

Risk Assessment



The assessment of risk is a very personal process, what is acceptable to one person may be far too risky for another to consider. The appreciation and assessment of risk and a person's decision making are heavily influenced by the way the mind works. A person's risk attitude is defined as their chosen state of mind with regard to those uncertainties that could have a positive or negative effect on a project's objectives. A range of possible attitudes can be adopted by a person towards the same situation, and these result in differing behaviours, which lead to different consequences, both intended and unintended¹.

Risks at different levels

The basic definition of risk is an *uncertainty that matters*. Risks always involve uncertainty, and they matter because they have the potential to affect objectives. This means that each risk must be linked to at least one objective. Risk cannot be defined in a vacuum each time a risk is defined, there has to be something that is "at risk", which is our ability to achieve an objective. Similarly many risks have a range of potential impacts, (not all earthquakes are of the same intensity) the as intensity (sometimes called 'dose') varies, so should the response - this is called the dose-response assessment, or the effect-response assessment.

Organisations have different types of objectives, ranging from high-level corporate objectives down to detailed technical or operational objectives. Each type of objective can be affected by uncertainty. So where there are multiple levels of objectives, there are also multiple levels of risk.

People who are interested in achieving objectives at each level need to know about any uncertainty that could affect their ability to achieve those objectives. Some suggested levels and risk classifiers are:

- Strategic risks are uncertainties that would affect achievement of strategic objectives
- Reputation risks are uncertainties that would affect reputational objectives
- Project risks are uncertainties that would affect achievement of project objectives
- Technical risks affect the achievement of technical objectives
- Environmental risks affect environmental objectives
- Safety risks affect safety objectives

From this basis we can define a strategic risk as *any uncertainty that if it occurs will affect achievement of strategic objectives*. The distinctive characteristic of strategic risks is that they are linked to strategic objectives and this becomes important when considering risk ownership. Each risk should be owned by the person who owns the objective that would be affected. Therefore, strategic risks should have senior management owners, since these are the people who are responsible for achievement of strategic objectives of the organisation. In the same way, project risks are usually owned by people at the project level, and most technical risks are owned by technical staff.

Identifying risks at different levels is easy; start with the objectives at that level, then look for the uncertainties that matter using the attributes discussed below.

¹ For more on risk attitude see: <http://www.risk-doctor.com/pdf-files/umraNov04.pdf>

Factors Affecting Risk Assessment

The assessment of risk is multidimensional; the *PMBOK® Guide* focuses on Probability and Impact, but there are other important characteristics to consider, a more complete set of risk attributes include:

- **Probability** - How likely the uncertain risk is to occur².
- **Impact** - How significant the effect of the risk event would be if it actually happened, measured in time, cost and/or safety.
- **Manageability** - How easy is it to do something about the risk? We may decide that a medium-probability/medium-impact risk that we can do nothing about is more risky than a high-probability/high-impact risk which is simple to deal with.
- **Proximity** - If the risk happens, how soon do we expect that to be? A risk that might happen tomorrow should be treated as more important than one which might not occur until next month or next year.
- **Propinquity** - How important is the risk to me personally, or to my team or our business? We are more sensitive to risks that affect us directly, and view risks to others as less important.
- **Urgency** - How much time do we have in order to implement an effective response to the risk? If we must act now to address the risk, we should give it higher priority than one where we have longer to respond.
- **Detectability** - How easy is the risk to detect as it is emerging? Easy to detect risks are easier to respond to than risks that just ‘happen’ without warning.
- **Relatedness** - Is this risk related to other risks? A risk with complex links or dependencies with many other risks should be treated as higher priority than a simple independent risk.

For more on these additional dimensions of risk assessment, see the *Prioritising Project Risks* guide published by the UK Association for Project Management (APM)³.

Because the effect of the risk is in the future, its affects have to be imagined and are therefore subject to a range of cognitive biases. Cognitive bias is a pattern of deviation in judgment that occurs in particular situations; we are all subject to an extensive range of observed biases⁴.

