Chapter 7
Risk Management in Information Technology Projects

The Nature of Risk

The life of a project manager is a life of conflict. In truth, project management is conflict management. The project manager's job is to smoothly negotiate the obstacles encountered during every phase of the project's life. If there was no risk or conflict in a project, there would be no need for a project manager—project management would become an administrative task. But risk is two-sided; there is the possibility of loss and the potential for gain. The risks in IT projects generally exhibit significant extremes of both sides—the losses are great if the risk event occurs unabated, but the gains can be immense if the risk is planned for and eliminated, or at least mitigated and made manageable.

This chapter discusses the basic definitions of risk and risk management. A risk management model and process are presented that will prepare the organization to plan for and reduce IT risks.

Risk Defined

Risk is characterized by three components:

1. The event (i.e., what can happen to the project, good or bad?)
2. The probability of event occurrence (i.e., what are the chances the event will happen?)
3. The impact to the project (i.e., what is the effect on the project, good or bad, if the event actually does occur?)

Types of Risk

There are two types of risks—business and pure, or insurable, risk. Risk is not necessarily negative; it may be an opportunity for gain. The key to risk management is recognizing the potential risk events and whether they can be directed and controlled for a neutral or positive effect on the project. If the risk event can only lead to negative impacts, then it should not be attempted; it should be avoided, transferred to someone else, or transferred to another organization.

Business Risks

A business risk is one that provides an opportunity for gain as well as for loss. An example of a business risk is a customer change to the project scope. The change might represent a risk to the provider because it involves skills or expertise the company does not possess. However, the scope change might produce additional revenue if the company can hire additional resources, team with another company, or hire a vendor to provide the necessary expertise. Business risks are the risks that can be managed. Management of insurable, or pure, risks should never be attempted.

Insurable or Pure Risks

Insurable risks, sometimes called pure risks because they offer only opportunities for loss, are risks that the organization should never take on. Incredibly, IT organizations routinely attempt such projects because of the prevailing view that everything can be fixed with software.

Some examples of insurable risks are natural disasters such as fires, floods, hurricanes, and earthquakes. For instance, if a company is located in a high-risk area for hurricanes, it will insure against such loss. But there are other, more subtle types of pure risk. Often a company will attempt a project because the major project requirements are within the company's capability, even though one or two other requirements may not be. Since they are qualified to accomplish the majority of a project's requirements, many companies make the assumption that they will be able to complete the rest. Mature, or learning, organizations recognize these disastrous situations and plan for them. These organizations have effective project selection and risk management processes. The project selection process was discussed in Chapter 3.

The risk management process is best understood through the use of a risk management model, such as the one discussed below. This risk management model can be applied in any organization and used in any industry.

A Risk Management Model

Risk management, like every critical management activity, is best accomplished when a formalized and documented set of guidelines and standard operating procedures are implemented and followed by everyone in the company. The Project Management Institute (PMI) has provided guidelines for a risk management process in their *Guide to the Project Management Body of Knowledge* (PMBOK Guide), including their own model. The model in

Exhibit 7-1 contains all the PMI model steps but is more detailed to better explain the risk management components and process elements. One key component of PMI's model that is implicit, but not stated, is that of continual evaluation. Risk management is an ongoing process that continues throughout the project's life cycle.

Planning Risk Management—The First Step

Risk planning should begin during the project selection phase. Project selection is the process of determining whether the company or organization should pursue a project. One criterion in the

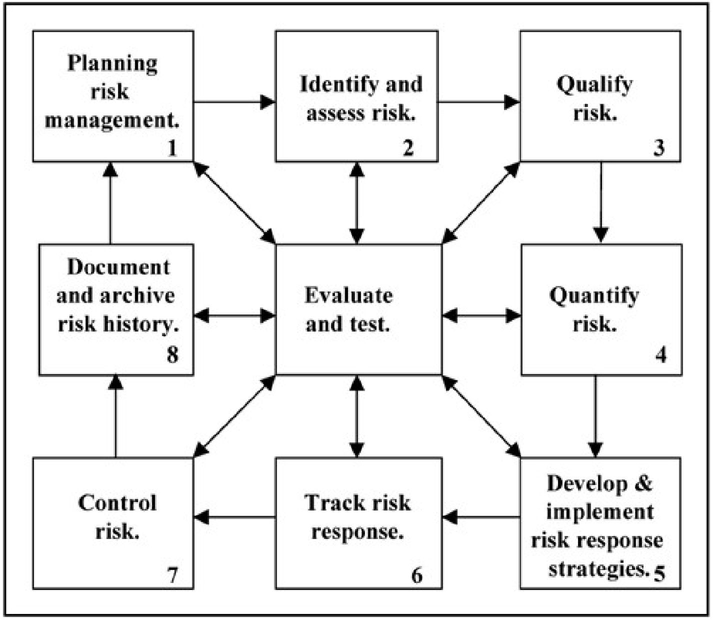

Exhibit 7-1. A risk management model.

selection process is risk—risk in the schedule, budget, resources available, expertise required, and fit with the organization's strategic plan.

