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# Project Risk Management

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- Calculate potential impacts on your budget or schedule
- Prioritize which risks to worry about the most
- Make a plan for minimizing risks or reducing their impact

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# Project Risk Management

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## Deltek Special Edition

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**Development Editor:** Steve Kaelble
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**Business Development Representative:** Ashley Barth
**Production Editor:** Selvakumaran Rajendiran

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# Introduction

Risk is an everyday part life of every project. Bad weather could delay progress on a construction site. So could late arrival of key materials. The start of a new contract year could cause labor costs to increase. Countless factors threaten the schedule as well as the budget. How in the world does any project manager or sponsor sleep at night, knowing how many things could go wrong?

Project risk management is the systematic, thoughtful process of foreseeing the many possible risks that face an upcoming project. Not just foreseeing them, but analyzing them to figure out how likely it is any particular risk will actually happen, how painful it could be, if there's any way to keep it from happening or reduce the potential impact, and how much it would cost to do so.

## About This Book

*Project Risk Management for Dummies,* Deltek Special Edition, spells out the processes of project risk management. It starts at the beginning, noting that you can't really get an accurate understanding of risk if you don't have a solid project plan. It spells out the process for identifying and understanding the uncertainties and discrete risk events that threaten to cause headaches for the schedule, for the budget, or both.

The book outlines the creation of a risk register that serves as a library of bad things that can happen, and describes how to map the risks to understand which specific project activities each risk might impact. It describes how to analyze the risks to figure out which ones are the biggest concerns, how to calculate contingencies, and how to decide which risks to consider mitigating.

# Foolish Assumptions

One should not make too many assumptions, but because you chose to pick up and start reading this book, we're able to make a few assumptions about you, the reader:

- Your organization's lifeblood is projects: construction, design, maybe something else — unique initiatives with individual timelines that need to be successful.
- You've got risks on your mind and are hoping to improve your ability to foresee them and get a handle on them.
- You'd love some quick insights into tried-and-true ways for managing risk and making your projects successful.

# Icons Used in This Book

Lovely icons decorate the margins of this book, and they're not there just to be cute. Check out the paragraph next to each icon for some helpful information.


Here's a helpful hint for making the process of project risk management easier or more fruitful.


As you work your way through the pages, be sure not to miss the important point next to this icon.


This book is all about risk, and this paragraph is all about something that could go awry if you're not careful.


Are you one of those people who likes the little details? This paragraph might be of interest to you.

# Where to Go From Here

Read on, of course! The next page would be a great place to start, but it's not the only option. Check the chapter titles and flip to whatever is most on your mind right now, whether it has to do with schedule risk, cost risk, or something else. Whatever you choose, enjoy!

# Chapter 1

# Preparing for Project Risk Analysis

***In This Chapter***

- Understanding what a plan can do for you
- Dealing with variations from the plan
- Evaluating the quality of the plan

What ingredients do you need before you dive into project risk analysis? You won't get anywhere without two key ingredients: a project, and a well-crafted project plan. This chapter spells out some of the basics that a project plan must cover and explores the characteristics the plan must have if it's going to be useful for project risk analysis.

## The Importance of the Plan

For the record, a *project*. . .

- Is a unique, temporary endeavor.
- Contains a defined start and finish.
- Is an individual or collaborative enterprise that is carefully planned and designed to achieve a particular aim.


Take a look at that third bullet point — the project should be "carefully planned." Any worthwhile project needs a plan, though the project plan can take any number of different formats. It could be anything from a hand drawing to a fully built mathematical project model constructed in a Critical

Path Method (CPM) project scheduling tool. Or anything in between.


Without a project plan, the players in the project are kind of like the cacophony of an orchestra tuning up — there's a lot of talent, but the sound is hardly musical. When the project plan is fully built to include the entire scope of the project — sequenced with all handoffs documented and agreed upon by all project participants and stakeholders — it becomes a "single sheet of music" that all involved can utilize.

After the project plan has been established, it's time to begin performing work on the project according to the plan. Let the beautiful music begin!

# Deviating from the Plan


The project plan is exactly that: a plan. Even the best-made plans will experience small problems, and sometimes large problems. These deviations from the planned execution strategy and timeframes are called *variances*. When you construct the project plan in a logical sequence, you'll be able to see how early-project variances will ripple throughout remaining sequence of work.


Project risk management provides you with information to help you understand a number of important things:

- What's certain about your project, and what is not
- Which specific threats and opportunities may affect your ability to deliver the project
- Which of these threats are the most important to minimize and mitigate
- How much mitigation each risk will need
- How much time delay and cost overrun, if any, the project team should expect

The only way you'll be able to successfully answer those questions during risk analysis is if you have a project plan that's an accurate, living, breathing representation of all aspects of the project. If there's a chance that threats will ultimately delay the project, stakeholders will need to be able to see this delay

in advance. That way they can make proper decisions to maximize use of resources and potentially prevent a significant delay. An inadequate project plan won't function properly as a predictor of schedule and cost overruns.

# The Right Ingredients


How can you tell whether a project plan is adequate and up to the task at hand? Just check it against nine crucial characteristics. These are quantitative measures that have proven to be critical in understanding whether a particular project plan will be a reliable tool for forecasting the outcome of a project.

Here are the nine leading characteristics of a well-constructed project plan. Following this list, there's more discussion about these vital points.

- There isn't any missing logic. The project schedule is fully linked.
- The average number of logic links per activity is 2.0.
- The project has an unbroken critical path.
- It doesn't rely too much on hard constraints.
- There's no negative float in the project baseline.
- There's enough detail on all of the activities in the plan. Generally, the duration of each individual activity should be less than 10 percent of the overall timespan of the project.
- Relationship lags have been used minimally or not at all.
- Relationship leads have not been used.
- Merge hotspots have been avoided.

## No missing logic or links


Each activity in the schedule should, at the very least, have one predecessor link and one successor link. In this ideal situation, the activity can't begin until the predecessor has completed, and this activity's completion triggers the successor activity. When this can be said about all of the activities in the

plan, it's an indication that the plan's activities and handoffs have received proper attention and sequencing.

## Logic density that's just right


An activity with exactly one predecessor link and one successor link has a logic density of 2.0. If the project as a whole has an overall logic density of 2.0, it's considered to have lean and efficient logic. It's an indicator that the project logic will be easy to interpret by all project team members, including those who have only limited project planning experience. On the other hand, a logic density approaching 4.0 or higher suggests that project logic may be confusing. That would undermine the usefulness and efficiency of reviewing and updating the project plan during project execution.

## An unbroken critical path


A properly sequenced project will have one critical path, yet while this path can be viewed as necessary, it's fragile. Any interruptions to critical path work will flow through to the end of the project. If an activity on the project's critical path is delayed, it can cause the entire project to be delayed. That, of course, can result in a very unhappy customer! In the ideal project plan, every day that project work is occurring will have one or more critical activities. If that's not the case, it's likely that the integrity of the project plan has been compromised by confusing, inaccurate activity links or the use of unnecessary activity constraints.

## Ease up on the restraints

CPM project plans thrive when dates are treated as system outputs. Inputs from the project team are activities, durations, and logic. CPM planning software can take these inputs and readily produce scheduled dates for all project activities. A date input, on the other hand, is a constraint. That can undermine the project date calculations, resulting in unachievable dates. Introduce fewer hard constraints into the project plan, and the forecast reliability will greatly improve.

## Say no to negative float

When an activity has negative float, that can delay the overall completion of the project or a key milestone. Delays will happen, for sure, but when a project plan has negative float from the outset, it practically guarantees that the project will not complete on or before the planned finish date.

## All of the details are filled in

Activities with insufficient detail can be cumbersome to manage, and it's too easy to assume that "all is well" with them. Activities with shorter durations are easier to assess for progress, which leads to a more reliable project status assessment overall.

## Relationship lags are a drag

Relationship lags introduce artificial time gaps between activities. They're sometimes used to describe a natural waiting period between two activities, but these are better expressed as unique activities with a clear description and visibility in the project plan.

## The lowdown on leads

Leads are negative time lags, allowing overlap between activities. Leads are often misunderstood and misused, which reduces the quality and accuracy of the project plan.

