CHAPTER 5

Perform Qualitative Risk Analysis

Objectives of the Perform Qualitative Risk Analysis Process

Does it make sense to plan responses to all the risks from the Identify Risks process? No, because some of the risks identified are not very probable or, if they occur, will not have a great impact. The overall objective of the Perform Qualitative and Quantitative Risk Analysis processes is to determine which risks warrant a response. The specific objectives of Perform Qualitative Risk Analysis are to:

- *Subjectively* evaluate the probability and impact of each risk
- Create a shorter list of risks by determining the top or critical risks that you will quantify further and/or address in the Plan Risk Responses process
- Make a go/no-go decision (Having evaluated the risks, do we still want to do this project?)

The inputs to Perform Qualitative Risk Analysis include:

- Risk management plan
- Risk register (list of potential risks)
- Project scope statement
- Project type and an understanding of the work needed to complete the project
- Data about the risks to be used during this step to measure their precision
- Assumptions to test
- Scales for probability and impact (if they are standardized for your department or company)
- Historical records: How were similar risks qualified in the past?

Determine Additional Information Needed

There needs to be a real understanding of the risks in order to measure them in the Perform Qualitative Risk Analysis process. Otherwise it can feel as if this step involves asking questions, rather than subjectively measuring probability and impact. Before you start the Perform Qualitative Risk Analysis process, verify that the following work has been performed:

- Ask the experts and the customer any questions not answered in the project charter or earlier discussions
- Review data already supplied to the team in light of questions that arose during the Identify Risks process

Determine Frequency and Timing

If you have not used RMC Risk Notes (previously described) to identify risks, you may need to collect more information about when and how often a risk might occur before you can effectively qualify risks. When a risk might occur in the project life cycle, and how often, will help to determine its impact and your risk response. A risk that could occur later in the project should be rated higher than one that could occur earlier in the project, because the later the risk occurs, the greater the impact it will have on the project. A risk that could impact an important part of the project should be rated higher than one that could affect less important activities. A risk that might occur more than once may need the same response several times or a unique response for each occurrence.

Assumptions Testing

Before you can use the risk information collected, assumptions made when determining risks must be tested. Too many guesses make the data unreliable, thus adding risk to the project if these assumptions are wrong.

Imagine one of your stakeholders had assumed incorrectly that training the end users was part of the project, or a stakeholder assumed that the project work would not interfere with his or her daily work. Each instance of assumption, if wrong, could add risk or cause the related risk to have a greater probability or impact.

A project manager should look at the stability of each assumption (how realistic or valid is it?) and the consequences if the assumption is false. First, the project manager should make certain that assumptions have been satisfactorily identified in the Identify Risks process. *"What assumptions have been made?"* Then, if the project manager feels more work with assumptions is needed, a separate discussion with the risk team about the assumptions, stability, and consequences could be the start of the Perform Qualitative Risk Analysis process. The higher priority the project, the more certainty is needed.

In assumptions testing, the stability and consequences are rated from 1 to 10. A stability rating of 5 to 10 means the assumption is valid. A consequences rating of 5 to 10 means the assumption could have a large impact on the project. You can use this version or another scale or interpretation on your projects.

Assumptions Testing		
Assumption	Stability (1 to 10)	Consequences If False (1 to 10)
Project work will not interfere with stakeholder Morgan's daily work.	2	8

Data Quality Assessment

Beginning in the Perform Qualitative Risk Analysis process, the project team will be relying on the data about risks acquired in the Identify Risks process. It would therefore be wise to make sure the data to be used in qualitative risk analysis is precise and reliable. Before we start qualitative risk analysis, we need to ask ourselves, "How well understood is the risk?" This should include an analysis of the following to rate the precision of each risk:

- Extent of the understanding of the risk
- Amount of data available about the risk
- Reliability and integrity of the data

Use a Chart

This analysis could be accomplished by the use of a chart (see the following example) that uses a scale of 1 to 10 (or any other rating scale; I prefer a numerical scale since most people feel such a scale is easier to interpret and score). Determine if the entire team will rank each risk and compile the answers, or if you will do the work yourself. The choice depends on your understanding of the project and

your professional experience. The higher priority the project, the more precise the data needs to be.

Data Quality Assessment Chart			
Risk	Extent of the Understanding of the Risk	Availability of Data about the Risk	Reliability of the Data
The XYZ system will arrive late, causing a two-week delay in the deliverable due date.	9	7	2
The software will not be compatible with the computer operating system, resulting in the need to select new software.	2	2	9

In this example, a decision has been made that any risks receiving a five or lower score in any area will be further investigated. Therefore, you, the risk team, and other stakeholders might be involved in additional expert interviews and data collection before detailed qualitative risk analysis is begun. Take this seriously, as data quality assessment will help make the rest of the risk management process flow more smoothly as well as decrease the number of risks.

Probability and Impact Scales

Once you are sure you have enough information about all the risks identified in the previous step, the probability and impact of each risk must be determined. Probability is the likelihood that a risk will occur. Impact is the effect the risk will have on the project if it occurs. For the purposes of the Perform Qualitative Risk Analysis process, probability and impact will be estimated subjectively, with the word "impact" encompassing all possible impacts.

If risk scales are not already standardized in your organization, you must decide which scales to use to determine probability and impact qualitatively. The following chart shows four possible choices of scales to use for probability and impact.

