Project risk analysis software

How to choose the one that's right for you

By David Vose

Vose Software

Risk analysis should be an integral part of the design and execution of your important projects. Without risk analysis you will almost certainly not allocate sufficient budget and commit to a delivery date that is too ambitious. Risk analysis can also show you how to organize your project to avoid the largest risks and reduce uncertainty – which could be a major competitive advantage.

You will need a software tool to do a meaningful project risk analysis. A list of risks in a spreadsheet will not get you there because the interaction of risks and uncertainty in a schedule is complex.

Our company produces a project risk analysis software tool called Tamara. Most prospective users who contact us are unsure about out how to determine which of the available project risk analysis software products would best suit their needs. This is a summary of the considerations I believe are most important in making that choice for a medium to large company with sizeable projects seeking to integrate project risk into their overall risk management processes.

What are the minimum specifications you'll need?

There are a few simple requirements that need to be met for any company considering using a project risk analysis software tool:

- **It's a commercial product** – if you are going to use a tool to help make important decisions, you will need to have the quality guarantees, technical support, updates, bug fixing and training offered by commercial products.
- **It works with the scheduling software your company uses** - for large businesses, that usually means Oracle Primavera (and perhaps a P6 database), but Microsoft Project is also quite powerful and easier to use for simpler projects.
- **It integrates cost and schedule risk in one model** – because time are cost are intimately related. It is extremely tedious and time-consuming work to try to analyze cost and schedule risk on different platforms.
- **It is a Monte Carlo simulation tool** – the only way to assess schedule risk is to use Monte Carlo simulation techniques because of the complex logic involved.
- **It isn't spreadsheet based** – a spreadsheet like Excel is the wrong environment to model schedules – it doesn't have the right graphical tools, and it will be painfully slow to build and run for large schedules. But if your schedule is under 20 or so tasks, you can get by using IF, MIN and MAX functions to build a simple schedule.

- **It has good reporting capabilities** – being able to customize and format the outputs will make a big difference to the quality of your reporting. Key reports are: basic statistics, histograms and cumulative curves for cost, start, finish and duration for any task or selected group of tasks; cost v finish date scatter plots; trend plots showing expenditure over time; and tornado sensitivity plots. Another interesting but non-essential plot is the stochastic Gantt chart plotting the start and finish dates of individual tasks or groups of tasks.
- **It can handle the largest project schedules you use** – bigger, more complex projects will usually expose you to the most risk, so make sure it works for those projects.
- **The company making the software is well established**

Will the software be practical to use?

The software should be quite quick and easy to use, and ensure that the schedule is written in a way that makes risk analysis practical:

- **Does it check the schedule integrity?** After importing a schedule, the software should check its suitability for simulation by comparing to certain well-documented standards - like being schedule (not resource) driven, not having too many leads and lags, or orphan tasks, etc.
- **Can it update against an evolving master schedule for the project?** As your project develops and the schedule becomes more detailed, or as it is executed and tasks are completed, you will want to be able to quickly re-evaluate the risk. Ideally, you should be able to use the same software from initial project conception all the way through to delivery.
- **How does the software work with a real schedule of your own**? Demo models may look convincing but are always tiny and very simple in comparison to a real-world project. Ask for a trial version and see what happens when you try to assign risk and uncertainty to one of your largest schedules. Make sure the software can handle running a simulation of you largest risked schedule for 3,000 samples – which is enough to get good graph and statistics.
- **Can you assign uncertainty to task duration quickly?** If your schedule contains hundreds of tasks, describing the uncertainty for each task will get very tedious and take a lot of time unless there is aa quick way to do it.

Will the software produce good results?