## The trouble with merge hotspots


Merge hotspots have a very high number of direct predecessors. The problem is, the more predecessors that lead to a task, the less likely it is that the task can start and complete as planned. Imagine what would happen if a professor decides not to begin the day's lecture until each of 100 students arrives at class. That professor may be waiting a long time, if not forever, because some students will inevitably be late, and some probably won't show up at all. The professor in this example is experiencing a merge hotspot.


No project plan is perfect. It's a prediction, after all. But it must be a high-integrity plan, or it can't be properly analyzed and adjusted for risk. Project risk analysis can be performed to a high level of quality and predictability, but only when the project plan itself is a high-quality, accurate depiction of project events and the relationships between those events.

# Avoid the Pitfalls


To avoid the pitfalls of "risk done wrong," consider these examples of trouble spots.

- Assure that the project plan is properly constructed and robust.
- Rally the team to participate in the risk exercise. Make it interactive, engaging, and fun.
- Agree on a simple language and conventions for risk inputs and outputs.
- Work continually toward developing a follow-up plan throughout the exercise.

# Chapter 2

# Schedule Risk Analysis

***In This Chapter***

- Understanding direction uncertainty
- Examining schedule risk events
- Introducing correlation to the model

Every effective project needs a solid plan, and every good plan needs a reliable schedule. But just how reliable is that schedule? There's not a schedule in the world that carries no risk of going awry. That's just a fact of life. Stuff happens.

The real key to success, then, is analyzing the plan to understand what risks might mess up the schedule and what should be done about them.

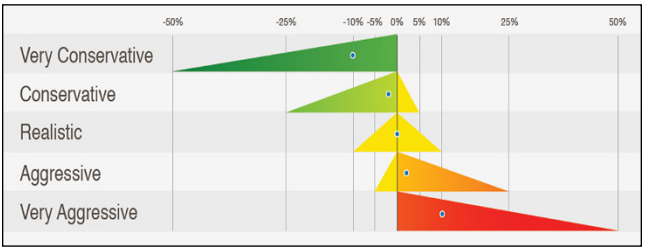
## One Thing Is Certain: Duration Uncertainty

*Duration uncertainty* describes the range of values that result from things such as incomplete scope definition, resource variability, estimating variability, and the like. These are things that everyone knows will happen, but because they aren't predictable for probability or impact, you must accommodate them.

### Create a duration uncertainty template


To make it easier to identify duration uncertainty, you can create a template. This template suggests levels of uncertainty and uses percentages of the remaining duration to calculate the minimum, the most likely, and the maximum values for the risk

model. Typically, the "most likely" value is equal to the remaining duration, but as indicated in Figure 2-1, it can be adjusted.




*Source: Deltek*

**Figure 2-1:** The duration uncertainty template.

The uncertainty range will use a shape or distribution — the most common choices are triangular, beta pert, normal, or tri-gen. The triangular distribution is the default in most tools, because it's simpler to explain and easier for users to understand.

## Get help ranging activities

The most efficient way to determine the ranges for the schedule activities is to realize that this endeavor requires harnessing technical exercise, which bears some resemblance to herding cats. You must manage the people in the room and make it as easy as possible for them to participate in the work.

With that in mind, first organize the schedule activities to match the group you're working with. For example, if you're working with the procurement group, show only that group's activities. And there's no point in showing the construction group anyone else's activities.


Grouping by Work Breakdown Structure (WBS) or code field — whichever is more familiar — will speed up the ranging process. Then, remove all of the nonrelevant columns and the date columns. Remember that the ranging exercise is *not* about picking a new date, but simply about setting a range. Be sure the team doesn't get distracted by the date columns.

Begin by setting everything to "realistic" (that indicates plus or minus 10 percent). Trying to range every activity is an exercise in craziness, so by setting everything first to

"realistic," the group can focus its attention on what is clearly *not* realistic, or the exceptions. That's a simple trick for making the ranging work much more manageable. See Figure 2-2.

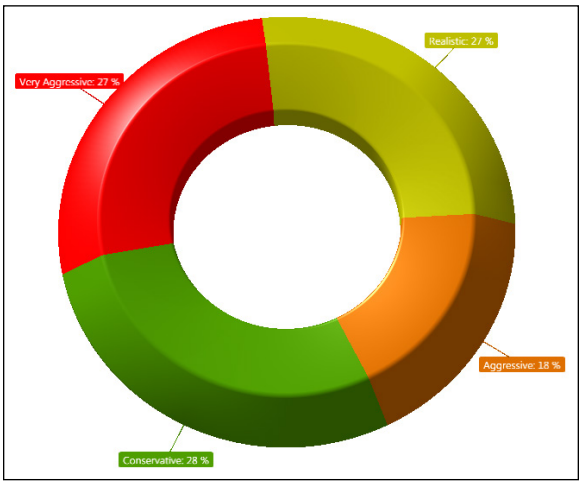
| 1 Year Update.0050 | Procurement | 182d | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0350 | Bid reviews | 30d | | | | 27d | 30d | 33d |
| 0360 | Initial Long Lead it... | 90d | | | | 90d | 90d | 135d |
| 0370 | Vendor B | 15d | | | | 14d | 15d | 16d |
| 0380 | Vendor A | 25d | | | | 22d | 25d | 28d |
| 0390 | Outsourced PMO | 95d | | | | 71d | 95d | 100d |
| 0400 | Secondary Long Le... | 60d | | | | 57d | 60d | 75d |
| 0680 | Vendor C | 20d | | | | 18d | 20d | 22d |

*Source: Deltek*

**Figure 2-2:** Ranging activities for duration uncertainty.

Going section by section, have the team identify the exceptions, referring back to the actual range for the activity. Don't hesitate to ask if something doesn't make sense: "On what planet have we ever delivered this work in five to ten days?"


After all of the exceptions are adjusted, examine the duration uncertainty profile for the project activity grouping (WBS or code field). See Figure 2-3. The project team has been heavily involved in the details in this exercise. The profile lets team members see the portion of those activities in each uncertainty category. That helps them confirm that they got it right, and if not, shows them where additional adjustments and exceptions are required.




*Source: Deltek*

**Figure 2-3:** Procurement duration uncertainty profile.

# Examining Schedule Risk Events

Just like duration uncertainties, discrete risk events must be accounted for appropriately in the risk model. So, after you've gotten the uncertainties calculated, the next step is to quantify and assign the discrete schedule risk events. Although duration uncertainty isn't predictable, discrete risk events *are* predictable and are likely to add either time to the schedule or cost to the budget (or both).

## Set up a risk matrix

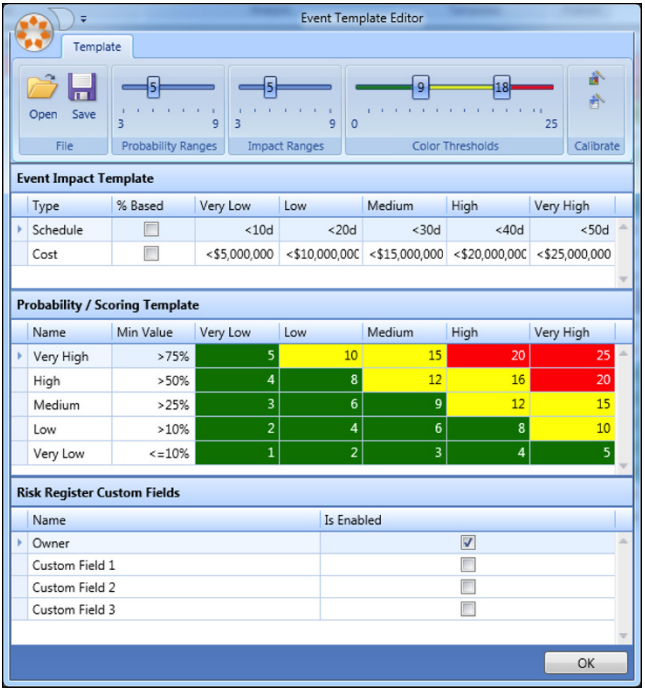

The first step for discrete risk events is to set up the *risk matrix* (see Figure 2-4). On this grid, the probability of the risk event happening is on the vertical axis, and the severity of the consequences are displayed on the horizontal axis. When the risk event is evaluated, it's given the score and color that corresponds to the place where its probability and impact values intersect.