Probability and Impact Scales										
Option	Rating									
1	Very Low		Low		Moderate		High		Very High	
2	.05		0.1		0.2		0.4		0.8	
3	0.1		0.3		0.5		0.7		0.9	
4	1	2	3	4	5	6	7	8	9	10

Remember that a 9 or 10 for probability is considered a fact. A risk with a probability of a 9 or 10 should be considered in developing the work breakdown structure and other parts of the project management plan.

Reducing Bias

It is important that all those who are evaluating the risk use a standard interpretation for their assessment of probability and impact, in order to achieve consistent evaluation of risk across multiple projects. Sometimes it is difficult for people who are evaluating risks to be objective. They may attempt to bias the results in one direction or another (motivational bias), or their evaluation may be biased due to a difference in perception (cognitive bias). Having a description for 1 to 10 in the matrix will help eliminate some of these biases, but the risk team should continue to look to expose biases throughout the life of the project.

Remember that probability rating cannot be more than 8 on a scale of 1 to 10, as a higher rating indicates that you are dealing with a fact, not a risk!

The rating on any scale should be defined. Here is an example:

Probability										
Rating	1	2	3	4	5	6	7	8	9	10
Interpretation	Low		Medium		Medium-High		High		Fact	

Generally, the impact includes impacts to all the project objectives. A further interpretation of the impact rating follows:

Scale for Impact	
Rating	Interpretation
10	Project failure
9	Over budget by 40% or project delayed by 40%
8	Over budget by 30% to 40% or project delayed by 30% to 40%
7	Over budget by 20% to 30% or project delayed by 20% to 30%
6	Over budget by 10% to 20% or project delayed by 10% to 20%
5	Slightly over budget
4	Large reduction of time or cost reserves
3	Medium reduction of time or cost reserves
2	Small reduction of time or cost reserves
1	No real impact

Warning: High, Medium, and Low Scales

Based on extensive experience in teaching risk management and watching problems occur repeatedly, it's evident that many companies make a big mistake of using high, medium, and low to sort their risks.

Why is this a mistake? For even 30 risks, a high, medium, low range does not provide enough spread between each risk to sort the risks. Why bother? As tested with thousands of people in my risk management classes, if you use numbers (even though qualitative risk analysis is subjective), your scale is broader and you will have fewer ties and a clearer picture of which risks to carry forward. A broader range will also decrease the ambiguity that can arise from differing interpretations of the terms "high," "medium," and "low."

How to Determine Probability and Impact

Imagine that you have identified over 500 risks. You know you have to determine the probability and impact of each one. Many project managers pick a risk and ask the team to determine its probability. When a consensus is reached after about 10 minutes, they determine the impact. Now imagine the reaction of the team. They are realizing they will be there for hours in order to determine the probability and impact of all the risks and stop fully participating. Would you like to see a way to significantly shorten the duration of this effort? Here are several ways to do just that.

Choice 1: Explain the risk and impact to five people familiar with the project and/or the risk in question. Ask them for their opinion of the level of probability using the 1 to 10 scale. Of the five probability ratings you receive, discard the highest and lowest, and then average the remaining three ratings. Round off the answer to the nearest number ending in zero or five.

Choice 2: Have all the risks entered into a computerized spreadsheet and create a form. Have each person list the probability and impact of each risk using a predetermined scale. Then total the probabilities for each risk, and find the mean. This becomes the probability rating for the risk. Do the same for the impact, and for all the other risks. There is one caveat, however: this method can be tedious to the contributors. Thus, you may lose buy-in and productivity. There is another method that is also fast and yet keeps the interest of the participants. See the next choice.

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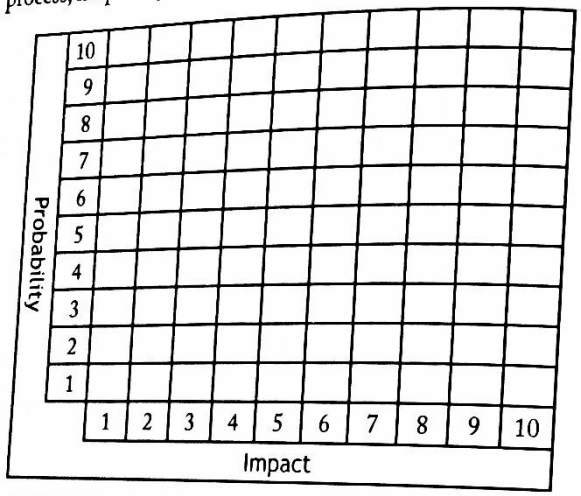
Choice 3: Here is a method (my favorite) for sorting a huge number of risks—fast. Using the specially formatted RMC Risk Notes described in the Identify Risks chapter makes this method even faster!

