Chapter 11: Project Risk Management

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Learning Objectives

- Understand *risk* and the importance of good project risk management

- Discuss the elements of *planning risk management* and the contents of a risk management plan

- List *common sources of risks* on information technology (IT) projects

- Describe the process of *identifying risks* and *create a risk register*

- Discuss *qualitative risk analysis* and explain how to calculate risk factors, create probability/impact matrixes, and apply the *Top Ten Risk Item Tracking technique* to rank risks

Learning Objectives

- Explain *quantitative risk analysis* and how to apply decision trees, simulation, and sensitivity analysis to quantify risks
- Provide examples of using different risk response planning strategies to address both *negative and positive risks*
- Discuss how to control risks
- Describe how *software* can assist in project risk management

Opening case

　　Cliff 是一个小的信息技术咨询公司的总经理，该公司从事因特网应用程序开发和全方位的服务支持。公司总共有 50人，由程序员、商务分析师、数据库专家、网页设计者、项目经理等组成。公司在过去的几年中绩效非常好，计划在下一年至少再雇10人，但近来在赢得合同方面遇到了困难。花时间与资源来对潜在客户的每个建议邀请书做出反应，正变得越来越昂贵。许多客户开始要求，在签订合同之前做些展示，甚至开发一些原型。在对待风险的事情上，克里夫采取的是一个积极进取的方法，喜欢投标盈利最高的项目。在投标这些项目之前，他没有使用系统化的方法来评价各种项目所涉及的风险。他的战略给公司带来了许多问题，因为他们在准备建议书方面投了大量的钱，却没有赢得几个合同。许多咨询室目前并没有承担项目工作，但工资单上却还有他们的名字。为了更好的理解项目风险，克里夫和他的公司应该做些什么？克里夫是否应该调整他在决定向哪种项目投标的战略？如何调整？

Opening case

　　克里夫和他的两位高级经理出席了一个关于风险管理的专题研讨会，在那里，演讲者讨论了几项技术问题，如估计项目的期望货币值、蒙特卡罗模拟等。克里夫问演讲者，如何使用这些技术帮助公司决定投标什么项目？因为投标项目经常需要前期的投资，并有可能没有回报。演讲者通过一个EMV的例子回答了他的问题，然后进行了一次快速的蒙特卡罗模拟。克里夫的数学基础很薄弱，他很难理解 EMV，认为该模拟太复杂了，对他来说没有实际用处。比起任何数学计算的输出，他更相信直觉。演讲者感觉到克里夫并没有被打动，于是她说明了赢得项目合同的重要性，而不能仅仅看到潜在的利润。她建议对于公司有机会赢取(50%左右)合同的项目，以及有利润潜力的项目，应该使用风险中型的投标策略，而不要把精力放在那种赢取机会很小、潜在利润巨大的项目上。克里夫不同意这一建议，他继续投标那些高风险项目。另两位出席研讨会的经理现在终于明白了为什么公司存在问题，他们不久后在更具竞争力的公司找到了新的工作，许多其他人跟着跳槽了。

Opening case

1. How to correctly evaluate the project risk?

2. Project risk management process? What are the tools and technologies in each process?

3. What is the reason for Bronx's failure? What inspiration does it bring us?

Main Contents

1. The importance of project risk management

2. Planning risk management

3. Common sources of risk on IT projects

4. Identifying risks

5. Performing qualitative risk analysis

6. Performing quantitative risk analysis

7. Planning risk responses

8. Controlling risks

1. The importance of project risk management

- **Project risk management** is the **art** and **science** of *identifying, analyzing, and responding to risk* throughout the life of a project and in the best interests of meeting project objectives

- Risk management is often overlooked in projects, but it can help improve project success by helping *select good projects*, *determining project scope*, and *developing realistic cost estimates*.