This score gives you a qualitative evaluation of the risk event. In the early days of schedule risk analysis, this was the only way to rank-order risk events. Project teams typically received the list of risk events in color order, and their job was to "mitigate all of the red ones, consider the yellow ones, and ignore the green ones."

## Build the risk register

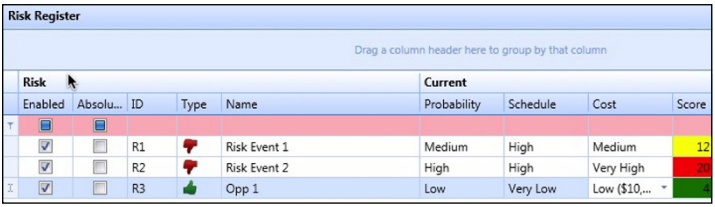
The risk register (Figure 2-5) is a library holding all the information about discrete risk events. This includes the risk event base information, mitigation actions, and post-mitigation ratings.

The base information includes the risk ID, risk type, risk name, probability, and impacts. The mitigation portion of the risk register includes the mitigation name, the time and cost to implement the mitigation, and the probability and impact ratings for the risk event after implementing the mitigation.




*Source: Deltek*

**Figure 2-4:** The risk matrix.




*Source: Deltek*

**Figure 2-5:** The risk register.

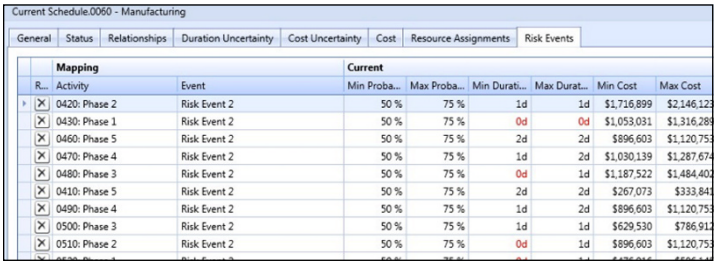
The risk register documents different types of schedule risk events, including:

- **Threats**: If this kind of event happens, it creates negative consequences for the project.
- **Opportunities**: This is a potential event that's a good thing for the project.

- **Calendar event**: This is a time-based threat with different probabilities and/or consequences depending upon the month.
- **Risk window**: This is a time period when work can't occur, with variable start and variable finish dates.

# Map the schedule risks

The last step before running the risk analysis is to attach the risk events to the activity or activities they will impact if they happen. This is called *mapping the risks*. See Figure 2-6.


Current Schedule.0060 - Manufacturing

General | Status | Relationships | Duration Uncertainty | Cost Uncertainty | Cost | Resource Assignments | Risk Events

| | Mapping | | Current | | | | | |
|---|---|---|---|---|---|---|---|---|
| R... | Activity | Event | Min Proba... | Max Proba... | Min Durati... | Max Durat... | Min Cost | Max Cost |
| | 0420: Phase 2 | Risk Event 2 | 50 % | 75 % | 1d | 1d | $1,716,899 | $2,146,123 |
| | 0430: Phase 1 | Risk Event 2 | 50 % | 75 % | 0d | 0d | $1,053,031 | $1,316,289 |
| | 0460: Phase 5 | Risk Event 2 | 50 % | 75 % | 2d | 2d | $896,603 | $1,120,753 |
| | 0470: Phase 4 | Risk Event 2 | 50 % | 75 % | 1d | 2d | $1,030,139 | $1,287,674 |
| | 0480: Phase 3 | Risk Event 2 | 50 % | 75 % | 0d | 1d | $1,187,522 | $1,484,402 |
| | 0410: Phase 5 | Risk Event 2 | 50 % | 75 % | 2d | 2d | $267,073 | $333,841 |
| | 0490: Phase 4 | Risk Event 2 | 50 % | 75 % | 1d | 2d | $896,603 | $1,120,753 |
| | 0500: Phase 3 | Risk Event 2 | 50 % | 75 % | 1d | 1d | $629,530 | $786,912 |
| | 0510: Phase 2 | Risk Event 2 | 50 % | 75 % | 0d | 1d | $896,603 | $1,120,753 |

*Source: Deltek*

**Figure 2-6:** Risk mapping.

For some risk events, the mapping can be clear and easy. But if there's a chain of activities, it can be a bit tricky deciding which activity the risk event should be mapped to. Map the risk event to the earliest activity it will impact in the chain, unless the risk event could uniquely impact every activity in the chain.

# Chapter 3

# Schedule Risk Exposure

***In This Chapter***

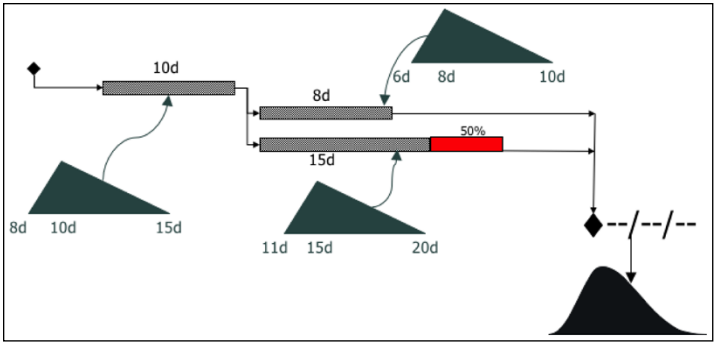
- Crunching the numbers
- Comparing schedule risk exposure

This chapter explores the analyses you'll run to determine schedule risk exposure, and how you can then compare the various analyses to learn how much risk comes from uncertainties, how much from risk events, and perhaps most important, how much benefit you can gain by doing something about those risks and uncertainties.

## Time for the Analysis

With the risk model assembled, you'll use a numerical analysis — such as Monte Carlo or Latin Hypercube — to crunch the numbers. You can use the entire risk model for the analysis, or it can be done using parts of the risk model.

During each analysis, the activity durations are sampled and used to create a critical path schedule. Then, the activity durations are sampled again and another critical path scheduled. Then again, and again, and again, and again. In fact, risk modeling software will typically generate 1,000 to 10,000 critical path schedules, which are referred to as *iterations*. The discrete risk events are added to the results in the proportion that they occur. So, if a risk event has a 50 percent probability of occurring, it would be present in about half of the iterations. Check Figure 3-1 for a sample critical path schedule with risk modeling.




*Source: Deltek*

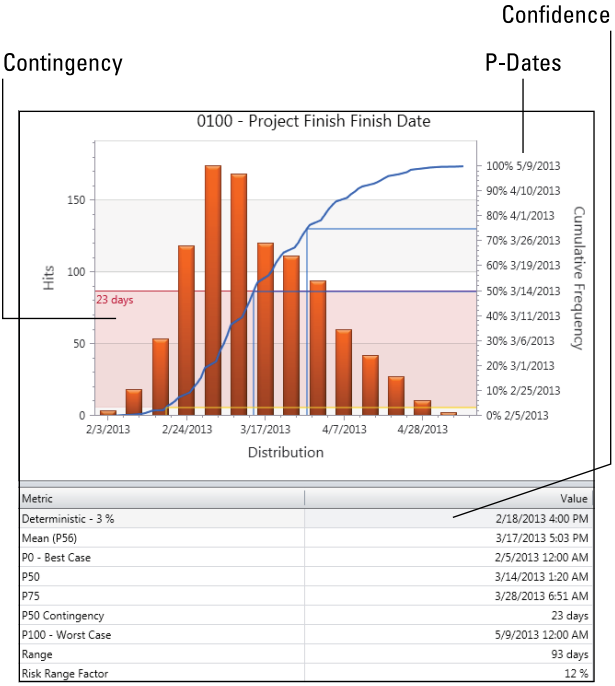
**Figure 3-1:** Critical path schedule with risk modeling.


The results from all the iterations are then charted into a histogram, which shows the profile of the results. The left-side date, or earliest date, shows the result if all the activities happen in the minimum amount of time estimated. The right-side date, or latest date, shows the result if all the activities took the maximum amount of time. Different middle dates result from the many various combinations of durations. The profile is created as each iteration, or result, is charted during the analysis, and the result is the risk exposure chart.