1. Create a six-foot by six-foot chart (1.83 meters by 1.83 meters) that looks like the following example. If you have many RMC Risk Notes to sort, you could create a separate chart to sort the opportunities.
2. Place the chart(s) on the floor. This location will make the chart(s) easier to reach and the process fun for the participants, thus increasing their participation and changing the pace and flow of your risk meeting—a true Trick of the Trade®.
3. Distribute the risks on the RMC Risk Notes to the team members who identified them and divide the risks identified by others evenly among the team members.
4. Have team members place their risks in the appropriate place on the chart (i.e., rate their probability and impact). With this method, 160 risks can be sorted in only 20 minutes.
5. You need to do more! Ratings done individually may not be accurate. Give each team member a different colored marker and ask them to look over all the risk ratings and mark the risks they feel need to be discussed, i.e., those ratings they disagree with. Interestingly, only a very small portion of the risk ratings will need to be discussed.
6. Discuss the risks that are marked and make adjustments.
7. Determine if any risks need additional information or clarification (as you did in data quality assessment), and eliminate any risks that are no longer considered valid risks.

8. Mark each RMC Risk Note with the probability and impact determined by the team so they can be moved and re-sorted in other ways throughout the risk process.

You have just performed qualitative risk analysis in record time. Can you see how this will speed up the process, keep everyone involved, and improve the quality of the results?



Determining Risk Ranking within the Project

Not all risks move forward in the risk management process, because some of them are improbable, and some will have very little impact. You will not have the time or money to deal with all the risks. Don't make the mistake of randomly selecting a specified number of risks to move forward. A better choice is to move risks forward depending on their ranking among all the risks.

The risk ranking is determined based on the risk scores (multiplying probability times impact) for each risk. Remember, it is not important if a risk is number two or three on the list. Many teams get carried away, taking the task of creating a prioritized list of risks too literally. This should not happen. It is only important to know which are the top risks that move forward and which are non-top risks that do not.

First determine the risk score for each activity, and then rank them.

Risk	Risk Score	Risk Ranking
A	56	1
B	30	5
C	35	3
D	12	6
E	5	7
F	42	2
G	32	4

Choice 1: In this choice, any risks with a risk score of a certain number (25, for instance; for scores of five on probability and five on impact) will move forward. If you and your company are less risk averse, you could choose any risks that have a risk score of 49 or higher (seven on probability and seven on impact) or some other combination.

Choice 2: Create or request a standard probability and impact matrix for all projects in your organization. Any risks that fall within the predetermined range are automatically moved forward. Those that fall into the middle area may be moved forward or just documented. A standard probability and impact matrix takes the form of a shaded chart. The probability and impact of each risk is looked up on the chart to determine if the risk moves forward in the risk process.

The next chart shows a probability and impact matrix adapted from a scale where choices of 1 to 10 can be selected for impact, and 1 to 8 for probability. A risk that falls into the white area would not move forward. A risk that falls into the middle, light gray area would be reviewed by the risk team and a determination made if the risk moves forward based on detailed knowledge of the project. A risk that falls into the dark gray area would definitely move forward in the risk management process.

The following examples show how the project risk score is used.

"We are working on four projects with risk scores of 50 to 62, and we do not have the resources to manage another project at that level."

Or, *"We were very interested in completing this project but now that we have discovered that the project's risk score is the highest of any project we have attempted, we will not go forward because the potential benefit does not justify the risk."*

Or, *"The risk score for this project is 72. Management is willing to invest $100,000 more in the project if we can decrease the risk score to 60."*

If You Do Not Have Historical Records

If you do not have historical project risk scores to compare against, consider the following options:

1. The department manager could create a checklist to calculate a high-level risk score for all similar, previously completed projects and then compare the high-level scores for each project to determine which are the ones with the greatest risk.
2. Determine the risk score for the project. Ask management if that level of risk is acceptable. If, yes, move on. If not, try to lower that number with risk response planning efforts. At the same time, you should start to collect risk scores for use on future projects.

Determining Risk Ranking Between Projects

A project's ranking as compared to other projects affects the project management plan! The project that has the highest risk ranking as compared to other projects should have the best project manager assigned to it. A high risk ranking might cause more experienced resources to be committed to the project and might get more management support.

The risk ranking of a project is based on its risk score, as compared to the risk scores of other projects.

Let's see an example. For this company, all risks with a risk score of 35 or higher move forward in the risk management process.

Risk Score Form for XYZ					
Threats and Opportunities	Probability	Impact	Risk Score (P x I)	Risk Ranking within the Project	Calculation of Project Risk Score
1T	8	7	56	3	56
2T	6	5	30	Non-top risk	
3T	5	7	35	7	35
4T	3	4	12	Non-top risk	
5T	5	1	5	Non-top risk	
6T	6	7	42	5	42
7T	4	8	32	Non-top risk	
8T	7	7	49	4	49
9T	8	8	64	2	64
10T	3	3	9	Non-top risk	
11T	5	3	15	Non-top risk	
12T	8	9	72	1	72
1-0P	6	6	36	6	(36)
13T	3	8	24	Non-top risk	
Total Risk Score for the Project (282 divided by 7 risks)					**40.3**

Compare the risk score of this project to the risk scores of other projects in the company or department to get the risk ranking for the project.

Project Risk Ranks		
Project	Risk Score for Project	Risk Ranking Compared to Other Projects
XYZ	40.3	4
A	64.0	2
B	33.1	6
C	71.3	1
D	55.6	3
E	38.9	5
F	23.5	7

The result—Our project XYZ has a risk score of 40.3 and is number 4 in the ranking of risk scores for all projects in the company.