1. The importance of project risk management

Table 11-1. Project Management Maturity by Industry Group and Knowledge Area*

KEY: 1 = LOWEST MATURITY RATING   5 = HIGHEST MATURITY RATING

| Knowledge Area	Engineering/ Construction	Telecommunications	Information Systems	Hi-Tech Manufacturing
Scope	3.52	3.45	3.25	3.37
Time	3.55	3.41	3.03	3.50
Cost	3.74	3.22	3.20	3.97
Quality	**2.91**	3.22	2.88	3.26
Human Resources	3.18	3.20	2.93	3.18
Communications	3.53	3.53	3.21	3.48
Risk	**2.93**	**2.87**	**2.75**	**2.76**
Procurement	3.33	3.01	2.91	3.33

*Ibbs, C. William and Young Hoon Kwak. "Assessing Project Management Maturity," *Project Management Journal* (March 2000).

1. The importance of project risk management

- Study by Ibbs and Kwak shows risk has the *lowest* maturity rating of all knowledge areas

- A similar survey was completed with software development companies in Mauritius, South Africa in 2003, and *risk management also had the lowest maturity*

1. The importance of project risk management

Figure 11-1. Benefits from Software Risk Management Practices*
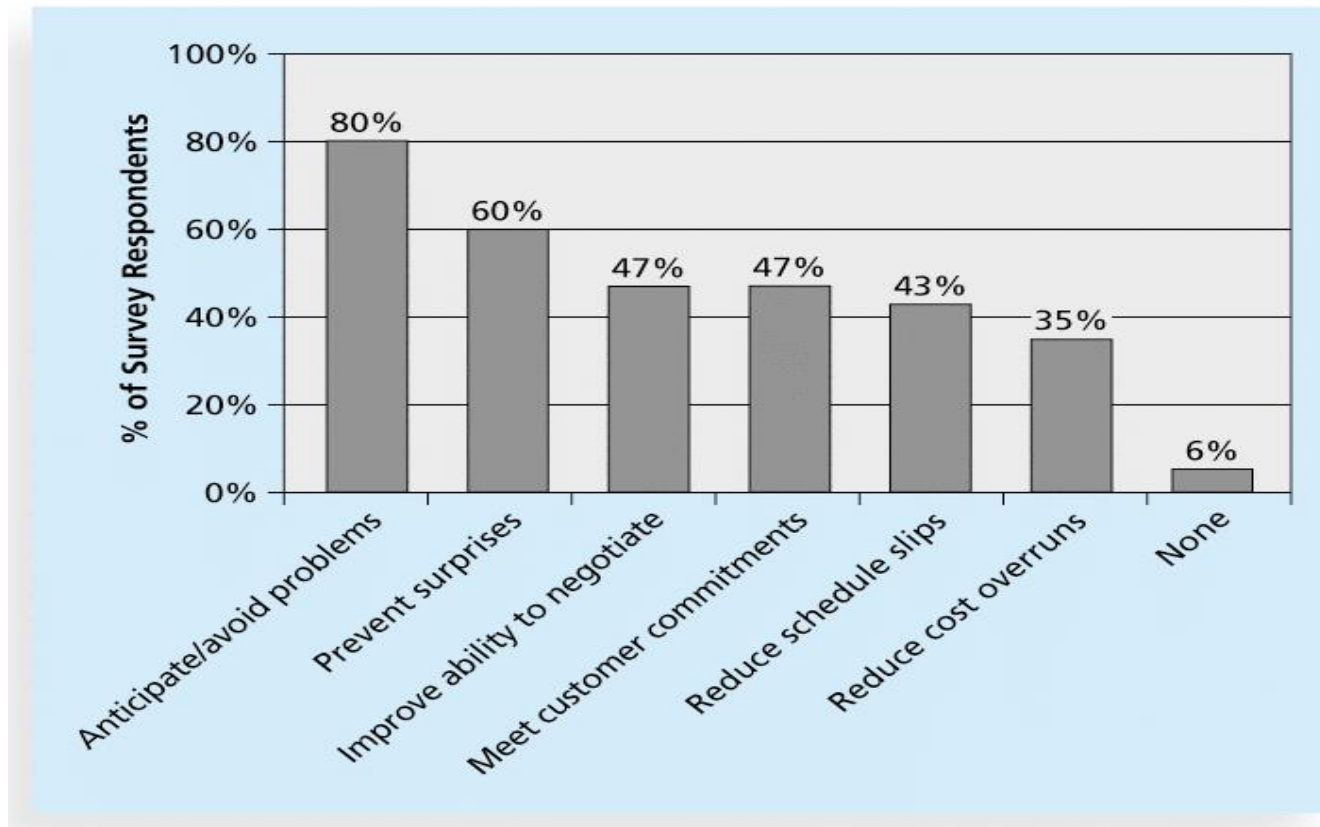
- KLCI study shows the benefits of following good software risk management practices