The major inputs to the risk planning step are:

- ✔ The project charter
- ✔ Organizational policies or guidelines
- ✔ Contract documents (if the project results from an external customer; statement of work or other departmental project document if it is for an internal customer).
- ✔ The work breakdown structure (WBS)
- ✔ Network analysis

The project charter describes the project manager's limits of authority, the project priority, and the support requirements from various functional units in the organization. The project charter readily identifies many potential risk areas. For instance, if the project priority is four, then it is immediately apparent that the project can lose out if resources are tight. Other risks are not always so obvious. In fact, some risks may be so subtle that, if a project fails, they are never recognized. Consider, for example, this typical scenario in the IT environment: A project has the potential for propelling the organization into the next level of market competitiveness, if it is successful. Under this scenario, this type of project gets a great deal of senior-level scrutiny and guidance. It gets so much guidance, in fact, that senior management's good intentions hamper the project manager's efforts to the point of project failure. In other words, too much of even a good thing can interject risk into the project. Only a good project sponsor, charter, and mature senior management can prevent this kind of risk from occurring.

Along with the project charter, there are other company policies and guidelines to aid the project team. These policies and guidelines include templates, checklists, and guidance for identifying and planning risk contingencies.

Contractual documents, particularly those from external customers, contain information that can usually identify potential risk areas. This information has to be factored into the project planning. For instance, most contracts contain, at least, a high-level schedule. If a customer has a hard schedule completion date requirement, it may represent a potential risk to the seller, if resources are insufficient to meet the date.

The WBS is the most important tool for risk planning because it contains all the project tasks, and, consequently, a quick view of the potential risks. Since tasks drive the skill set and resource requirements, it will be apparent whether the project requires effort that falls outside the organization's capability—a critical risk that requires an alternative approach or a strategy to include teaming or outsourcing the work.

The network analysis provides insight into task interrelationships and potential risks associated with timing requirements and path convergence problems. Path convergence is the convergence of two or more network paths into a single node, as shown in Exhibit 7-2. In the exhibit, the convergence of paths from Tasks A, B, and C into Task D create greater uncertainties in starting

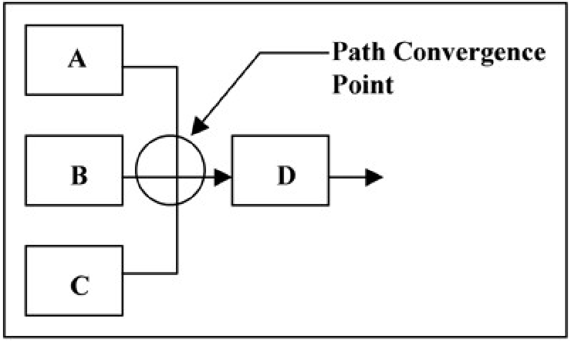

Exhibit 7-2. Path convergence in a network analysis.

the path out of D on time. If either of the durations for A, B, or C are in error, then the start time for D is affected. If all three are in error, then the start time of D is affected exponentially.

The major output of the risk-planning step is the risk management plan. The risk plan is a part of the overall project management plan and is often provided as an attachment. Many customers, particularly public sector customers, require a risk management plan as a part of any proposal submitted on a competitive bid. Exhibit 7-3 is an outline of a sample risk management plan.

Sections of the Risk Management Plan

The risk management plan guides you in the process of managing the risks of a particular project. Therefore, it is imperative that a plan is developed for every project and that the plan clearly identifies how the project risks will be identified, responded to, tracked,

Risk Management Plan

I. Project Name and Brief Scope Description

II. Risk Management Methodology

III. Roles and Responsibilities

IV. Funding

V. Risk Measurement and Interpretation Methodology

VI. Levels of Risk Response Responsibility

VII. Risk Communication Plan

VIII. Risk Tracking and Documentation

IX. Appendixes

  i. Risk table

  ii. Risk response plan

Exhibit 7-3. Risk management plan format.

and controlled. Let us look at the nine sections of the risk management plan.

1. ***Project Name and Brief Scope Description.*** This section provides the name of the project (and often the project manager's name) as well as a short description of the project's purpose.

2. ***Risk Management Methodology.*** This section provides a narrative about the tools or techniques used to identify the risks and how the risk response strategies will be determined. This section also contains the data sources from which the risk and risk strategies are developed, such as historical data from previous, similar projects.

3. ***Roles and Responsibilities.*** The roles and responsibilities of each project team member and other task contributors should be clearly defined in this section. If the responsibility to report, eliminate, or track a risk is not clearly assigned, a diligent team member can easily ignore an impending risk event. Of course, the project manager has ultimate responsibility for administering the risk plan and risk response strategies, but she can, and should, delegate responsibility for identifying risks and reporting triggers that presage a risk event.

4. ***Funding.*** Budgets for risk contingencies should be defined and guidance for their administration published at the start of the project. Many organizations assign the responsibility for the contingency, or reserve funding, pool to the project manager. However, funding for contingencies is strictly the responsibility of senior management in other organizations. This section of the risk management plan should clearly state how the contingency funding is to be administered.

5. ***Risk Measurement and Interpretation Methodology.*** The method or methods used to measure risk and interpret scores are defined in this section. Most companies have guidelines for applying a weighting factor and/or a score for each type of risk. Scoring methods are important in both the quantitative and qualitative analyses to reduce the effects of subjectively assigning a value

to a risk. Scoring methods should be chosen in advance, and they should be applied consistently throughout all steps of the risk management process.