Look for Trends

Any trends in the number of risks identified, the number of high-scoring risks, or the interest and support of risk management by project stakeholders should be reported to management. As time passes and management better understands their role in risk management and the importance of risk management in general, this step will become an important feedback loop for management.

Go/No-Go Decision

Should we do this project? How risky is it compared to other projects? Here we see another reason so many people are starting to learn about risk management. A go/no-go decision can be made for the project based on the risk in the project, not just if it can meet the time and cost objectives!

Ask yourself:

- Is the project too risky to continue, compared to the potential benefits?
- Have risks been uncovered that could have a major impact on the project?

If so, management should be informed, a go/no-go decision made, and an exit strategy from the project planned if the decision is a "no-go." *"Now that we know this, do you still want to do the project?"*

A go/no-go decision can be made at any time during the project. However, this point is the first of several times this assessment would be made on a more formal basis.

Document the Results

What do you do with non-top risks (the ones that do not move forward in the risk management process)? Think about this: our major effort for risk identification occurs during project planning. You will not know the project as well during planning as you will during project executing. Some of the ratings for the risks will change when better or more complete information becomes available. Therefore, non-top risks are documented

and revisited later in the Monitor and Control Risks process to confirm the risk ratings and risk scores.

The following is an example of such documentation. The source of the risk should be listed to make it easier to revisit the risk during the Monitor and Control Risks process with the person who identified it.

Non-Top Risks						
		Risk Rating		Risk Score		
Risk	Activity	Probability	Impact	P x I	Ranking	Source

Documentation also includes keeping records of the risks that will continue through the risk management process. The best way to do this without a lot of rework is to add to the risk register (as shown next).

Risk Register												
	Threats and Opportunities			Potential Risk Owner	Potential Responses	Triggers	Category	Risk Rating		Risk Score	Ranking
	Cause	Risk	Effect					P	I	P x I	
Overall Project Risks											
Risks per Activity											
A											
B											
C											
D											

Use care! All projects are different. If you think there should be other information recorded on your projects, change the form. You should always adapt any examples in this book to your real-world needs. Be careful not to get carried away. Ask yourself what

information you really need to manage risks later in the project, to include in the project management plan, and to begin the creation of historical records.

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Consider assigning each risk a unique identification number to make it easier to track risks throughout the project management process.

Move Risky Activities Forward

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Imagine that an activity contains no major risks, but all the small risks add up to make the activity one of the riskiest to deal with. Wouldn't it be wise to move the riskiest activities forward in the risk management process in addition to the highest risks?

Risks that move forward include overall risks to the project as well as the riskiest activities.

An activity can be risky based on the number of risks it contains or its risk score. Such information will tell you:

- If you have any activities that stand out as being riskier than others
- Which activities must be included in risk response planning in addition to individual risks
- How to better assign resources
- Where, in addition to the critical path, you should focus your management attention

For example, in Project A, risks with risk scores of 50.0 or higher have been carried forward into the Plan Risk Responses process. The average number of risks per activity is three. Activity X in that project has only one risk carried forward into the Plan Risk Responses process; however, the activity contains a total of eight risks with the following scores:

Risks	Risk Score
Risk 1	50
Risk 2	22
Risk 3	13
Risk 4	18
Risk 5	45
Risk 6	33
Risk 7	44
Risk 8	35
Total Risk Score	**32.5**

This activity, and any like it, should be carried forward into the Plan Risk Responses process.

Move Common Causes of Risk Forward

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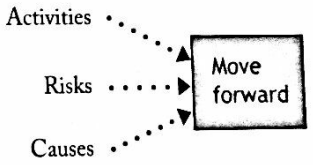
In addition to sorting risks by activity, an even more sophisticated effort is to sort them by cause. If you use the cause-risk-effect format to write your risks, and then sort them by cause, you may discover that one activity, person, event, etc., is causing more than one risk. Therefore, not only the highest ranked risks and activities, but also the most common causes of risk, move forward in the risk management process.

Risks that move forward include common causes of risk.



Common Causes of Risk		
Cause	Risk	Effect
The country's infrastructure is different than that of the home country	which means the equipment could be damaged from storms that would not be considered normal	resulting in a loss of equipment and possible delays to the project
The country's infrastructure is different than that of the home country	which could cause interruption of electrical power or brownouts for part of the day or year	resulting in possible project delays

There is no clear method to determine which causes move forward. You could select the causes with the most occurrences, ones with more than five occurrences, or any other such number. It is best to just see what you have and make a decision based on your understanding of the specific project you are working on.

Risk responses developed after consideration of all these factors will have a much greater impact on diminishing the overall risk picture.

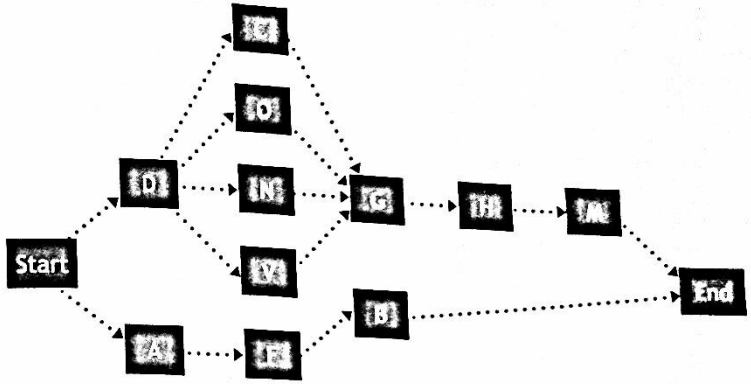
Show Risky Activities on the Network Diagram

The project manager, the team, and others need to be aware of which activities require the most attention. Using the network diagram as a communication and/or management tool on your projects, show the riskiest activities by highlighting them in another color. Most software programs will allow you to do this in addition to coloring the critical path.