The purpose of the software is to assess the riskiness of the project as accurately as possible, and to give you insight into what drives the risk and thus how you might organize and manage it to reduce that risk. Key questions are:

- **How many different ways can the software describe how risk and uncertainty impact your project?** If you don't have a wide range of options for describing risk, the model will be a poor reflection of reality, the results will be inaccurate and you will gain little insight into how to manage risk. Realistically, for every project you will need at least the following:
    - Uncertainty in scope

- Uncertainty in productivity rates
- Risk events that extend a task's duration

You will also very likely need one or more of the following:

- Risk events that can impact several tasks simultaneously
- Risk events that are exactly the same, but can impact the schedule independently at different places
- Risk events that can occur several times, like a strike or equipment failure
- Risk of extra non-scheduled work, like having to resubmit a permission request or redo a design
- Risk of a different productivity rate, like having to use a less capable contractor
- Calendar-based interruptions, like stopping all work because of weather, vacations, or a site shutdown after an accident

- **What probability distributions does the software use for describing uncertainty?** The usual distributions offered are:
  - Normal – to be avoided, because it can take negative values, and you need to provide a mean and standard deviation which most people don't understand well. It's symmetric shape is also not a good reflection of the uncertainty one usually encounters.
  - Lognormal – also to be avoided, even though it has a natural shape, because again you need to specify the mean and standard deviation, and the most likely value is not the same as the mean.
  - Uniform – says the task has equal chance of being between two values. A very crude distribution as we should always have *some* idea of the most likely value (probably the one provided in the master schedule).
  - Triangle – required a minimum, most likely and maximum value, which are intuitive, but it has an unrealistic shape and it is strongly influenced by the maximum value which, in reality, is very hard to determine.
  - PERT – also called BetaPERT. Same inputs as the triangle, but a more natural shape though this tends to underestimate the risk of large values. Same issue with determining a maximum.
  - Modified PERT – can give a realistic shape, and requires a minimum, most likely and maximum value. Same issue with determining a maximum.
  - Three-point – uses minimum, most likely and a cumulative probability value like the P90. The P90 is the value you are 90% sure the duration won't exceed, which is much easier to estimate than an absolute maximum (consider answering '*What is the absolute* maximum *time it would take for you to get to work tomorrow?*' versus '*Nine times out of ten you will get to work within what time?*'). Produces the same natural shape as the Modified PERT.
- **How does the software apply correlation?** Correlation is an essential element of project risk analysis. It describes how a longer duration for one task will likely correspond with longer durations of others – usually because a team is more or less efficient than one is expecting, or the work has a different level of complexity than envisaged. Without correlation, you will underestimate your risks significantly. In the real world, almost all tasks will be correlated with at least one other. There are two approaches to modeling correlation:
  - *Correlation matrices* which requires the user to guess a set of correlation coefficients. This presents a huge challenge to the user for several reasons:

correlation coefficients have no real-world meaning, they are just statistical measures, making their estimation a stab in the dark; the number of coefficients you would to estimate for a schedule of k tasks equals k(k-1)/2 so for a miniscule project of just 10 tasks, you'll need 45 coefficients, and for 100 tasks you'll need 4,950 coefficients; and these coefficients have to be consistent with each other – figuring out which one to change to achieve this consistency is extremely difficult so software usually does it for you, changing the values in ways you cannot control. In practice, users of software tool that employ correlation matrices just give up on correlation!

- *Driving factors* which require the user to specify what actually create the correlation, for example uncertainty in the level of productivity of a team, the work rate of a piece of equipment, the scope, or the complexity of the work. This method is far more intuitive, trackable, and can be applied across huge schedules very quickly. It also provides insight into what drives the project risk that correlation coefficients cannot.

Can you use the software with other tools?

If project risk management is part of a larger corporate risk management effort, you will need the following:

- **Link the project risk results to an Excel risk analysis.** If you want to do more in-depth analysis, e.g. discounted cashflows, integrating with company forecasts, etc. you will need such a capability. To do it properly, the simulation data (not just summary statistics) must be exported from the project risk software into the spreadsheet.
- **Link the project risk model to a corporate risk register database**. This ensures that the risk assumptions in your model are consistent between projects, use the latest information and are in line with the corporate view of important risks. It also opens up the possibility of incorporating the effect on projects of the corporate strategy for managing key risks.

How expensive is the software?

A rough rule of thumb is to compare cost of ownership over a five-year period. That should take into account maintenance, updates, any training required and – what most people forget - the cost of the time that will be required to build models, maintain them, run updates and produce reports.