6. ***Levels of Risk Response Responsibility.*** This section defines who has responsibility for each risk response according to a predetermined threshold. That is, during a project life cycle, risk events of different levels of impact can occur. The project manager has discretionary authority to handle certain levels of risk, but he must elevate the decision to a higher senior management position or to a committee, if the impact of the risk exceeds a certain monetary level. In some instances, only the customer has the authority to implement certain risk response strategies because of the costs to the project in time and money. The effectiveness of a risk management plan is measured against how well any actual risk event is kept below the lowest risk threshold.

7. ***Risk Communication Plan.*** This section describes report formats and outlines who receives reports on risk events, responses implemented, and the effectiveness of the risk response strategies.

8. ***Risk Tracking and Documentation.*** This section describes the process for tracking the effectiveness of the risk response strategies and how they are documented and archived as lessons learned.

9. ***Appendixes.*** This section provides a vehicle for attaching any additional information or plans, depending on the needs of each individual project. The two most common appendixes are the risk table and the risk response plan.

- ✔ ***The Risk Table.*** This is a table or matrix of all the identified risks in the project. Many project teams prefer that the table contains only those risks being managed at the moment and that it be revised as you deal with each risk.

- ✔ ***The Risk Response Plan.*** This is a detailed plan explaining the response strategies for each of the identified risks in the risk table.

Identifying and Assessing Risks—The Second Step

Identifying risks is not a task that many project teams or organizations have done well in the past. Even today, risk identification and assessment, or the lack of it, is one of the key reasons that projects fail. In general, risk identification and risk management are not done well because of the difficulty in identifying risks. Given that risk is an uncertain and sometimes an unknown event, risk management tends to be viewed as more esoteric compared to the hard engineering components of the project. Therefore, many project teams and organizations are not as comfortable with it. Once a procedure for identifying risks is in place, however, managing them becomes less scary and much easier.

Risk identification is best accomplished with a team simply because the collective knowledge and experience of a group of people is far greater than an individual's can be. There are several methods useful in the process, but the best methods all are some variation of brainstorming. The brainstorming technique itself is generally the one method that yields the greatest number of identified risks because it is designed to produce a large amount of data in a relatively short period of time. Another technique especially useful for identifying sources of risk is the Ishikawa, or cause-and-effect, diagram. This diagram is also called the fishbone diagram because of its resemblance to the skeleton of a fish when it is completed. This technique is most often associated with quality analysis but can be used any time the objective is to identify the root causes of a problem. It has the added advantage of being a brainstorming technique as well and lends itself nicely to team development. Exhibit 7-4 is an example of how a cause-and-effect diagram can be used to identify software problem risks.

Checklists and Assumption Analysis

Historical data from the lessons-learned archives provides a rich source of information from which checklists can be developed.

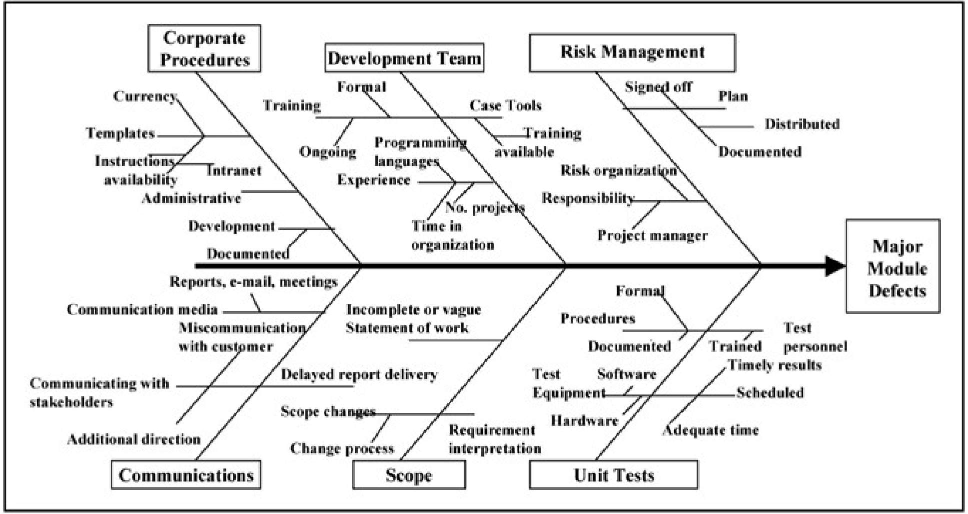

Exhibit 7-4. Cause-and-effect diagram for analyzing risk.

The organization's guidelines should include such a checklist. However, a word of caution: If they are used exclusively, checklists can create a false sense of security. The problem with checklists is that it is easy to assume every potentiality has been considered, if all the blocks are checked on the list. A checklist is simply a guide that contains the most common risks. Hence, it is only as good as the data used to develop it. The checklist is helpful and will reveal a number of potential risks, but the prudent project manager will use the checklist as one of several techniques for identifying her project risks.

All projects and project solutions are based on assumptions. Even the customer's scope statement is based on some assumptions. A major part of the risk identification process is an assumption analysis to determine assumption validity and whether any potential risks are present because of inaccurate, inconsistent, or incomplete assumptions.

An assumption analysis is best accomplished by listing all assumptions from scope statements, contract documents, and any other project descriptions in a matrix that describes each assumption and its rationale. Each of the assumptions can be checked against its reason and revised or discarded, depending on the validity of the rationale.

