models. They can be used to develop an understanding of the sources of uncertainty and their role in a project. However, there are also some characteristic outputs that most stakeholders will recognise; the cumulative distribution of capital cost or NPV, Figure 3, and sensitivity (tornado) diagram, Figure 4.

Figure 3: Example cumulative distribution of capital cost or NPV



The cumulative distribution shows the range of values that can realistically arise and the likelihood of exceeding any specific value in that range. It summarises the uncertainty in a key project measure, such as the cost, NPV or duration, and is used to set targets, commitments, contingencies and warning thresholds.

Figure 4: Example tornado diagram



The tornado diagram shows which sources of uncertainty make the greatest contribution to the uncertainty in the project as a whole. It shows which factors drive the width of the cumulative distribution and provides insights that may be used to validate a model or identify factors for more detailed study and other actions.

3 Process

3.1 Links to Qualitative Analysis

It is critical to the integrity of the process that quantitative analysis be integrated with a sound qualitative understanding of risks. Any major risk recognised in the qualitative analysis must be reflected somewhere in the quantitative models, often in more than one place as the relationship between risks and quantitative uncertainty is rarely 1-to-1. Similarly, each component of the models must be related to at least one item in the project risk register. This linkage is reflected in the structure of Figure 1.

3.2 Key Steps

The approach to a specific analysis must take account of the context: the technical form of the analysis and modelling will vary depending on what is to be modelled. However, as an example, the key steps in a range analysis of a capital cost estimate will usually include:

– Developing suitable summary views of the estimate and, where necessary, the schedule, that retain the core structure of the estimate and project plans while reducing the detail to a level appropriate for modelling;
– Extracting from these summary views a set of drivers, which may be costs and durations themselves but may also be factors like labour productivities or materials' prices that feed into the calculation of costs and durations;
– Construction of initial models in Excel, Pertmaster or other tools;
– Planning and facilitating a program of workshops to gather range forecasts for the parameters of the models;
– Gathering definitive base cost estimate and schedule values;

- Preliminary evaluation of the models so that they can be validated against other sources of information and the project team's judgement;
- Completion of the models and production of reports on the process, the input data and outputs.

4 Effort

The level of effort involved in a range analysis depends on:
- The scale and complexity of the project;
- The extent of interactions between the schedule and the cost including, where relevant, escalation and time dependent costs such as overheads;
- Whether the team has been exposed to the process before;
- The quality of the general project risk management process and the risk register for the project.

To assess the level of effort and plan a range analysis, it is necessary to gain some understanding of all these factors and review the structure of the estimate and schedule, usually at a summary level.

5 Conclusion

Range analysis is a valuable tool to support planning and baselining of projects. Because of its interactions with qualitative risk analysis and the intrinsic complexity of the modelling task, it is important to guard against the dangers of failing to produce useful outcomes, indulging in excessive levels of non-productive analysis or diverting the project team from other critical tasks.

The process outlined here is based on extensive practical application and many years of refinement. It provides a basis for planning and executing a range analysis systematically to assure high quality outcomes while containing the effort demanded of the project team.

6 Contacts

For more information about other aspects of range analysis and quantitative modelling of uncertainty, see our web site at www.Broadleaf.com.au, or contact

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