You can determine several things from this risk exposure chart. You'll learn the probability (P-value) of delivering the project by a specific date or earlier — that shows up along the right side of the chart. The blue curved line in the diagram represents the cumulative probability curve.

The second thing you'll learn from the risk exposure chart is the *confidence* — that's the probability that the original deterministic delivery date can be met. In the example in Figure 3-2, this confidence level is only 3 percent. For most typical projects this value is less than 10 percent. Sounds like the original schedule wasn't done very well, right? No, that's not what this means. Schedules aren't designed to account for uncertainty unless the durations are padded.


So how many iterations should be run during risk analysis? That depends on the complexity of the schedule, the number of activities, or cost lines, and the desired P-value for the results. The higher the P-value, the more iterations that will be needed for repeatable results, because at high P-values, you're out on the end of the risk exposure histogram with fewer samples.



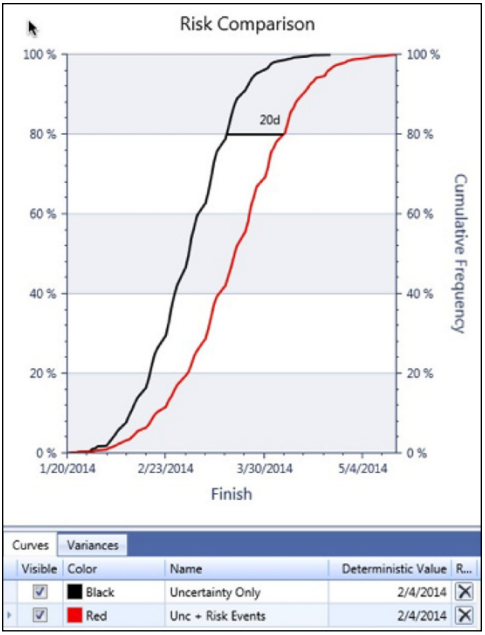

| Metric | Value |
|---|---|
| Deterministic - 3 % | 2/18/2013 4:00 PM |
| Mean (P56) | 3/17/2013 5:03 PM |
| P0 - Best Case | 2/5/2013 12:00 AM |
| P50 | 3/14/2013 1:20 AM |
| P75 | 3/28/2013 6:51 AM |
| P50 Contingency | 23 days |
| P100 - Worst Case | 5/9/2013 12:00 AM |
| Range | 93 days |
| Risk Range Factor | 12 % |

*Source: Deltek*

**Figure 3-2:** Risk exposure.

# Comparing Schedule Risk Exposure


One of the best ways to analyze the risk exposure results is to set up a side-by-side comparison of the cumulative probability curves, or *S curves*. A common comparison is to show the results of the uncertainty-only risk analysis next to those of the uncertainty-plus-risk-events analysis. You can calculate the variance between the two analyses for a desired value. See Figure 3-3. At a P-80 level, the discrete risk events add an extra 20 days to the contingency need compared with just the uncertainty-only analysis.




*Source: Deltek*

**Figure 3-3:** Risk exposure comparison.

Another common analysis is the uncertainty-plus-risk-events and a risk-mitigation analysis. It includes all the duration uncertainty modeling plus all of the discrete risk events, without any mitigation. After you run the analysis with possible mitigation, you can add that S curve. That way you can display the amount of benefit gained by implementing the mitigation as another variance.

# Chapter 4

# Schedule Risk Drivers

***In This Chapter***

- Determining the schedule contribution
- Figuring out what's driving the risk
- Comparing schedule risk drivers

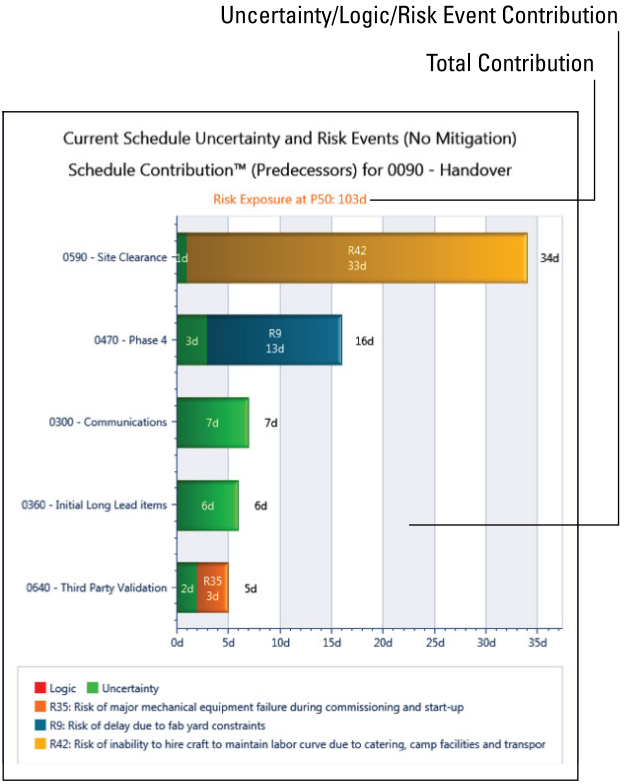
Your analysis so far has done a great job of identifying what the biggest schedule risks are, how likely they are to occur, and what kind of impact they are likely to create. That's all useful information, but when you're trying to figure out which risks need the most attention, you want to know what's going to have the biggest impact on the schedule.

This chapter discusses how you go about exploring and quantifying schedule risk drivers, determining what the schedule contribution is, and comparing the relative importance of the various schedule risk drivers.

## Determine the Schedule Contribution

After you've created the risk exposure and calculated the contingency, the next step is to examine which activities are impacted the most, and which risk events are the biggest drivers. That's where a tornado (or Pareto) diagram comes into play. Up at the top, it identifies the activities and risk events that are the biggest concern. This helps sort the deck, allowing you to focus resources only on the activities and risk events that matter the most.

You'll pick a P-value for this analysis, and it's usually the same P-value you used in the risk exposure analysis. The contingency needed to have that P-value level of confidence is identified. The schedule contribution reveals the top activities that contribute to the contingency. For example, in Figure 4-1, the activity Site Clearance contributes 34 days to the total 103 days of contingency your project will need to achieve the 50 percent confidence date of February 19.




*Source: Deltek*

**Figure 4-1:** Schedule contribution.

The analysis also shows how much of the duration contribution comes from logic, duration uncertainty, and discrete risk events. In this example, most of the schedule contribution

for the Site Clearance activity comes from the R42 risk event (that's the risk that you won't be able to hire craft). The analysis is very helpful, because it shows the activities that should be the biggest focus of any optimization efforts, and points out which activities *aren't* worth focusing on.

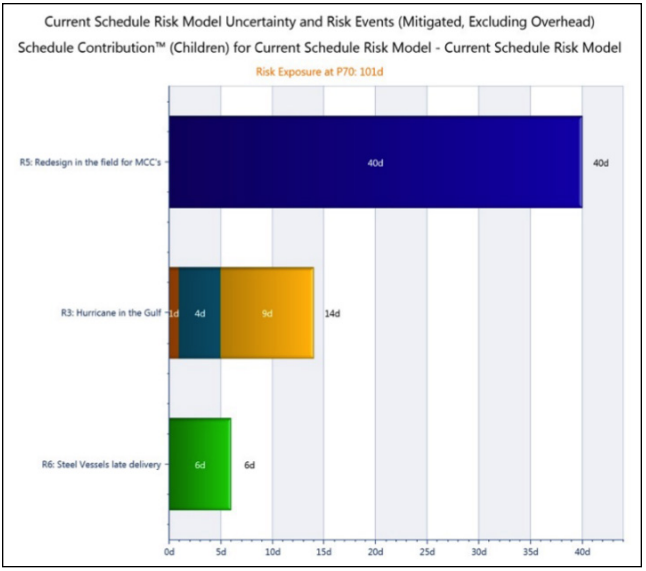
For this example, even if you were able to eliminate all of the contribution for Communications, Initial Long Lead Items, and Third-Party Validation, you still wouldn't get as much benefit as you would just by reducing the contribution from Site Clearance. That doesn't mean those other activities aren't important or don't have a contribution. But it points out in no uncertain terms that if you only have limited project resources, it makes a whole lot more sense to work on the largest impact first.