The assessment of risk has to be made on an aggregate basis (the overall riskiness of a project or program) and an individual basis. The three factors to consider are the organisation or individual's:

- **Risk appetite** - the overall level of risk an entity is willing to accept in anticipation of a reward⁵.
- **Risk tolerance** - the total amount of risk an entity is able to withstand (ie, how much risk can it tolerate without undue stress or failure)
- **Risk threshold** - the level at which a single risk is considered to become unacceptable. Below this level the risk can be accepted and managed if it does not cause the overall risk profile to exceed the entities risk appetite or risk tolerance. Above this level the risk has to be removed or modified to make it acceptable.

² For more on **probability** see: https://www.mosaicprojects.com.au/WhitePapers/WP1037_Probability.pdf

³ To buy, see: <https://www.apm.org.uk/book-shop/prioritising-project-risks-a-short-guide-to-useful-techniques/>

⁴ For more on **bias** see: https://www.mosaicprojects.com.au/WhitePapers/WP1069_Bias.pdf

⁵ An individual's risk appetite is assessed using 'Expected Utility Theory' (or 'Utility Theory'). It is a statistical methodology that incorporates a person's attitude toward risk into a decision making process.



Assessing the impact of Variability and Events

Assessing the Impact of a risk typically falls into one of two processes, assessing the affect of variability or assessing the consequences of an event. These assessment processes should not be confused.

Event impact. Some risks will either occur or not occur; eg, a test failure. Assessing the likely impact of this type of risk requires data and a calculation based on the probability of the event occurring and its effect on project objectives (usually time and cost). The ‘expected value’ of the event is assessed by multiplying the impact by the probability.

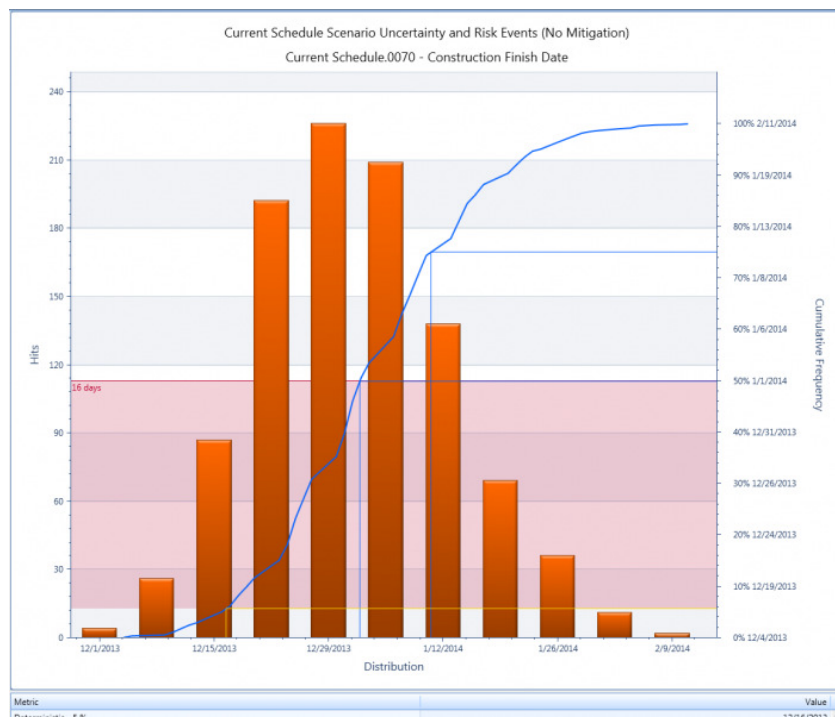
There is a 30% probability a test will fail and the rework will cost \$5,000. The ‘expected value’ of this event is $30\% \times \$5,000 = \$1,500.00$ therefore a provision of \$1500 to cover the expected loss is desirable.

Whilst it is a good start, this assessment is relatively simplistic – The cost of a test failure will fall in a range, it may be a simple fix that only needs a couple of hours to rectify and re-test, it may take several days to track down the root cause of the failure and complete the repairs; and within this range, some types of failure are likely to be more common than others. A Monte Carlo approach to assessment provides a better overview of the profile of any specific risk event.

