*Practical Project Risk Management*[1]

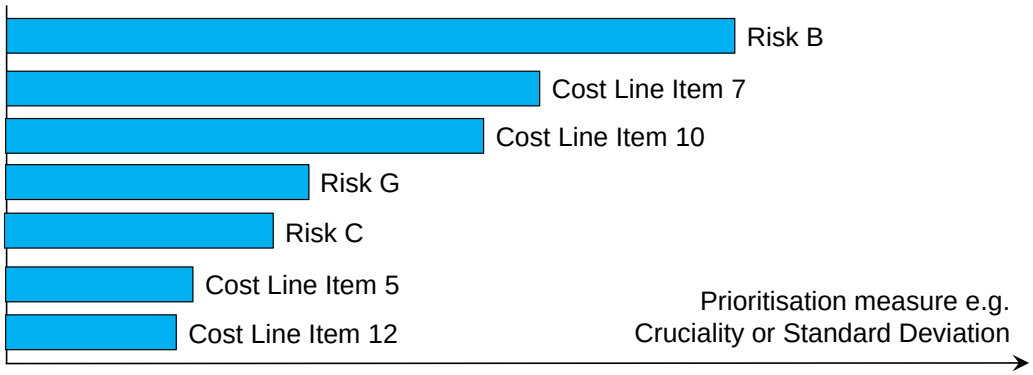
# Cost & NPV Risk Analysis Tornado Charts: A brief guide [2]

## Purpose

Use the statistical outputs of a risk model to identify the model's components that have the greatest influence on the model's simulation of project's performance. This guidance should be read in conjunction with the *Cost Risk Analysis* and *Net Present Value Risk Analysis* guidance sheets (August & November 2023)

## Displaying a Risk Model's Prioritization Results with a Tornado Chart

A Monte Carlo cost risk model includes variable components, such as cost line items and risk events that can be used to simulate variations of overall project cost. A net present value (NPV) risk model has a similar cost structure, but also includes components to simulate the effect of benefits variance. These components, together with their associated estimates generate inputs to the model. When the model has been used to perform a Monte Carlo simulation, its outputs can be used to create Tornado charts using a variety of different measures.




A cost risk model example is shown above. The lengths of the tornado chart bars indicate the relative influence that the model's components are likely to have on the variation of overall cost. The longest bars identify the components that are the most significant.

[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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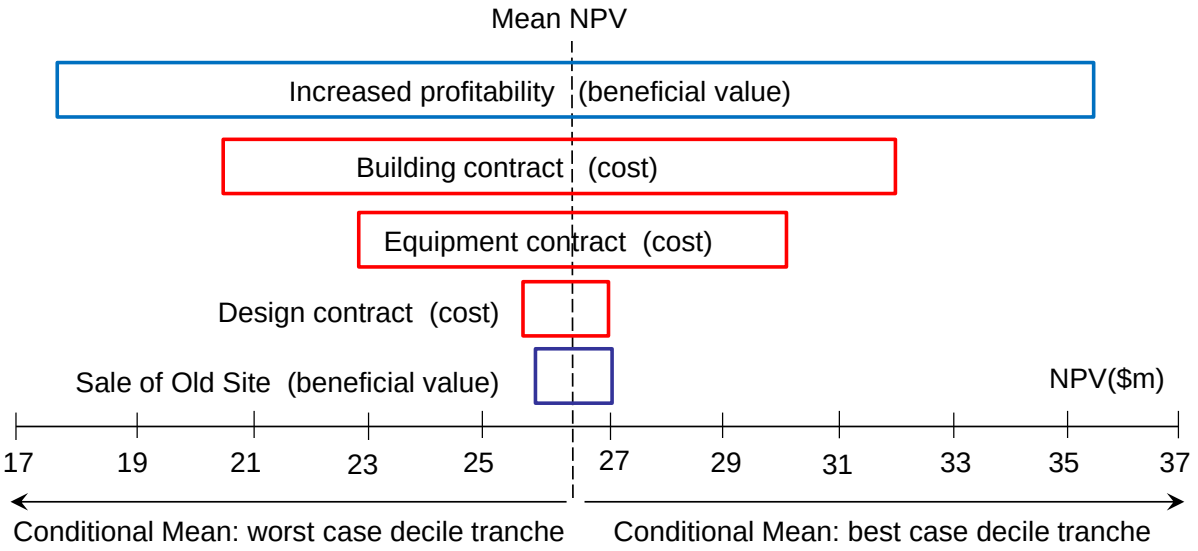
## Cost and NPV Modelling Prioritization Measures

**Standard Deviation:** The variability of each line item or risk that is modeled using a probability density function with cost estimates. (Note that for risk events, standard deviations should be calculated across all outcomes of the risk, including those when the risk does not occur).

**Cruciality:** The correlation between the outcome of each component of the model and the value simulated for overall cost or NPV. (Note that cruciality results should be produced by running a version of the model without correlation inputs).

**Conditional mean:** Conditional mean results are calculated using selected tranches of the model's output. For example, if a simulation's 5,000 iterations are sorted by rank order into ten tranches of the values simulated for overall cost, the worst case (10th decile) conditional mean for each input would be the mean value simulated for the input for each of the 500 iterations that formed part of the lowest decile tranche. (Note that conditional mean prioritization results should also be produced by running a version of the model without correlation inputs).

Conditional means might be preferred to cruciality results because they are expressed in units of cost and thus easier to understand. However, to be valid, the inputs for all components must be estimated in the same units e.g. $. The figure below shows an NPV risk model example.




## Common Faults

1. Obtaining tornado charts with correlation between components included in the risk model, thereby promoting associated components incorrectly higher up the order.
2. Measuring the standard deviation of a risk event by using only the probability distribution that represents the risk impact (conditional on the risk occurring).
3. Failure to act upon new insights gained by modelling (results reported but not acted upon).
4. Weak risk estimates (often for activities) leading to misleading prioritisation results.

## About the Author

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**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.)