Rather than spread the team across all the items on the critical path in the single view that you get from the scheduling tool, the risk analysis lets you use the team more effectively by focusing only on the activities that make a difference in the end delivery date. Remember, the scheduling tool's critical path is only one possible outcome for your schedule. The risk analysis shows you 1,000 potential critical paths.

## What's Driving the Schedule Risk?

The driver analysis can be evaluated from the discrete risk event as well as from the activity perspective. The analysis is flipped, showing the top risk events that contribute to the contingency. Check the example in Figure 4-2. One risk event (Redesign in the Field for MCCs) is clearly the largest contributor. Perhaps it seemed like late delivery of steel vessels was bound to be a problem, but this analysis reveals it to be much lower on the list.

A risk analysis saves you from spending time and money on mitigation that doesn't matter, or missing mitigation that could provide a substantial benefit.




*Source: Deltek*

**Figure 4-2:** Risk driver analysis.

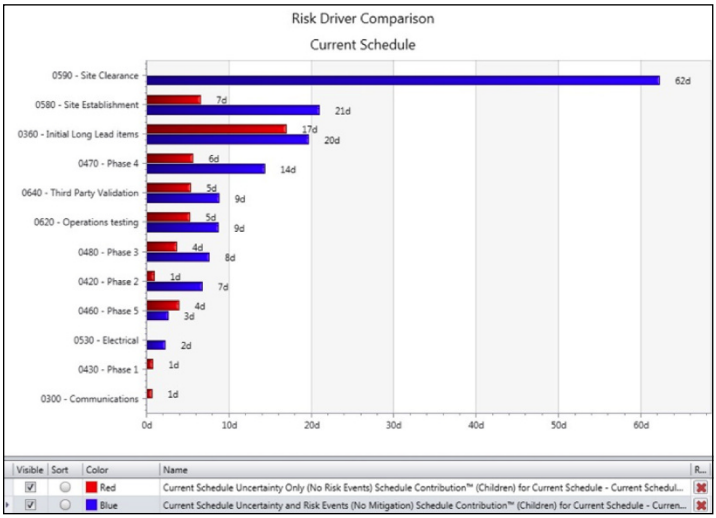

Schedule risk analysis does keep track, during each iteration, of which activities fall on the critical path. But criticality doesn't give any indication of the size or degree of impact. So, two activities that are both on the critical path are treated as equally important, if criticality is the only thing considered. That doesn't make sense when one activity has a duration of two days and is highly certain, while the other activity has a duration of 15 days and is highly uncertain and, on top of that, has a risk event.

Because what is defined as critical changes with the building of the risk model, use it as an output from the schedule risk analysis. Remember, a much more useful measure is to look at schedule contribution, as it gives a rank order, and quantification, of the activities that are actually "pushing" your schedule.

# Compare Schedule Risk Drivers

Just as you can compare risk exposure curves, you can compare the schedule risk drivers (see Figure 4-3). By comparing

the risk drivers, before and after mitigation, you can determine the benefit to a particular activity or the neutralization of a particular risk event.




*Source: Deltek*

**Figure 4-3:** Risk driver comparison.

# Chapter 5

# Schedule Risk Mitigation

***In This Chapter***

- Analyzing the mitigation possibilities
- Performing a cost/benefit analysis
- Creating the new deterministic schedule

All of the work so far has been leading up to this important place: mitigating the risks. In the simplest of terms, you're considering which risks to try to do something about, and then doing what you can to either prevent those risks from occurring or lessen the impact if they do occur.

## Mitigation Isn't Free


*Mitigation* is the possible new work that can reduce the probability, or the impact, of a discrete risk event. Some people call it *risk handling*. Mitigation options include transferring the risk, reducing the risk, or accepting the risk.

Mitigation analysis is a cost-benefit analysis through which a possible solution to "high risk" is proposed. The analysis evaluates the benefit of implementing the proposed mitigation. Then you can compare that benefit with the time and money it will take to implement the mitigation. Many project teams like to pretend that mitigation is free. It isn't. Figure 5-1 shows risk event mitigation in action.

There's a specific methodology for mitigation analysis, and it's frequently misused. Just as you need clear, specific language to describe the risk events, it's important for mitigation, too.

| Mitigation | | | |
|---|---|---|---|
| Enabled | Description | Duration | Cost |
| ☐ | | | |
| ☐ | | 0d | $0 |
| ☑ | Mitigation 1 | 30d | $50,000 |
| ☐ | | 0d | $0 |

*Source: Deltek*

**Figure 5-1:** Risk event mitigation.


To begin with mitigation, start with the top discrete risk events. Capture the possible mitigation in the risk register, along with the cost and time to implement the mitigation. See Figure 5-2.

Now it's time for "let's pretend." The project team must think of the discrete risk event *and* assume that the proposed mitigation has been implemented. With that assumption, team members re-evaluate the probability and impact for that discrete risk event.

| Mitigated | | | |
|---|---|---|---|
| Probability | Schedule | Cost | Score |
| | | | |
| Medium | High | Medium | 12 |
| Low | High | Very High | 10 |
| Low | Very Low | Low | 4 |

*Source: Deltek*

**Figure 5-2:** After mitigation risk score.

# Time for the Cost/Benefit Analysis

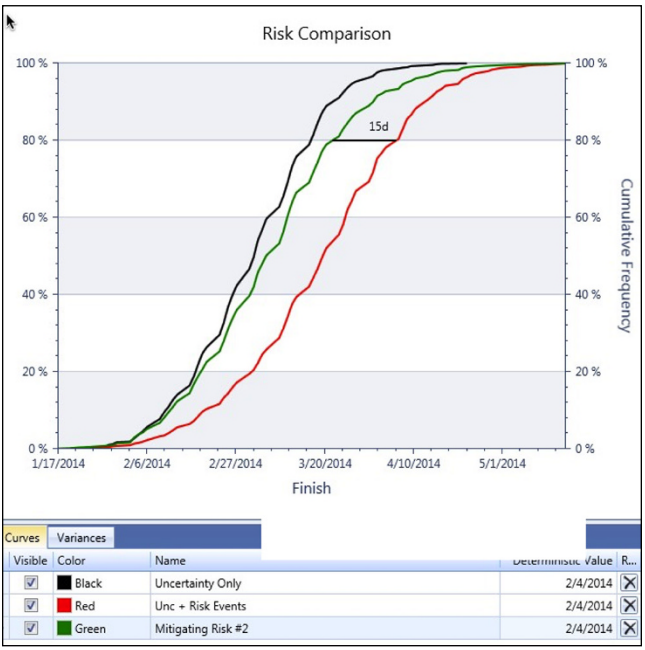
You've reached the point in the process where the true cost/benefit analysis can be done. Before starting the mitigation analysis, it's important to identify the most important result you're trying to deliver in the project — is it cost or schedule? Of course, every stakeholder or customer always wants to protect *both* cost and schedule, but there are times when

it's possible to deliver only one or the other, so choices must be made.


Knowing which option "wins" helps with the cost/benefit analysis of possible mitigation work. In addition, if the schedule is cost-driven and a schedule risk analysis is being done, it's important to identify the cost of a day saved (or lost). Know these parameters ahead of time, and your mitigation proposal can be in sync with the goals of the project.

You'll run a third risk analysis, this time using the probabilities and impacts from the risk events — but after mitigation. This analysis can tell you whether there's enough benefit to make the mitigation worth the cost and time.

Figure 5-3 suggests that doing the mitigation reduces the risk event impact by 15 days. But the mitigation costs $50,000, so is this a good business decision or not? It all depends upon the business, the specific project, and the value of a day.



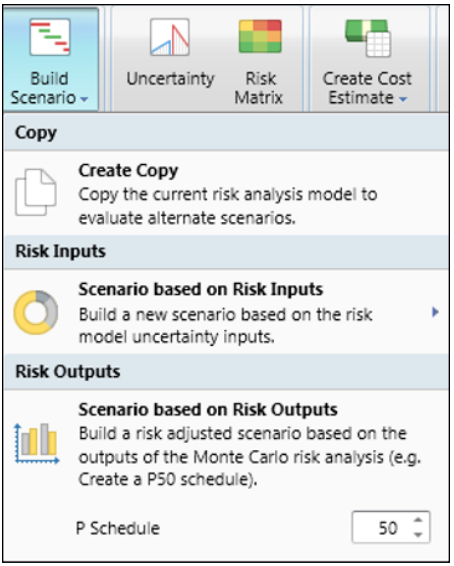

*Source: Deltek*

**Figure 5-3:** Risk exposure comparison with mitigation.

# The End Game: A Risk Adjusted P-Value Schedule

Now that you've completed the schedule risk analysis with mitigation, you can create a deterministic schedule — using all the risk modeling, including duration uncertainty, risk events, and mitigation adjustments.