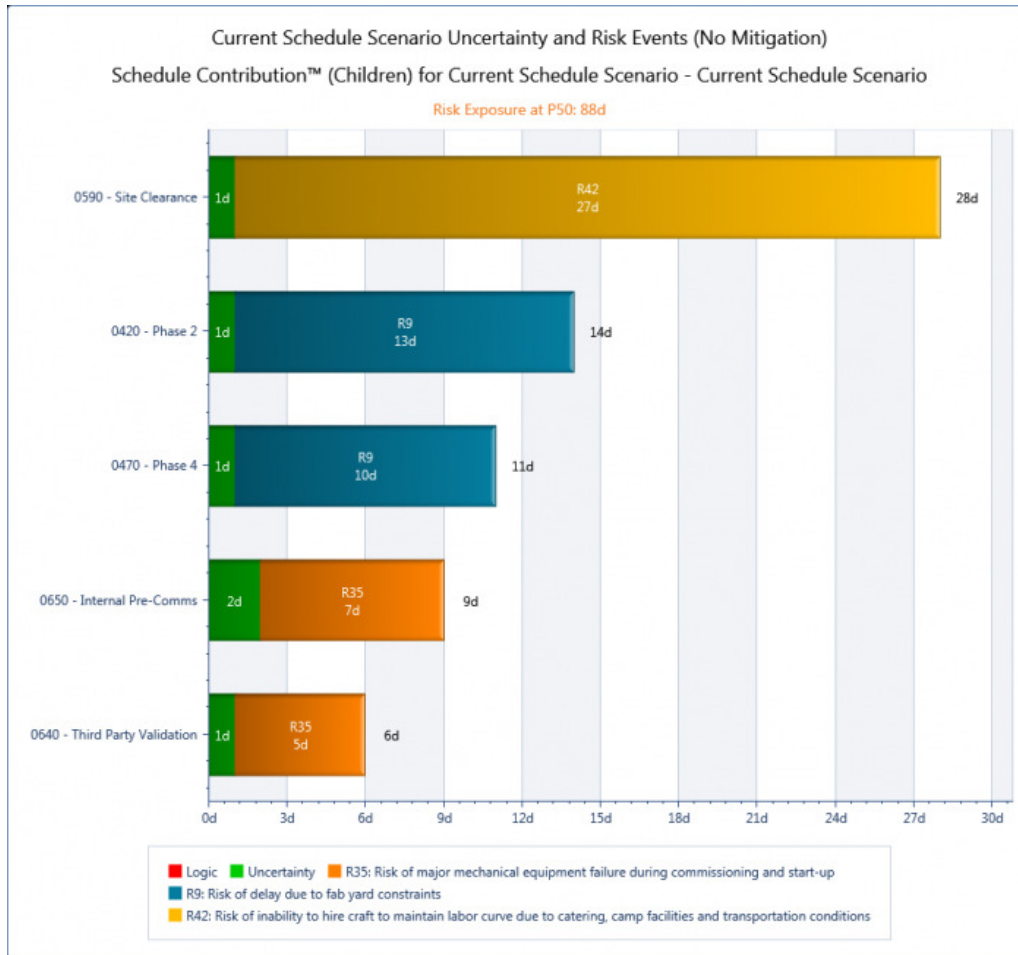
Allowances. Some risk events are virtually inevitable; you just do not know when they will occur. Incremental weather is normal, it rains, gets too hot, too cold or too windy to work depending on your location. Assessing appropriate provisions for this type of risk requires understanding the project’s exposure to the risk and having access to historical data. A provision based on the normal/expected occurrence over the time of exposure.

Variability. Assessing an appropriate allowance for the variability embedded in the estimating process is best done by using *Monte Carlo*. All processes are subject to normal variability, including estimating the duration and cost of project activities. The associated uncertainty as to exactly what this variability is, is not a property of the activity (which will take a definite length of time and cost an actual amount of money to complete) rather a property of our current knowledge of the activity. The fact we do not know enough about the activity to be sure of its outcome is exactly what we are trying to model by estimating a distribution for the range of probable outcomes using techniques such as *Monte Carlo*. The less we know about a task the less valid is any single-point estimate and the more important it is to use a range estimate.