Note Path Convergence and Path Divergence

An activity may not seem risky on its own. However, when you take a look at a network diagram created during project management planning and see that many paths converge into that activity or diverge from that activity, then the risk of the central activity is greatly increased. All activities have uncertain outcomes. Watch for predecessor activities that affect the performance, and therefore the risk, of successor activities. A successor activity with two or more predecessor activities might have more risk than is apparent if you only look at that activity. For example, if you only look at the risks of activity G, without looking at the network diagram, you would not

see the risk caused by the number of activities leading into it; activity G has more risk because of that convergence.



Build Historical Records

Building historical records is an important part of project risk management. You should record the results of the Perform Qualitative Risk Analysis process for use on future projects.

List the Activity Risk Score and Person Assigned on the Bar Chart

Have you thought about listing the risk score for each activity on the bar chart? This can be huge, because it keeps everyone focused on the riskier activities.

A bar chart shows the project schedule developed from the work breakdown structure, network diagram, and estimates. One of the tricks of risk management is to realize that simply because they have become known, many risks will not occur. Take advantage of this phenomenon by letting as many people as appropriate know the risks identified on your project by putting the risk score and the name of the resource assigned to each activity on the bar chart as shown next.

CHAPTER 6

Perform Quantitative Risk Analysis

Objectives of the Perform Quantitative Risk Analysis Process

Are you worried about this topic? Don't be. If you have decided to move into the Perform Quantitative Risk Analysis process, the focus now changes to *numerically* analyzing the probability and impact of each risk and analyzing the extent of overall project risk. In simple terms, we are now looking for probabilities like 20 percent (rather than a probability risk rating of three) and impacts like two weeks or $30,000 (rather than an impact risk rating of eight). We drop the subjective risk score concept from qualitative risk analysis in favor of the more objective concept of expected monetary value. The evaluation is expanded to look at the specific time and cost impacts of each risk.

Quantitative risk analysis is an attempt to determine how much risk the project has, and where, so that you can spend your limited time and effort in the areas of greatest risk, to decrease the risk on the project. After you have planned responses, the Perform Quantitative Risk Analysis process can be redone to illustrate the benefits of the risk response efforts.

The Perform Quantitative Risk Analysis process can be thought of as an attempt to make more informed decisions about the amount of risk on the project than is possible with qualitative risk analysis. The amount of time and effort spent on the Perform Quantitative Risk Analysis process will improve the data used for decision making, but decisions are always made with incomplete data. Doing quantitative risk analysis at any level has a cost. The trick is to balance the amount of effort with the needs of the project. More time should be spent on the Perform Quantitative Risk Analysis process for complex projects and complex decisions. Less time should be spent on this process

for short projects, less important projects, and projects that are less complex. Use your judgment on how much time should be spent here.

More detailed objectives of the Perform Quantitative Risk Analysis process include:

- Decide which risks warrant a response
- Objectively evaluate the probability and impact of each risk
- Determine the level of risk the project currently has and whether that level of risk is acceptable for the expected gain from the product of the project
- Determine how much the project will cost and how long it will take if no further risk management actions are taken to decrease project risk
- Determine which risks require response planning
- Determine the probability of achieving cost or schedule objectives for the project

In order to perform quantitative risk analysis well, the following inputs are needed:

- Risk management plan
- Risk register, which currently includes:
  - Prioritized risks from the Perform Qualitative Risk Analysis process
  - List of risks carried forward for additional analysis
- Historical records: how were similar risks quantified in the past
- Outputs from other parts of project planning, including the cost management plan, and schedule management plan

The Perform Quantitative Risk Analysis Process Is NOT the Most Important Part of Risk Management

A question I am frequently asked before risk management classes is, "Are you going to cover quantification?" It seems like people are looking for a magic cure—something that will make all their troubles go away.

What good is quantifying risks if you have not identified as many specific risks as possible? Time spent in the Identify Risks process can yield more benefits than a quantitative assessment of risks.

Also keep in mind that many people hate numbers. Some quantification techniques are considered too "quantitative" for many stakeholders, thus turning them off to risk management as a whole. There are also those who are terrified of dealing with probabilities and statistics. Be careful how much you expect to gain from the Perform Quantitative Risk Analysis process.

Quantitative risk analysis is not always required in risk management.

Probability and Impact

Good quantitative risk analysis makes use of probabilities, but do not get turned off yet! Let's make it easy.

Many people in RMC risk management classes ask, "How do you come up with probability and impact ratings?" especially when we get to the topic of the Perform Quantitative Risk Analysis process.

To make decisions based on 100 percent objective data, you would need to have a perfect understanding of the situation and complete information. Conversely, you could base a decision on 100 percent subjective data, which would rely on intuition and guessing without any evidence or support. Most decisions are made with data that falls somewhere in between. Obviously, it would be better to have objective data. But such data would be impossible to achieve in the real world and extremely expensive if it were possible to collect it.