At this stage of risk planning, it is important that no filtering or prioritizing is attempted. The objective is to identify all potential risks. Filtering and prioritizing are techniques employed in the next step—qualifying the risks.

Qualifying Risks—The Third Step

Qualifying risks involves three components or substeps—filtering the risk to determine if it actually is a risk and when it is likely to occur during the project life cycle, determining the probability that a risk event will occur, and prioritizing the risk.

Risk Filtering

Once a list is developed, each risk is filtered to determine whether it is within project scope, if it is likely to occur, what its significance is, when it might occur within the project life cycle, and even if it is a real risk. It is not uncommon to identify a potential risk only to decide after careful deliberation that it is not a risk at all, or, if it is a risk, that the consequences of the impact are so small as to not be a concern. The best method for assessing risks is through a process of filtering, as the one shown in Exhibit 7-5. It is important not to prioritize risks at this stage. At this point of the analysis, the objective is to determine risk characteristics.

Many times a perceived risk is often not a risk when measured against the project scope. If the action generating the perceived risk is not within the scope, then it is not a risk and can be ignored.

Filtering the list developed during risk identification results in a final or revised risk list. The next step is to determine the probability of risk event occurrence. Whenever possible, it is better to assign a percentage probability to the risk. This is because the next step of the risk analysis process is to quantify the risk or measure the relative importance of one risk over another.

It is not always possible to assign a percentage probability when you lack historical data or experience. In those cases, the best that can be done is to assign a low, medium, or high probability of risk. Even in that case, a range of numerical values may be possible, as shown in Exhibit 7-6. Even taking the middle of the range, or being pessimistic and taking the high end of the range, provides a numerical result for a better comparison. The importance of assigning a percentage probability to the risk will become clear in the discussion on quantifying risks.

Prioritizing Risk

The risk-filtering step should result in a revised list of risks that accurately represent the most likely risk events to expect during a

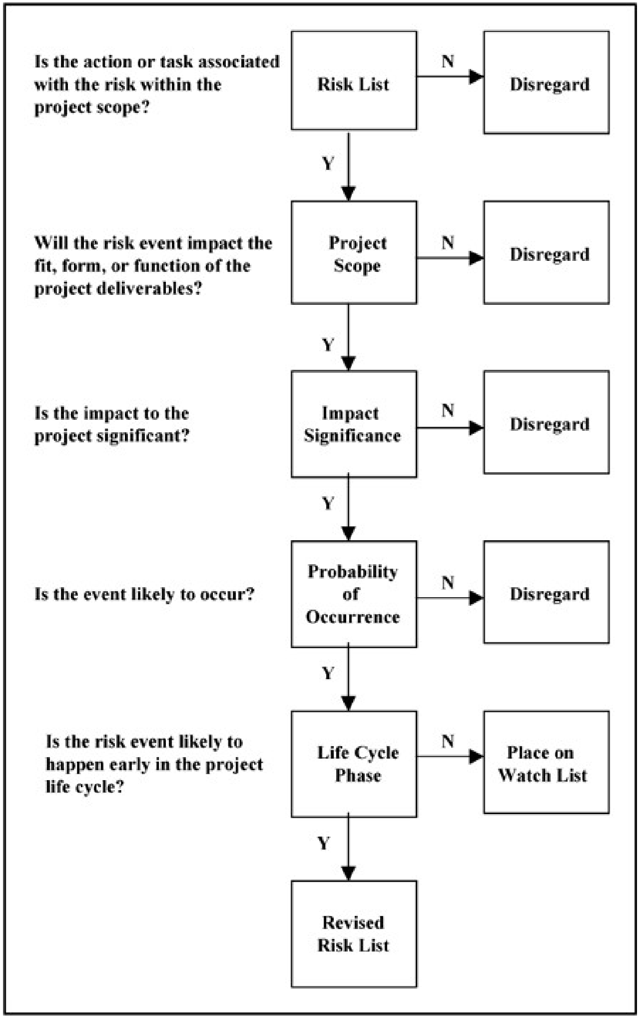

Exhibit 7-5. The risk-filtering process.

Risks	Very Low 0–5%	Low 6–15%	Medium 16–40%	High 41–80%	Very High 81–100%

Exhibit 7-6. Changing subjective ratings into percentages.

project's life cycle. Although it is important to identify potential risks, it is absolutely crucial to prioritize them. One serious mistake project managers make is to attempt to manage all risks on the revised list. Fortunately, that is not necessary because the reality is that we can manage about ten risks at a time. Hence, for greater efficiency and effectiveness, a list of the top ten risks should be actively managed with a watch list of the remainder to replace those that are mitigated, controlled, or eliminated, or that don't materialize. One of the best and easiest ways of prioritizing risks is with some form of a comparative ranking method. Exhibit 7-7 illustrates one such method.

Comparative ranking methods simply compare each risk against every other risk to determine its relative importance. Ranking is usually determined through voting and is best done as a team effort. The form in Exhibit 7-7 also provides for the application of a weighting factor to each of the risks. Organizations are either risk-prone, that is, willing to take more risks, or risk-adverse, unwilling to take much risk. The team will, therefore, assign a weighting factor to each type of risk to take into account the corporate risk-taking culture.