Monte Carlo simulation involves running the project many hundreds (if not thousands) of times with different values selected for each element based on the range of options defined by the subject matter expert’s (SMEs) for that element. This example looks at time. A similar analysis can be done for costs.



The overall variability and contingencies are only part of the information available from a sophisticated *Monte Carlo* simulation. Another important output is the importance of specific risk events or types, usually displayed in a ‘Tornado chart’:



This chart combines specific risk events and uncertainty in a single analysis.

The risk tornado chart is used to report key risk drivers. This can be done simply by using metrics such as criticality, which reports how many times an activity falls on the critical path. The idea is that the more times the activity falls on the critical path, the more often it is going to be a risk driver.

More sophisticated metrics consider the size or degree of impact on the finish date of the project. An activity can have a high criticality but only have a couple of days’ impact on the project; this is not as concerning as an activity that only falls on the critical path 30% of the time, but when it does has a six-month impact on the project finish date.

This problem led to the development of the Schedule Sensitivity Index. Schedule sensitivity is a combined measure of how often and how big an impact an activity has on a given date. It is represented as a percentage and is calculated as:

$$SSI = (\text{Criticality Index} \times \text{Task Standard Deviation}) / \text{Project Standard Deviation}$$

This shows the correlation between the amount of uncertainty of an activity and that of the project completion but this is a difficult to understand concept and consequently SSI has proven to be of limited use.

A better approach is to use a metric called Schedule Contribution Factor™. This meaningful risk metric reports the biggest risk drivers in a schedule and their contribution to risk in terms of duration. Further, it separates contribution from uncertainty and contribution from risk events in order to clarify whether it is the activity scope/certainty or indeed a risk event impacting the activity that causes it to become a key risk driver.

The Tornado chart above shows an example where the overall P50 risk exposure is 88 days and the top five drivers are listed in rank order. Site clearance is, on average, having a 28 day contribution to this 88 day risk exposure. Interestingly, only one of the 28 days is actually due to schedule uncertainty with the remainder coming from a risk event associated with hiring sufficient labour. In other words, while site clearance is the largest risk contributor, sharpening our pencil on the accuracy of the duration estimate will not fix the problem; in reality, the issue lies in not being able to hire sufficient labour (Risk #42 in the risk register). In a similar manner, the second two biggest risk-driving activities are both largely impacted by the same risk, fabrication yard constraints (risk #9).

Conclusion

It is important to ensure specific risk events are not included twice. The allowance for variability calculated using *Monte Carlo* and the allowances for specific events are combined to assess the overall contingency allowance that needs to be held in management reserves for the project.

Determining the acceptable level of risk for a project based on the multiple dimensions discussed above and the level of contingency needed to make the project ‘acceptable’ depends on the risk attitude of the decision makers. These processes should form part of an overall risk management⁶ system. However, it is also important to recognise there are likely to be unpredictable events occur that cannot be assessed because we ‘don’t know what we don’t know’⁷.

Risk White Papers

Mosaic’s risk White papers are:

- Risk Management: https://www.mosaicprojects.com.au/WhitePapers/WP1047_Risk_Management.pdf
- Types of Risk: https://www.mosaicprojects.com.au/WhitePapers/WP1057_Types_of_Risk.pdf
- Risk Assessment: https://www.mosaicprojects.com.au/WhitePapers/WP1015_Risk_Assessment.pdf
- Probability: https://www.mosaicprojects.com.au/WhitePapers/WP1037_Probability.pdf
- Our blog posts on risk are at: <https://mosaicprojects.wordpress.com/category/project-controls/risk/>

⁶ For more on **risk management** see: https://www.mosaicprojects.com.au/WhitePapers/WP1047_Risk_Management.pdf

⁷ For more on **unknown unknowns** see: https://www.mosaicprojects.com.au/WhitePapers/WP1057_Types_of_Risk.pdf



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