Even subjective data can lead to better analysis and decision making than you would get from not doing risk management at all. The best you can do is to invest the most appropriate amount of time and effort in collecting the most accurate data available to help make better decisions.

Some of the ways to come up with quantified probabilities and impacts are similar to those discussed in the Perform Qualitative Risk Analysis chapter, but with quantitative analysis, you calculate a cost or time (or customer satisfaction, quality, or other) impact and a percentage for probability.

Some of the best ways to quantitatively come up with probabilities and impacts are:

- **Guess at a percentage of probability, or a dollar or time impact using subjective judgment:** This concept is described next.
- **Calculate the actual cost and/or time impact:** Note that there is no such thing as an exact probability.

- **Use historical records:** What were the time, cost, and probability single value estimates or distributions on other projects?
- **Use the Delphi technique:** This technique was described in the Identify Risks chapter. In this case, the probability and impact single values, distributions, or ranges are determined for each risk and consensus is achieved.
- **Conduct interviews:** This technique was described in the Identify Risks chapter and is further described below.

Yes, it is okay to guess probability and impact in the Perform Quantitative Risk Analysis process. Though the impact can often be based on a calculated estimate (a guess like two weeks or US $34,000), the probability is often a more subjective guess (e.g., I have worked on similar activities before and I guess this risk is 20 percent probable). It would be better to be objective, but that is not always possible.

okay to guess at the ability and impact!

The key to decreasing the limitations of subjective evaluations is to:

- Estimate something small (e.g., the estimate for an activity or work package instead of a larger piece of work).
- Give as much detail as possible to the person(s) performing the evaluation.

To quantify risks through interviews, separate interviews with many different people are held for each risk. Interviewing to quantitatively determine probability and impact is a time-consuming activity. Experienced project managers may choose to combine this interview with the expert interview conducted during the Identify Risks process, but be wary. You will inevitably spend time collecting probabilities and impacts for risks that do not make it past qualitative risk analysis. If you do use interviewing, follow the rules for expert interviews discussed in the Identify Risks chapter. Remember: to get a clearer picture of the risk, ask for a range, not a single estimate.

As you get more familiar with statistics, you might begin to study more advanced topics such as objectivity, bias, beliefs, and perception errors. There is always more to learn if you want to improve your risk interview skills.

Another very advanced topic in risk management is to begin to look at other impacts in addition to time and cost. What about impacts to other project constraints? Are impacts to quality or customer satisfaction less important? Though they may be hard to measure, they are not less important to an advanced, project-management literate company.

Expected Monetary Value of Risks

In the real world, not all negative or positive events that could happen will happen. The concept of expected monetary value is used to determine what the overall probable circumstance will be as a result of the events.

Expected monetary value is the probability weighted average of all possible outcomes and is calculated as EMV = P x I. It helps determine which risks need the most attention and should therefore be moved into the Plan Risk Responses process.

Expected monetary value, as used here, is the sum of all quantitative probabilities times their impacts. Since opportunities are benefits or savings, they are subtracted from the expected monetary value of the threats to come up with the total expected monetary value of the risks.

The following is a standard form for quantitative risk analysis.

Quantitative Risk Analysis Form					
Risk	Activity	Probability	Cost Impact	Expected Monetary Value of the Cost	Risk Moved into Plan Risk Responses?
14	B	30.00%	$66,000	$19,800	Yes
13	C	50.00%	$39,000	$19,500	Yes
12	B	50.00%	$22.000	$11,000	Yes
8	A	75.00%	$12,000	$9,000	Yes
1	A	30.00%	$20,000	$6,000	Yes
20	B	30.00%	$8,000	$2,400	No
21	B	25.00%	$9,000	$2,250	No
10	E	80.00%	$1,900	$1,520	No
18	F	30.00%	$4,300	$1,290	No
7	A	10.00%	$11,000	$1,100	No
4	C	25.00%	$4,000	$1,000	No
5	B	5.00%	$15,000	$750	No
19	B	15.00%	$5,000	$750	No
17	C	20.00%	$3,200	$640	No

Quantitative Risk Analysis Form					
Risk	Activity	Probability	Cost Impact	Expected Monetary Value of the Cost	Risk Moved into Plan Risk Responses?
16	B	10.00%	$5,900	$590	No
9	D	25.00%	$1,200	$300	No
3	D	5.00%	$5,000	$250	No
11	F	60.00%	($1,800)	($1,080)	No
2	B	10.00%	($22,000)	($2,200)	No
6	E	15.00%	($35,000)	($5,250)	Yes
15	A	15.00%	($86,000)	($12,900)	Yes
Total expected monetary value of the cost of threats and opportunities				**$56,710**	

In the preceding example, it had been decided that any risks with an expected monetary value of $2,500 or higher would move into the Plan Risk Responses process. Notice how fast and easy this calculation is. Such a calculation could also be done for time.

Don't forget to move risky activities forward into risk response planning!

Do not forget to identify and consider high-risk work packages and activities as well. In order to know which activities have the highest risk when planning responses, let's look at the same data sorted by activity.