RISKS	Risk A	Risk B	Risk C	Risk D	Risk E	Risk F		Totals	Weight	T x W	Rank
Risk A											
Risk B											
Risk C											
Risk D											
Risk E											
Risk F											

Exhibit 7-7. Comparative risk-ranking form.

To use the comparative risk ranking form, the risks, A through F in our example, are listed down the left-hand side and across the top of the form. Then each risk is compared against every other risk in turn. If Risk A is considered more important, in terms of impact to the project, than Risk B, then in the square at the intersection of Risks A and B, write A = 1, as shown in Exhibit 7-8. Continue the process until every risk has been compared against every other risk. Total the scores for each risk (as

RISKS	Risk A	Risk B	Risk C	Risk D	Risk E	Risk F		Totals	Weight	T x W	Rank
Risk A								A=4			
Risk B	A=1							B=2			
Risk C	A=1	B=1						C=1			
Risk D	D=1	B=1	D=1					D=3			
Risk E	A=1	E=1	E=1	D=1				E=3			
Risk F	A=1	F=1	C=1	F=1	E=1			F=2			

Exhibit 7-8. Risk comparisons.

shown inExhibit 7-9) and apply any weighting factors. The final ranking is shown in the last column. If each risk is considered to be of equal weight, then the scores will determine the relative ranking.

Quantifying Risks—The Fourth Step

Assigning a percentage value for risk probability creates opportunities for risk comparisons that wouldn't otherwise exist. The most difficult task throughout a risk analysis is estimating the probability of occurrence of the event with any degree of accuracy. One can argue that assigning a percentage of probability is very subjective and, therefore, inaccurate. However, it must be remembered that risks do not have to be measured in absolute terms to be of value; they can be measured relative to each other.

The most commonly used tool for determining the relative value of project risks is expected value. Expected value (EV) is a technique useful in assessing different technical approaches or making trade-off analyses. The concept is based on the probability of different outcomes occurring and explicitly considers the risk

RISKS	Risk A	Risk B	Risk C	Risk D	Risk E	Risk F	Totals	Weight	T x W	Rank
Risk A							A=4	.2	.8	1
Risk B	A=1						B=2	.2	.4	3
Risk C	A=1	B=1					C=1	.2	.3	4
Risk D	D=1	B=1	D=1				D=3	.2	.6	2
Risk E	A=1	E=1	E=1	D=1			E=3	.1	.3	4
Risk F	A=1	F=1	C=1	F=1	E=1		F=2	.1	.2	5

Exhibit 7-9. Weighted risk comparisons.

of the different approaches. That is, if there is a chance that one of several outcomes for a given scenario can occur, depending on the risks involved for each of the different conditions, then the most likely outcome over time can be determined. This most likely result is known as the expected value.

Expected value is based on the notion that each result is mutually exclusive. That is, the outcome is a random occurrence. A probability can be assigned to that outcome. Mathematically, expected value can be defined in this fashion. Suppose a random variable *X*, defined if the set of its possible values is given and if the probability of each value's appearance is also given, possesses *n* values. Then, these possible values (*p*) can be represented as $X_1, X_2, \ldots X_n$.

If $p_1, p_2, \ldots p_n$ are the probabilities associated with each *X*, then the *expected value* of *X* can be represented by the equation:

$$\mathrm{EV} = \sum_{i=0}^{n} p_i X_i$$

The interpretation of this equation is that the expected value of an event is the sum of all the possible values of the variable multiplied by the probability of each of those values occurring. Expected value is generally used in conjunction with decision tree analyses, but can be used alone. The key point about expected value is that it is most effective when it is used to compare two or more potential outcomes, which helps eliminate some of the subjectivity in a risk analysis. An example will demonstrate how expected value is used.

Example

Your company runs a bus service in a midsize city. Currently, the company is using two bus models, both of which have exhibited frame defects over the past five years. The frame repairs cost an average of $500 per failure, but there has been only one failure per bus during a given year. The following table summarizes the data that have been collected on the frame failures.

	Model A (250 buses)	Model B (175 buses)
Year	**Frame Repairs**	**Frame Repairs**
1	10	8
2	21	12
3	34	16
4	54	25
5	63	45

The company is considering replacing the current fleet with 500 new buses using either Model A or B. If Model A's original cost was $61,000 and Model B's cost was $64,000, with salvage values of $8,000 and $12,000, respectively, what would be the expected cost of each model? Assume that routine yearly repair costs for each model are the same. Using the five-year study data, decide which bus model is the best for the company based on expected cost as the decision criterion. Assume a 10 percent rate of return to calculate the net present value.

Solution

The first step in determining the expected cost for each bus is to figure the probability of failure occurrence. In this case, probability can be calculated for each year by dividing the number of failures per year by the total number of failures in each model. For example, in year one, Model A had ten frame failures requiring repair. The probability of a recurrence in year one for the new fleet of Model A buses will be 10/250 = .04, or 4 percent (number of failures divided by fleet size). For Model B, it will be 8/175 = .05, or 5 percent. The table below provides the probability of occurrence for each year and each model.

	Model A		Model B	
Year	**Failures**	**Probability**	**Failures**	**Probability**
1	10	0.04	8	0.05
2	21	0.08	12	0.07
3	34	0.14	16	0.09
4	54	0.22	25	0.14
5	63	0.25	34	0.19

The expected value of the repairs during year one for the new fleet of 500 buses can now be calculated by multiplying the probability of occurrence by the number of buses and by the average cost of each repair. Hence, for Model A, year one:

$$EV = .04 \times 500 \times \$500 = \$10{,}000$$

The following table summarizes the expected value for each year and each model.

