A Better Way to Manage Risk

White Paper

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Limitations of Risk Matrices

Managing risk is an essential component of any project, with insufficient risk management leading to unanticipated circumstances, cost overruns, and potential project failure. Successful risk management accurately identifies, quantifies, assesses, and communicates project risk. Risk matrices (sometimes known as heat maps), are one of the most common tools for risk management decision-making due to their ease of use. Unfortunately, the risk matrices' oversimplification of risk assessment leads not only to inaccurate decision-making but to false confidence in said decisions based on their generation from a quantitative approach. While more sophisticated approaches were historically untenable, modern computing allows for more robust quantification of risk that avoids many of the pitfalls of the risk matrix.

The limitations of the risk matrix approach largely stem from the oversimplification of quantified risks through assignment to arbitrary categories in order to facilitate decision making (Thomas, Bratvold, & Bickel, 2013). The effect of this oversimplification is that, even when used correctly, risk matrices lead project teams to accept risks they should avoid, spend resources on risks they should ignore, and mis-quantify the risk associated with undertaking a project. (Thomas et al., 2013).

Monte Carlo Simulation

Given these inherent flaws, organizations should consider replacing the use of risk matrices with a more robust quantification process. We recommend Monte Carlo simulation, which more accurately quantifies risk by estimating the probability and impacts of potential outcomes through repeated sampling from a specified distribution. Monte Carlo simulation avoids the pitfalls of risk matrices by 1) eliminating arbitrary categories, 2) accounting for variability in the probability that potential outcomes will occur, and accurately representing said variability through selection of the correct probability distribution, 3) accounting for correlations between risk items, and 4) allowing for prioritization of risk items for which changes have the biggest impact on model results.

Monte Carlo Simulation in Use

Let's assume there is a risk associated with a critical equipment delivery. When defining the outcome using a risk matrix, we estimate that the probability of occurrence is 20% and the mean delay if the risk occurs is 4 weeks. Based on risk matrix categorization, this is a 'Yellow' risk which leads us to take no action and monitor the situation. But let's assume that although the mean delay is 4 weeks, the length of the delay could vary between 2 weeks and 1 year. Using Monte Carlo simulations, one can evaluate the effect of this variability to better inform the decision-making process.

A related benefit of Monte Carlo is the ability to account for correlation between potential events (Hubbard, 2009). That is, to simulate the fact that changes in one risk event's probability or outcome can affect the probability of another. For example, if one trade's productivity is negatively impacted due to being in a confined space, other trades' productivity in that area is likely to be impacted as well. Monte Carlo simulation allows one to account for this correlation between risk items.

One final benefit of using Monte Carlo simulations is the ability to perform a sensitivity analysis on the results. This allows one to characterize how sensitive a simulation's output is to variation of each of its inputs. The implications of this sensitivity for risk management is that they allow one to determine which risks cause the greatest effects or, if mitigated, will provide the greatest benefit to a project's outcome. This allows the project team to prioritize its limited resources where they will have the biggest impact.

Implementing Monte Carlo Simulations

Given the benefits of Monte Carlo simulations, why are they not more widely used? Aside from historical limitations in computing power slowing their uptake in practice, a common objection is that it is too complication. While it is true that a specific skillset is required, Monte Carlo simulations are much less complicated than the projects they are being applied to. Any modern laptop has enough compute power to run Monte Carlo simulations on even large models in a matter of minutes. Furthermore, there are commercial off the shelf software programs that allow one to build Monte Carlo simulations very quickly and without needing to know any computer code (Hubbard, 2009).

In conclusion, there are fundamental flaws associated with the use of matrix-based risk processes, these flaws are inherent with the risk matrix design and cannot be avoided. Fortunately, there is a better methodology, Monte Carlo simulation, which doesn't suffer from these flaws, accounts for variability of probabilities and outcomes via probability distributions, simulates relationships between risk items via correlations, applies focus on appropriate risk items via sensitivity analysis, and allows one to align decision making with one's level of risk tolerance.

If interested in learning how you can implement a Monte Carlo based risk process within your organization, please reach out to Chris McKee at ChrisMcKee@capopg.com.