Quantitative Risk Analysis Form						
Risk	Activity	Probability	Cost Impact	Expected Monetary Value of the Cost	Risk Moved into Plan Risk Responses?	Activity Moved into Plan Risk Responses?
8	A	75.00%	$12,000	$9,000	Yes	
1	A	30.00%	$20,000	$6,000	Yes	
7	A	10.00%	$11,000	$1,100	No	
15	A	15.00%	($86,000)	($12,900)	Yes	
	A Total			$3,200		No

Quantitative Risk Analysis Form						
Risk	Activity	Probability	Cost Impact	Expected Monetary Value of the Cost	Risk Moved into Plan Risk Responses?	Activity Moved into Plan Risk Responses?
14	B	30.00%	$66,000	$19,800	Yes	
12	B	50.00%	$22,000	$11,000	Yes	
5	B	5.00%	$15,000	$750	No	
16	B	10.00%	$5,900	$590	No	
2	B	10.00%	($22,300)	($2,200)	No	
19	B	15.00%	$5,000	$750	No	
20	B	30.00%	$8,000	$2,400	No	
21	B	25.00%	$9,000	$2,250	No	
	B Total			$35,000		Yes
13	C	50.00%	$39,000	$19,500	Yes	
4	C	25.00%	$4,000	$1,000	No	
17	C	20.00%	$3,200	$640	No	
	C Total			$21,140		Yes
9	D	25.00%	$1,200	$300	No	
3	D	5.00%	$5,000	$250	No	
	D Total			$550		No
10	E	80.00%	$1,900	$1,520	Yes	
6	E	15.00%	($35,000)	($5,250)	Yes	
	E Total			($3,730)		No
18	F	30.00%	$4,300	$1,290	Yes	
11	F	60.00%	($1,080)	($1,080)	Yes	
	F Total			$210		No
Total expected monetary value of the cost of threats and opportunities				**$56,710**		

The previous chart shows you that activities B and C have the most cost risk on the project. These activities should also move into the Plan Risk Responses process. Notice that activity B has many risks that individually would not have been moved to the Plan Risk Responses process? They may not be large risks, but they contribute to the

activity having the most risk. The risk of the activity can be decreased by eliminating or decreasing the probability of some of its associated risks.

Document the Non-Top Risks

One of the mistakes often made in risk management is to forget to document the risks that do not move forward in the risk process so that these risks can be revisited later during risk reviews. It is possible that some of the risks with low probabilities or impacts may have been evaluated incorrectly or new information may come to light.

Risk Exposure

Determine the Level of Risk the Project Currently Has

We looked at individual risks, and then risks by work package and activity. Now we need to look at the overall risk in the project so that we can determine whether the expected monetary value of the project (the risk exposure) is within the threshold set by management. Of course, the risks listed are not all definitely going to happen because they are not 100 percent probable. If they were 100 percent probable, they would not be risks! We need to forecast the effect of those risks on the project. Expected monetary value of the project is one of the ways to forecast the project risk exposure.

Expected Monetary Value of the Project

Determine Project Cost and Length if No Further Risk Management Actions Are Taken

We can try to plan responses to certain risks in the Plan Risk Responses process and then redo this analysis to see how much we have decreased the risk of the project. This cycle is repeated until the expected monetary value of time is within the schedule requirements of the project and the expected monetary value of cost is within the cost requirements of the project. If no requirements exist, the cycle stops when the risk is acceptable compared to the benefits received for completing the project.

Using expected monetary value is fast and easy. Let me explain how to do it with a new example. Do you want to get the most value out of this book? Try to complete the exercises on your own before you look at the answers.

● ● ● ● **Exercise 1** You are planning the manufacture of a new product. Your project estimate results in a project cost of US $600,000. In addition, your analysis has come up with the following:

A. A 5 percent probability of a delay in receiving parts with a cost to the project of $75,000
B. A 55 percent probability that the parts will be $60,000 cheaper than expected
C. A 75 percent probability that two parts will not fit together when installed, resulting in an extra $100,000 cost
D. A 5 percent probability that the manufacture may be simpler than expected, resulting in a $25,000 savings
E. A 15 percent probability of a design defect causing $8,000 of rework

Question 1: What is the expected monetary value of the cost of these threats and opportunities?

● ● ● ● **Answer**

Risk	Calculation	Expected Monetary Value of the Cost
A	0.05 times $75,000	$3,750
B	0.55 times $60,000	($33,000)
C	0.75 times $100,000	$75,000
D	0.05 times $25,000	($1,250)
E	0.15 times $8,000	$1,200
Total		$45,700

What does this number $45,700 mean, and what do we do with it? Let's look at the next example to see the answer in action.

Question 2: Assuming that these are the only risks on the project:

1. What is the best case cost (only good things happen)?
2. With no further risk analysis, how much will management expect the project to cost?
3. What is the expected monetary value of the project?
4. What is the worst case cost (only bad things happen)?

● ● ● ● **Answer**

	Question	Calculation	Answer
1	Best case	$600,000 - ($60,000 + $25,000)	$515,000
2	Sponsor's or customers' expectations		$600,000
3	Expected monetary value (the best guess as to where you will actually end up)	$600,000 + 45,700	$645,700
4	Worst case	$600,000 + 75,000 + 100,000 + 8,000	$783,000

This means that without analyzing risks, a person could say that the project budget should be $600,000. But in reality, the estimates for the project are not deterministic; they have a range of probabilities based on the uncertainties of the project. Therefore, if we take the uncertainties into account, it is probable that the project cost could range from $515,000 to $783,000. You might ask yourself if those uncertainties are more than can be tolerated. Is the $783,000 beyond the cost risk tolerance for the project? If yes, the Plan Risk Responses process should be done to deal with or eliminate some threats impacting costs as well as to increase opportunities. This calculation should be redone and the process repeated until the project is below the cost risk tolerance.