	Model A	Model B
Year	**Expected Value (probability × cost × no. buses)**	**Expected Value (probability × cost × no. buses)**
1	10,000.00	12,500.00
2	20,000.00	17,500.00
3	35,000.00	22,500.00
4	55,000.00	35,000.00
5	62,500.00	47,500.00

Now determining the original cost and salvage value, we can construct an incremental table so that we can determine which of the two bus models represents the best value to the company. The original cost for Model A is $61,000, and for Model B it is

$64,000. The salvage value for Model A is $8,000 per bus, and for Model B it is $12,000 per bus. So for 500 buses:

	Model A	Model B
Original Cost	30,500,000.00	4,000,000.00
Salvage Value	32,000,000.00	6,000,000.00

The differential costs and benefits between the two models are:

	Year	Model A	Model B	Increment (B—A)
Original Cost	0	-30,500,000	-32,000,000	-1,500,000
	1	-10,000	-12,500	-2,500
	2	-20,000	-17,500	2,500
	3	-35,000	-22,500	12,500
	4	-55,000	-35,000	20,000
	5	-62,500	-47,500	15,000
Salvage Value	5	+4,000,000	+6,000,000	2,000,000

Calculating the net present value (NPV) will complete this analysis. But we must discuss present value (PV) first.

Present value is a financial calculation that takes into account the time value of money. That is, it is a way to estimate the future value of an investment or benefit as it is discounted over time. Mathematically, present value is determined by:

$$PV = \sum FV/(1 + i)^t$$

Where:

PV = present value of money

FV = future value of money

i = interest rate (often this is the internal rate of return or the cost of capital)

t = time period

n = number of time periods

Σ = sum of PV of all the investments or benefits

NPV is defined as the difference between the present value of the benefits and the present value of the investments or costs. Mathematically, NPV is:

$$NPV = PV_{(Benefits)} — PV_{(Investments)}$$

A positive NPV is considered good since the benefits outweigh the investments; a negative result indicates that the venture (or project) is not a good investment.

Using the incremental differences in the analysis of the two buses, the NPV can be found by:

$NPV = —1{,}500{,}000/(1 +.10)^0 — 2{,}500/(1 +.10)^1 + 2{,}500/(1 +.10)^2 + 12{,}500/(1 +.10)^3 + 20{,}000/(1 +.10)^4 + 15{,}000/(1 +.10)^5 + 2{,}000{,}000/(1 +.10)^5$
and $NPV = —1{,}500{,}000 — 2272.73 + 2{,}066.12 + 9{,}391.44 + 13{,}660.27 + 9{,}313.82 + 1{,}241.84$
or $NPV = —1{,}466{,}599.24$

Since the NPV is negative and the increment table was developed so that Model A is subtracted from Model B, that means that Model A has the largest benefit. Hence, the analysis indicates that Model A will be the most cost-effective choice of the two buses.

Notice that had NPV not been used to take into account the time value of money, that is, if a straight comparison between the costs and benefits of the two buses were done, then it would erroneously appear that Model B is the best value.

Decision Trees

A decision tree is a graphical way of representing the various possibilities or choices available in a decision-making process. The key to success in using decision trees is to identify all the possible outcomes. Decision trees also use probabilities in determining the likelihood of one outcome over another, so it is important to have as good a history of event results as possible. Finally, expected value is used to determine the most likely value of a particular branch in the decision tree. Although probabilities will be subjective to a large degree, the use of expected value with decision trees does provide a relative comparison of possible outcomes so that better-informed decisions can be made. Exhibit 7-10 is an example of how the decision tree is developed and used for decision making.

The square boxes in the decision tree represent decision points from which various decision paths can be taken. The circles, or nodes, represent points at which various outcomes might occur. In the example, the first decision to be made is whether to even develop the particular product. Not to develop the product could save the company $2 million, which might be the choice if there were other more technically and financially promising products being considered. Assuming the decision was made to pursue

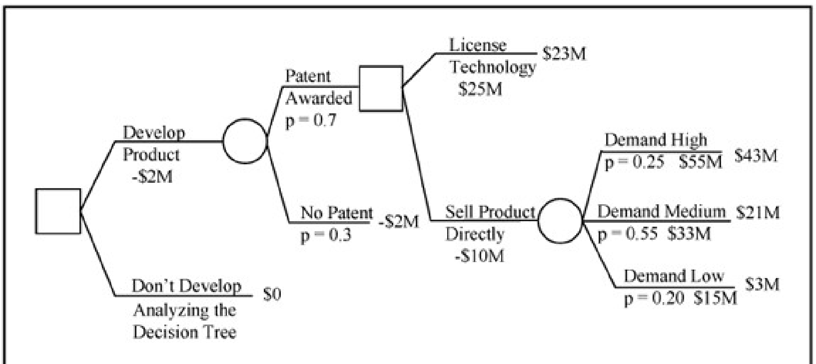

Exhibit 7-10. Research and development decision tree.

the product for the estimated development cost of $2 million, the next decision is dependent upon whether the company can obtain a patent for the product. The probability of obtaining the patent is 70 percent, but there is likewise a 30 percent chance the patent won't be awarded. Without the patent, the project might not be strategically viable and will be stopped. One benefit of the decision tree analysis process is that it provides go/no-go decision points that allow the company to end the project when it is obvious that continuing it would not meet long-term strategic goals.