Figure 5-4 shows how a P-50 risk-adjusted schedule will be created. The P-50 durations, from the schedule risk analysis, will be calculated. These durations will then be used, with the original schedule logic, to assemble a new project schedule. The only difference between the original schedule and this risk-adjusted schedule will be the individual activity durations. You'll have a 50 percent probability of delivering the activities in the new durations or less.




*Source: Deltek*

**Figure 5-4:** Creating a risk adjusted schedule.

# Chapter 6

# Cost Risk Analysis

***In This Chapter***

- Accounting for time in the cost model
- Identifying the base cost uncertainties
- Determining cost risk events

The cost risk analysis process is a lot like the schedule risk analysis process. You define cost uncertainty, then identify and map cost risk events. This chapter explores the difference between cost and schedule risk analysis, discusses how to account for time in the cost model, and details the process of cost risk analysis, including the identifying risks, exploring uncertainties, creating a risk model, and building a risk register.

## Cost Risk Analysis versus Schedule Risk Analysis

Think of a project that includes the installation of piping. Both a schedule risk analysis and a cost risk analysis should be conducted on the project. Here are factors that the two different kinds of analyses might focus on.

Cost risk analysis:

- Variation in the pipefitter's labor rate is included in the cost uncertainty.
- Variation in the price per foot of the piping material is included in the cost uncertainty.

Schedule risk analysis:

- Variation in the time it takes to install the piping is included in the schedule uncertainty.

# A Question of Time


The biggest question when doing a cost risk analysis is how to account for the impact of time on the cost model. It's important to make this a conscious decision so that you don't miss or double-count costs due to time. There are several ways to go about this:

- Have the cost estimator include the impact of time on the individual time-dependent costs.
- Use the schedule risk analysis results to provide the cost estimator with a risk-adjusted schedule, and thus, updated activity durations
- Use the schedule risk analysis results to directly adjust the cost uncertainty profiles in the cost risk analysis.

# Identify the Base Cost Uncertainty

As with schedule risk exposure, total cost risk exposure is divided into two buckets: cost uncertainty and cost discrete risk events. And also similar to schedule risk, it's important when you're setting up the risk model that you put the right things into the right buckets, so items aren't missed and aren't double-dipped.

*Cost uncertainty* has two components: base cost uncertainty and the uncertainty contribution due to time. You must account for both of these components in the cost uncertainty, and it's best if you can do so independently of each other. Including and analyzing them separately makes it easier to determine where to spend time and effort.

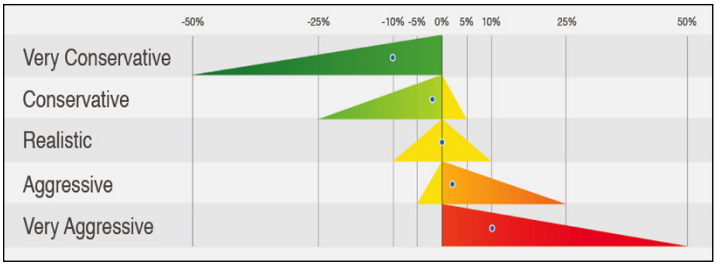

Organize the cost estimate with separate lines for time independent and time-dependent costs. This way of organizing will make the assembly of the cost risk model a whole lot easier. It also makes both the model and the analysis more accurate and precise.

## The cost uncertainty template

You'll have to identify cost uncertainty and include it in the risk model for every cost line in the estimate that has a remaining cost. You'll get your best estimates from your project team and other individuals who have the knowledge and experience related to this work.

The best approach is to create a template to make it easier for the team to range the costs. The template features levels of uncertainty and uses percentages of the remaining cost to calculate the minimum, the most likely, and the maximum values for the risk model.

Typically, the most likely value is equal to the remaining cost, but as in Figure 6-1, it can be adjusted. Frequently, the project's cost uncertainty template and duration uncertainty template are exactly the same.




*Source: Deltek*

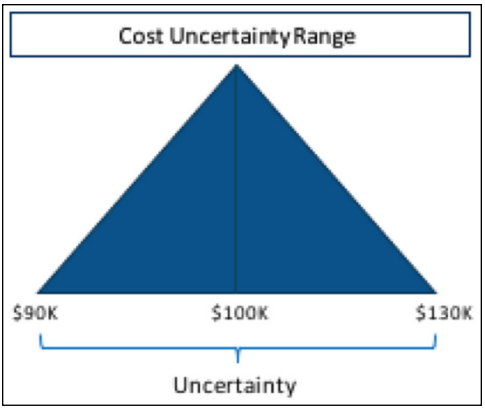
**Figure 6-1:** Cost uncertainty template.


Go ahead and use a different distribution if you've got a good, technical reason, but be sure to document the reason. Don't change it just to be different, though.

## The process of ranging costs

Begin the cost ranging with only the base cost uncertainty. You'll use the expected materials and labor contracts as references for how much these costs will vary.

You can speed up the ranging process if you organize the cost lines to match the group you're working with, by area, department, or control account. That way, you can remove all the nonrelevant columns and date columns. See Figure 6-2.




*Source: Deltek*

**Figure 6-2:** Base cost uncertainty range.

## How time affects cost

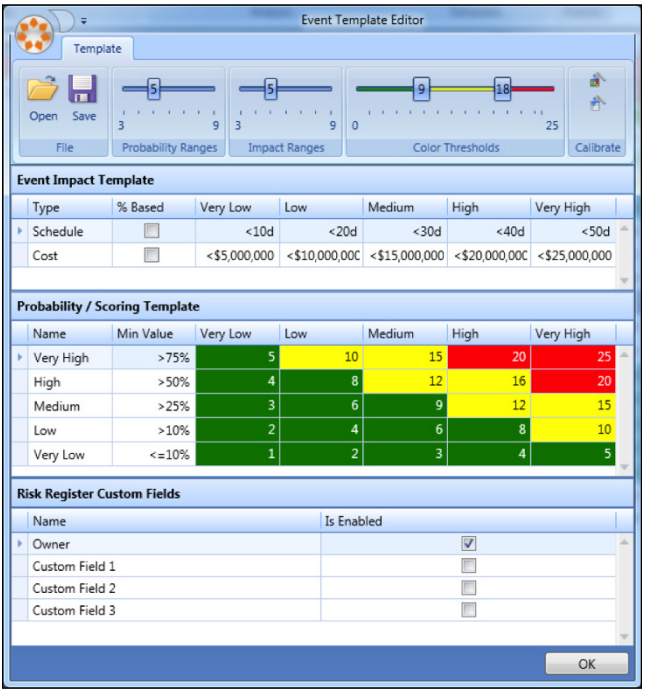

With the base cost uncertainty ranges established, you can layer the effect of time into the cost risk model. Not every cost line has a time impact. For those that don't, identify the schedule activity that best informs how long the costs will last.

# Determine the Cost Risk Events


The next step in the process is to quantify and assign the *discrete cost risk events* in the model. Just like setting up schedule risk events, the discrete cost risk events are captured in the risk register. Frequently, the discrete schedule risk events and the discrete cost risk events are the same.

# The risk matrix

The risk matrix used for the cost risk analysis will be the same as the matrix used for the schedule risk analysis. You do, however, need to evaluate the cost impact range for accuracy and appropriateness. See Figure 6-3.