Notice that the expected monetary value of the project just described is not as high as the worst-case scenario. It is common practice to use the expected monetary value of the project to forecast potential project costs because it is considered the only unbiased predictor and the best single value estimate for forecasting. Therefore, if no further risk management actions are taken to decrease the project threats, or to increase opportunities, the project should be thought to cost $645,700.

Expected monetary value of the project is one of the tools to forecast how much the project will cost or how long it will take.

Did you miss something that was hinted at but not directly stated? Let me rephrase. Using risk management, you can PROVE that schedule or cost objectives set by management or the customer are

unrealistic! Imagine that management has said that the project must be completed for less than $620,000. The previous chart shows that this is unlikely with the current state of risk on the project. Something has to be done. Risks must be eliminated or reduced or some other actions taken (see the Plan Risk Responses chapter), or budget constraints must be changed, such as increasing the budget to at least $645,700. Management might not like it, but this is a statement of fact. Something must give! You cannot do a $645,700 project for $620,000. Now at least you and your management can know what you are getting into before the project begins.

If you think that was exciting, you should see the next section of this chapter. But first, let's look at another example.

● ● ● ● **Exercise 2** You are planning the manufacture of a new product. Your project estimate results in a net project cost of US $400,000 and 224 days. In addition, your analysis has come up with the following (keep in mind that the real world will probably have many more risks than the five listed here):

A. There is a 5 percent probability of a stakeholder making a major change to the project, costing the project $75,000 and a 14-delay.
B. There is a 15 percent probability of gaining a new, valuable resource, making the project $30,000 cheaper than expected and saving 28 days.
C. There is a 75 percent probability that the software will be delayed in its release from the vendor, resulting in an extra $3,000 labor expense and a 56-day delay.
D. There is a 5 percent probability that the coding may be simpler than expected, resulting in a $2,500 savings and a savings of 14 days.
E. There is a 15 percent probability of a major bug causing $8,000 of rework and a 21-day delay.

Question: What is the expected monetary value of the cost of these risks? What is the expected monetary value of the time of these risks?

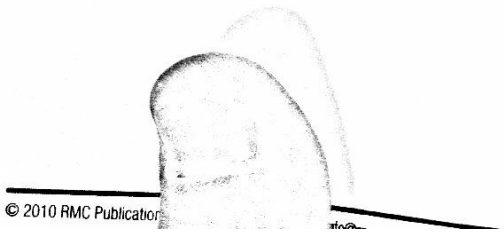
● ● ● ● Answer

Risk	Calculation	Expected Monetary Value of the Cost
A	0.05 times $75,000	$3,750
B	0.15 times $30,000	($4,500)
C	0.75 times $3,000	$2,250
D	0.05 times $2,500	($125)
E	0.15 times $8,000	$1,200
		$2,575

Risk	Calculation	Expected Monetary Value of the Time
A	0.05 times 14 days	0.7
B	0.15 times 28 days	(4.2)
C	0.75 times 56 days	42
D	0.05 times 14 days	(0.7)
E	0.15 times 21 days	3.15
		40.95 days

Question: Assuming that these are the only risks on the project:

1. What is the best case (only good things happen)?
2. With no further analysis, how much will management expect the project to cost (without a risk analysis)?
3. What is the expected monetary value of the project?
4. What is the worst case (only bad things happen)?



● ● ● ● Answer

	Question	Calculation	Answer
1	Best case	$400,000 - $30,000 - $2,500	$367,500
2	Sponsor's or customer's expectations		$400,000
3	Expected monetary value (the best guess as to where you will actually end up)	$400,000 + $2,575	$402,575
4	Worst case	$400,000 + $75,000 + $3,000 + $8,000	$486,000

	Question	Calculation	Answer
1	Best case	224 - 28 - 14	182 days
2	Sponsor's or customer's expectations		224 days
3	Expected monetary value (the best guess as to where you will actually end up)	224 + 40.95	264.95 days
4	Worst case	224 + 14 + 56 + 21	315 days

Do you see how much more information you have in order to really understand the uncertainties in the project?

Monte Carlo Simulation

Determine Project Cost and Length if No Further Risk Management Actions Are Taken

Remember that statistics class you wish you never took? Well, it can be useful in the Perform Quantitative Risk Analysis process. But since most projects do not need in-depth quantitative analysis, I will keep this section simple and easy to understand.

If asked for the probability or impact, you could respond with a single number. That estimate is said to be deterministic (based on a single value; the information is taken as fact or certain). Yet for most risks, the probability of occurrence is uncertain and is actually a continuous range of probabilities (e.g., there is a 20 percent probability that the cost impact of the risk will be $30,000, a 30 percent probability that it will be $38,000, and so on). Therefore, instead of a fixed, certain estimate, probabilistic methods determine distributions, or ranges, to give a comprehensive picture of the possible uncertainties.