The figures on the "High, Medium, and Low" branches from the "Sell Product Directly" node are estimates of what the revenues might reasonably be, based on market and competitive analyses. Thus, it is expected that there will be a 25 percent probability that the revenues will be $55 million. The $43 million figure at the end of the branch represents the net revenues that are expected if the "Demand High" branch actually materializes. In other words, when we subtract the $10 million costs for marketing and producing the product and the $2 million development costs from $55 million, the net result is $43 million. The net revenues of $21 million and $3 million for the "Medium" and "Low Demand" branches are determined similarly.

First, analyze the "Sell Product Directly" node. It has been determined that there is a 25 percent probability that the demand will be high for the product; a 55 percent probability there will be a medium demand; and, a 20 percent probability the demand will be low. The fact is, the demand will not be any one of these exactly. Rather, it will be something in between—sort of a weighted average of the three, or, more precisely, the expected value. To determine the expected value of revenues for the "Sell Product Directly" node, highlighted in Exhibit 7-11, we use the expected value formula shown previously and repeated here for convenience.

$$\mathrm{EV} = \sum_{i=0}^{n} p_i X_i$$

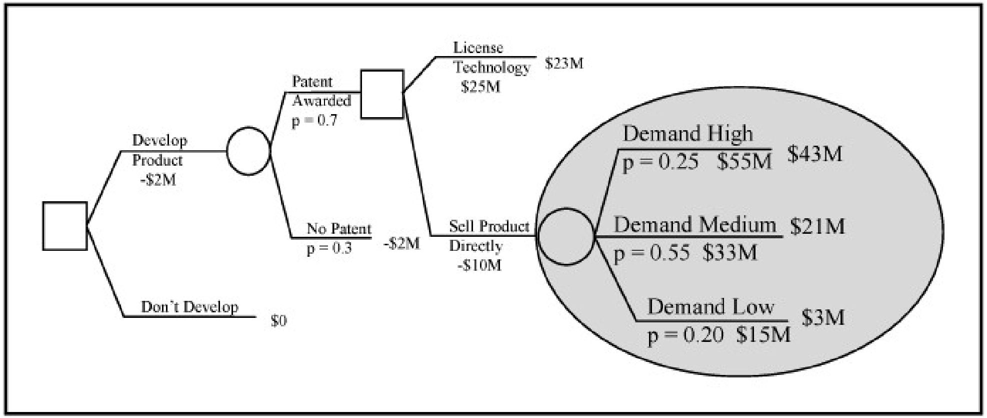

Exhibit 7-11. Research and development decision tree analysis.

Thus the EV for the highlighted potential events is:

EV = 43 ×.25 + 21 ×.55 + 3 ×.20
= 10.75 + 11.55 +.6
and EV = $22.9M0

So the expected value of selling the product directly is $22.9 million, which is only $100,000 less than revenues expected from licensing it. The choices to be considered are several. First, since the differences in expected revenues are so little, the conservative approach is to license the product, avoid the hassle of selling and producing the product, and possibly make $100,000 more. But the second, and very important consideration, is that if the company opts to sell the product directly, then it can keep its employees gainfully employed and still make the same amount of money. A third consideration that must not be overlooked is that EV is not the guaranteed amount of revenues that the product will generate—it is the most likely amount. To make a business decision, one has to consider the worst and best cases. In other words, selling the product directly might not generate but $3 million, but it could generate as much as $43 million. So the decision involves also the amount of risk the organization is willing to take. Assuming a strong project management capability, the best decision is to sell the product directly and work toward marketing and managing for a higher demand.

Developing and Implementing Risk Response Strategies—The Fifth Step

Risk response strategies are the project manager's methods for managing the risk events that occur. A proactive approach to risk management, as with every facet of project management, lessens the impact of those risks that can be identified early in the project's life cycle. Generally, there are four techniques for responding to risks: avoidance, transference, mitigation, and acceptance.

Risk Avoidance

Often the best defense against a risk event is simply to avoid it. We know that risks occur in every project, and it is not feasible, or even wise, to try to structure a project to have no risks. A project without risk is not worth pursuing. On the other hand, facing a risk that is likely to end in loss of time, revenues, or even the entire project, also is unwise. It is also unwise to accept a risk that we have defined as a pure or insurable risk. In these cases, it is best to consider alternative approaches that allow the risk to be transferred or, lacking that, avoided altogether.

The most common way of avoiding a risk is to consider an alternative approach that contains less or no risk. For example, if a system design calls for a new, undeveloped software operating system, it could represent a significant risk to the project. A less risky approach would be to use a proven off-the-shelf operating system, provided that it meets the customer's requirements. A common occurrence in information technology projects occurs during the development of a system that has a specified operating system for which a new version is developed prior to system completion. If the new software version is likely to have defects, it could be better to avoid any attendant risks by continuing with the previous version.