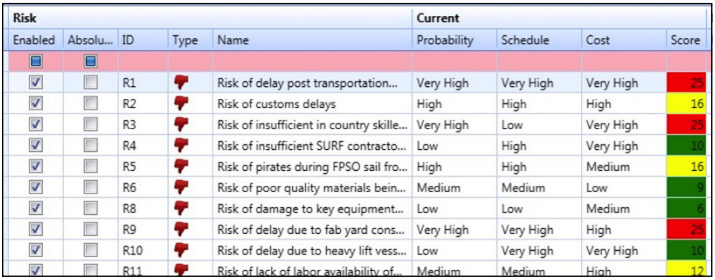



*Source: Deltek*

**Figure 6-3:** Risk matrix.

# The risk register

Similarly, the information contained in the risk register is no different for cost risk events as it is for schedule risk events. You'll see the same risk event base information, mitigation actions, and post-mitigation ratings. See Figure 6-4.



| Risk | | | | | Current | | | |
|---|---|---|---|---|---|---|---|---|
| Enabled | Absolu... | ID | Type | Name | Probability | Schedule | Cost | Score |
| ☑ | ☐ | R1 | | Risk of delay post transportation... | Very High | Very High | Very High | 25 |
| ☑ | ☐ | R2 | | Risk of customs delays | High | High | High | 16 |
| ☑ | ☐ | R3 | | Risk of insufficient in country skille... | Very High | Low | Very High | 25 |
| ☑ | ☐ | R4 | | Risk of insufficient SURF contracto... | Low | High | Very High | 10 |
| ☑ | ☐ | R5 | | Risk of pirates during FPSO sail fro... | High | High | Medium | 16 |
| ☑ | ☐ | R6 | | Risk of poor quality materials bein... | Medium | Medium | Low | 6 |
| ☑ | ☐ | R8 | | Risk of damage to key equipment... | Low | Low | Medium | 6 |
| ☑ | ☐ | R9 | | Risk of delay due to fab yard cons... | Very High | Very High | High | 25 |
| ☑ | ☐ | R10 | | Risk of delay due to heavy lift vess... | Low | Very High | Very High | 10 |
| ☑ | ☐ | R11 | | Risk of lack of labor availability of... | Medium | Medium | High | 12 |

*Source: Deltek*

**Figure 6-4:** Risk register.

The risk register will show different types of cost risk events, such as:

- **Threats**: These are bad things that will happen to the project if the event happen.
- **Opportunities**: If the event happens, these are positive consequences.

After the cost risk events are captured in the risk register, you must quantify both the probability and the impact. This leads to the calculation of the overall risk score (which should not be used).

## Cost risk mapping

The last step before running the cost risk analysis is to attach the risk events to whatever line or lines they will impact if they happen. As with the schedule work, this is called *mapping the risks*. See Figure 6-5.


Once the appropriate risks are mapped to the cost model, you must examine and verify the impact on the individual cost lines. Many risk models will map an individual risk event to multiple cost lines, so you must be sure that's done correctly.

Details | Mappings | Mitigation Steps

| | | Mapping | Current | | | | | |
|---|---|---|---|---|---|---|---|---|
| | R... | Activity | Min Proba... | Max Proba... | Min Durati... | Max Durat... | Min Cost | Max Cost |
| ▸ | ✕ | 480: Management | 75 % | 100 % | 0d | 0d | $106,857 | $133,571 |
| | ✕ | 490: Engineering | 75 % | 100 % | 0d | 0d | $26,714 | $33,393 |
| | ✕ | 500: Procurement | 75 % | 100 % | 0d | 0d | $614,426 | $768,032 |
| | ✕ | 510: Construction | 75 % | 100 % | 0d | 0d | $106,857 | $133,571 |
| | ✕ | 520: Offshore Installation | 75 % | 100 % | 0d | 0d | $2,137,133 | $2,671,416 |
| | ✕ | 540: Engineering | 75 % | 100 % | 0d | 0d | $2,270,703 | $2,838,379 |
| | ✕ | 550: Procurement | 75 % | 100 % | 0d | 0d | $151,380 | $189,225 |
| | ✕ | 570: Construction | 75 % | 100 % | 0d | 0d | $454,141 | $567,676 |
| | ✕ | 590: Offshore Installation | 75 % | 100 % | 0d | 0d | $2,270,703 | $2,838,379 |

*Source: Deltek*

**Figure 6-5:** Risk mapping.

# What about opportunities?

As with the schedule risk analysis, most risk registers only contain threats related to costs, but not opportunities. Shouldn't you just scoop up all of the opportunities and put them in the cost estimate? Not so fast. Opportunities, like mitigation, cost time and money to implement. By including them in the risk register and risk model, you can make smarter choices about which provides the biggest benefit. It may be that spending resources pursuing a cost opportunity is wiser than spending the same amount mitigating a cost risk. It's worth considering.

# Chapter 7

# Cost Risk Exposure and Mitigation

***In This Chapter***

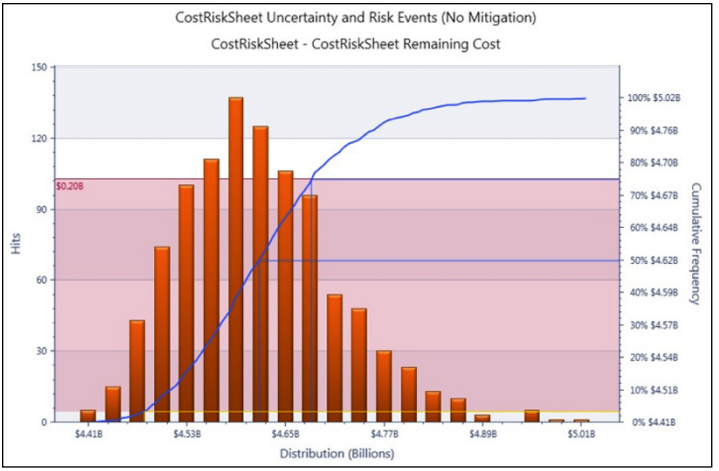
- Crunching the numbers
- Comparing cost risk exposure
- Determining the cost contribution
- Figuring out what's driving the risk

There are lots of similarities between the schedule risk analysis process and what you're going through to identify, analyze, and consider mitigating cost risks and uncertainties. It's all about anticipating cost issues that otherwise might be surprises, and deciding what to do about them, if anything.

This chapter explores the analyses you'll run to determine cost risk exposure, and how you can then compare the various analyses to learn how much risk comes from uncertainties and how much from risk events.

## Ready to Analyze


Cost risk analysis works the same way, mechanically, as schedule risk analysis does, with a total cost be calculated rather than a delivery date. During each analysis, the cost lines are sampled and a total cost value is added up, using the sampled costs. If a risk event has a 50 percent probability of occurring, then it would be present in roughly 50 percent of the iterations. See Figure 7-1.




*Source: Deltek*

**Figure 7-1:** Cost risk analysis.

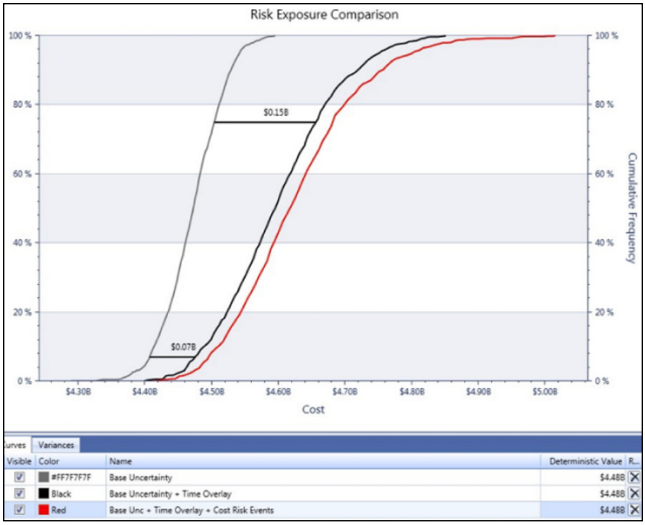
The results from all of these iterations are charted into a histogram for cost, just like they were for schedule. The histogram shows the profile of the results. The left-side figure shows the lowest cost, with the right-side showing the highest cost. The various costs in the middle result from different combinations of costs.

From this analysis you can determine the probability of delivering the project at cost, as well as the confidence level.

# Comparing Cost Risk Exposure


Like schedule risk analysis results, the cost risk analysis results can also be evaluated using a side-by-side comparison of the cumulative probability curves, or *S curves*.

For cost, a common comparison is to show base uncertainty, time overlay, and the risk events as additive curves. In Figure 7-2, the variance between the base uncertainty analysis and the base uncertainty plus time overlay can be calculated.



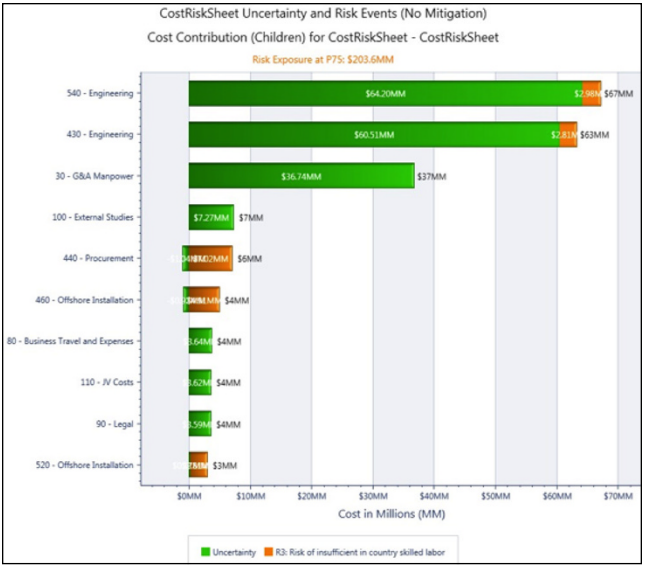

*Source: Deltek*

**Figure 7-2:** Cost risk exposure comparison.

# Understand the Cost Contribution


Once the risk exposure is created and the contingency calculated, the next step is to examine which cost lines are the most impacted and which risk events are the biggest drivers. A tornado (or Pareto) diagram is handy for this. At the top are the cost lines and risk events that are of the biggest concern, which helps you determine where to direct resources. See Figure 7-3.


This analysis sets the priorities for your consideration of mitigation. It ensures that you're spending time and money on mitigation that matters the most, and that you're not missing mitigation that could provide a substantial benefit to the project.




*Source: Deltek*

**Figure 7-3:** Cost contribution.

# Analyze and Handle the Cost Risk

The mitigation process for cost risk events is the same as for schedule risk events. Once you've identified the top cost risk drivers, you can evaluate options for mitigation. The analysis indicates the benefit of a proposed mitigation, and you can then compare that benefit with the time and money it will take to implement the mitigation. See Figure 7-4.

| | | | | | |
|---|---|---|---|---|---|
| Contract backup contractor | 10d | $1,000,000 | Medium | Medium | Low |
| Liaison with local authorities | 30d | $0 | Medium | Very High | Very High |

*Source: Deltek*

**Figure 7-4:** Cost risk mitigation.

Your next step is to propose mitigation, based on your evaluation of the top cost risk events and taking into account the cost and time to implement the mitigation.

# Chapter 8

# Nine Thoughts on Delivering the Risk Message

***In This Chapter***

- Keeping it simple and focusing on the audience
- Challenging the skeptics
- Moving forward with risk management
- Understanding risk avoidance
- Keeping the message alive

You've gone to a lot of effort to analyze risk and determine the best way to respond to it. Now, you need to sell your findings to the powers that be, the ones who hold the purse strings and have the ultimate say in dealing with risk. You need to create a compelling risk message.

That's easier said than done, and no matter how well you do your work, you may run into stubborn obstacles to the risk management for which you're advocating. Here are some thoughts about creating the message and ensuring its success.

## Keep It As Simple as Possible

Like all important messages, the content of the risk message should be tailored to the audience. A risk exercise for a medium or large project can be rather complicated, with many charts and tables to be created and analyzed. You'll find yourself creating quite an epic as you try to recap the exercise for senior management and the customer. No doubt they'll appreciate the hard work, but they will also appreciate

a concise summary of outcomes. In fact, the project sponsor may simply want to be in the position to answer the question, "Where can we help?"

## Try the Risk Driver Analysis

The risk driver analysis is often the perfect document to share with the sponsor. Above and beyond all the other charts, the risk driver analysis illustrates exactly which threats will drive the project to a delayed schedule and higher cost. The sponsor can use this concise information to determine the consequences of inadequate risk mitigation or inadequate contingency funding.

While statics, P-values, and histograms are longstanding aspects of risk analysis, they're not necessarily required to prompt action when you deliver the message. Stakeholders who want the additional detail should receive it, but the best bet may be to steer them toward the risk driver analysis, as it is the true bottom-line outcome of the risk exercise.

## The Hard-to-Convince Sponsor

You can put forth all of the risk analysis available, and no matter the importance or threat to the project, the evidence may prompt no action other than a wait-and-see approach. It may take several updates regarding impending delays before the sponsor begins to believe that the threats you've warned about are likely to drive true delay to the project.

With a situation such as this, the sponsor should receive updates to the risk exercise. Each time the project plan's progress is assessed, there should also be an assessment of the threats, opportunities, and uncertainty. This will allow the review of changes in the risk charts, so that the sponsor and team can determine if the probable risk impact to the project is increasing, unchanging, or decreasing.

## Words from the Skeptics

You may have conducted the most incredible risk analysis exercises, and still find them challenged by management.

You'll hear all kinds of comments and questions. "These risk models don't apply to us." "Risk always tells us that we can't finish on time or that the project will be too expensive, but we have to deliver anyway." "This looks like it was cooked up by some number-crunchers, not the project team." "We have to make the charts, but they don't really mean anything to our project."

## If the Message Is Challenged

Confidently recap the risk inputs that the team has provided. Candidly describe areas where sufficient information wasn't provided. Explain that risk analysis involves the concepts of probabilities and likelihood. No one will know for certain what will happen until the project is complete. Until that point, project risk analysis is the science of translating educated team inputs into reliable predictions of project performance.

## Boost the Credibility of the Message

Have team members who provided risk inputs explain the information that they provided, and elaborate on how it can affect their ability to complete their work. This will reinforce the message from the risk driver analysis. Reaffirm that project risk management isn't just guesswork. It's an objective exercise, using the proven concept of project simulation based on targeted inputs from the team members who are responsible for executing the work.

## Acknowledge That More Details Will Always Help

Convey that the message will certainly need refinement and updates as work progresses on the project. As more work is performed on the project, much more will be known about the dynamics of executing the project.

## You Got the Green Light. Now What?

Often, the sponsor does want to take action based on a credible risk assessment. Working with the sponsor to determine the best action can be an interactive exercise, and the risk message will likely change as different strategies are discussed. The sponsor may be able to make an adequate case to have funds provided to the project in order to mitigate risk. In this case, the risk assessment needs to be fortified with this information, with new risk driver analysis charts created.

In some cases, even with additional funding or resources, it's still not possible to mitigate for certain threats. It may be that it would take even more funding, or maybe the risk is simply too complex. When this occurs, risk avoidance may be discussed as a reasonable strategy. With a clear understanding of these challenging threats, the sponsor may engage the team to seek opportunities, or perhaps try to accelerate areas of the project which occur prior to the impact of the risk.

## Never Over 'Til It's Over

The "message" is never truly complete. It will evolve based on action or inaction taken by the project team. The only point when the risk picture is truly final is when the project is complete! Until that final moment of project completion, there will always be some level of threat, meaning that some form of risk analysis will continue to be needed. For this reason, it's essential to keep the risk message alive in the consciousness of the project team.

## Anticipate, analyze, and manage your project's risks

Imagine how many risks threaten the schedule or the budget of a complicated project! Managing those risks is a major key to success. This book reveals how you can recognize what those risks are, what they threaten, how much of a threat they are, what it would take to mitigate them, and whether it's worth the trouble.

- ***Understand the uncertainties* — identify what about cost or schedule you just can't be sure about**
- ***Register the risk events* — make a list of the troublesome things that are foreseeable**
- ***Analyze the exposures* — chart all of the possibilities for the schedule and the budget**
- ***Compare the culprits* — decide which risks are likely to have the most impact**
- ***Determine the best response* — make sound decisions about which risks to mitigate, and which to live with**

**Open the book and find:**

- **How to determine the range of an uncertain impact**
- **The lowdown on the risk matrix and risk register**
- **Ways to figure how many scenarios your analysis should study**
- **Thoughts on comparing one risk to another**
- **Suggestions for weighing risk mitigation costs against the benefits**

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