Risk Transference

Risk transference is commonly done in practice by teaming or by hiring a vendor. When the project requires expertise not resident in the organization or group, it is common practice to team with another company or to hire a vendor who does possess the requisite expertise. Common examples of risk transference also occur where insurance is the practical way of planning for risks. For instance, a company that is located in a flood plain or in a tornado alley would routinely purchase insurance against such risks.

Risk Mitigation

Mitigating risk means that the risk event is controlled in such a way that either the impact or the probability of the event occurrence is lessened. Mitigation can occur either by reducing the level of impact, that is, cost or schedule added to the baseline, or by reducing the probability of the event occurring, or both. Generally, mitigation occurs by adding more resources or by using better-trained or more experienced personnel. Using tested and tried technology, rather than newer, untested technology, can also mitigate risk. Risk mitigation is a form of risk acceptance. That is, the risk is expected, and it is an acceptable risk to take; however, an attempt is made to significantly reduce the impact to the project.

Risk Acceptance

Risk acceptance is simply that—the risk is expected, and the level of impact to the project is within the tolerance level of the project team or organization. Usually, this kind of risk is the result of such things as the unpredictability of resource availability. For example, there is always a certain level of risk associated with the real-world problem of sharing resources across multiple projects. A risk to schedule exists if the resources are not available at the time they are needed. In these cases, the risk is recognized and accepted, and it will be dealt with when it occurs.

Implementing Risk Response Strategies

Once a course of action has been developed for a risk event, the strategy must be implemented. A good strategy includes risk triggers to alert the project team of impending risk events. Although the project manager has the ultimate responsibility for the risk plan, she may designate a team member to monitor risk events likely to occur in their technical areas. Monitoring risks involves more than observing whether the anticipated risks occur; it involves determining if the strategies to respond to the risks are adequate or whether other actions are required, which is a function of the next step—tracking risk response.

Tracking Risk Response—The Sixth Step

Tracking risk response is the process of determining whether the planned response strategy is working or whether an alternative approach is needed. It also involves determining if new, unidentified risks occur as a result of implementing response strategies and if the project assumptions are still valid. As a result of risk response tracking, the project may need to be replanned, particularly if the response strategies are not effective, or the original assumptions are not valid.

Controlling Risk—The Seventh Step

Risks are controlled in one of two ways—contingency plans and workaround actions. Contingency plans are plans for implementing risk response strategies. These are plans that can be developed when a potential risk event is identified. Most project risks fall into the category of identifiable risks and are controllable through contingency planning.

Contingency planning usually involves setting aside some level of reserve, usually money but occasionally time as well, to ensure the project is kept on schedule. For example, if a risk is that some critical resources might not be available when needed, the contingency might be to hire a vendor or technical consultants to fill the resource void. Contingencies nearly always require additional funding—hence the need for a contingency reserve.

Workaround actions are activities implemented when the risk could not be foreseen or planned for. These events almost always cost more than the project budget allowed, so the funding is taken from a management reserve. Both contingency and management reserves are established specifically to ensure the project is kept on schedule if a risk event occurs. The basic difference between the two types of reserve is that contingencies are planned into the project budget and are usually controlled by the project manager, whereas the management reserve is not a part of the project budget and is controlled by senior management.

Documenting and Archiving Risk History—The Eighth Step

Neither project managers nor organizations are careful enough about documenting lessons learned and archiving them so that future projects can reap the benefits. The most common excuse is that the team members from a closing project are needed to start new projects and can't be spared for lessons-learned meetings. Ironically, meetings to develop lessons-learned information usually don't take much time since the information, in the form of status reports, audits, and other project paperwork, already contains the pertinent information. Lessons-learned meetings generally take between two hours' and days' time, depending on the size and complexity of the project. If the project manager and team members have maintained a complete project file, the lessons-learned information is already available—all that is needed is compilation of the information into a lessons-learned binder. The basic lessons-learned file information includes:

- ✔ Project name and start and finish date
- ✔ Key stakeholders such as the project manager, sponsor, task leaders, and customer
- ✔ Baseline and actual budget and schedule charts Project issues and their resolution
- ✔ Identified risks and results of contingency plans
- ✔ Unidentified risks, their resolution, and project impact
- ✔ Analysis of team planning and performance
- ✔ Analysis of metrics collection and usage
- ✔ Analysis of what went right and what went wrong in the project

Every lessons-learned analysis should be documented and archived with easy access to all project managers and teams. Many companies have begun making these lessons-learned libraries available online to make them even more accessible and effective. But even a hard copy in the organization's resource library is far better than no access at all. Many projects have been saved the problems and costs of reinventing the wheel by having access to workable solutions for risks that continue to reoccur.

Summary

Organizations in general and project managers in particular do not perform risk analyses as well or as thoroughly as they should. Part of the problem is that risks are not easily identified, and, therefore, it is human nature to ignore those things not easily quantified. But the fact is, all projects have risks, and to ensure success, they must be identified and planned for.

Every organization should have in place a risk management process. One model for such a process is contained in this chapter and consists of these steps.

1. Planning risk management
2. Identifying and assessing risk
3. Qualifying risk
4. Quantifying risk
5. Developing and implementing risk response
6. Tracking risk response
7. Controlling risk
8. Documenting and archiving risk history

One of the key factors for risk management success is documenting and using the lessons learned from each project. Without a documented chronicle of what went right, what went wrong, the reasons for both, and the solutions to problems, an organization cannot improve its project success rate. Managing risks is the key to project success.