1. The importance of project risk management

Discussion！

- What do you think is risk?

- Risk must have a negative impact on projects. Right? Why?

- Risk is the same as *crisis*. Right? Why?

- What is the function or effect of the risk management?

- Risk management should be taken before the start, throughout the life cycle, or after the end?

1. The importance of project risk management

Risk is the possibility of loss or injury. *Negative*

Risk is an uncertainty that can have a *negative* or *positive* effect on meeting project objectives.

Negative risks are threats that may cause some problems in the project.

Positive risks are risks that result in good things happening; sometimes called opportunities

1. The importance of project risk management

Crisis indicates an obvious danger to the success of a project.

Unlike crisis management, good project risk management often goes

unnoticed

Risk is the predisposition of crisis;

Not all risks will trigger a crisis.

Only when the harm caused by the risk reaches a certain degree will

it evolve into a crisis.

1. The importance of project risk management

Risk management involves understanding potential problems that might occur on the project and how they might impede project success.

- Managing negative risks involves a number of possible actions that project managers can take to *avoid, lessen, change, or accept* the potential effects of risks on the projects.

- Positive risk management is like investing in opportunities. **It is an investment.**

The **goal** of project risk management is to minimize potential negative risks while maximizing potential positive risks

1. The importance of project risk management

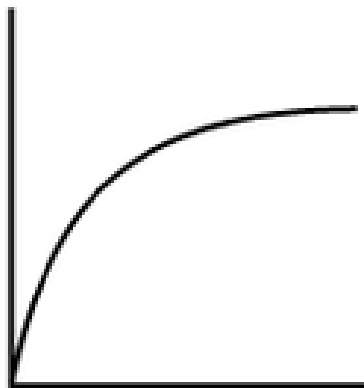**Attitudes toward risks are based on two themes:**

- **Risk appetite**: is the degree of uncertainty an entity is willing to take on, in anticipation of a reward.

- **Risk tolerance**: is the maximum acceptable deviation an entity if willing to accept on the project or business objectives as the potential impact.

1. The importance of project risk management

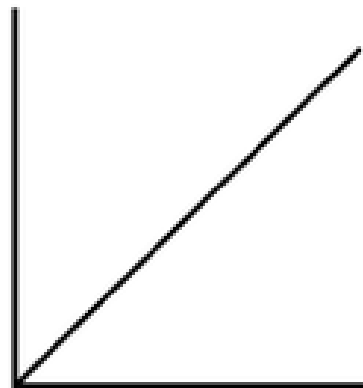- **Risk utility**: is the amount of satisfaction or pleasure received from a potential payoff.
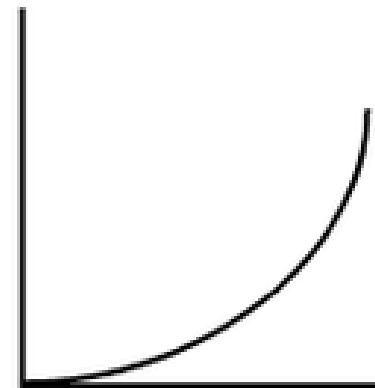
1. The importance of project risk management

Known risk: is something used to describe risks that the project team has identified and analyzed.

Unknown risk: is something that have not been identified and analyzed, cannot be managed.

Known known	**Macau Casino、Insurance Company**
Known UnKnown	**Traffic accident、Fall ill**
Unknown Unknown	**Earthquake、Fire、Once in a century**

1. The importance of project risk management

The goal of project risk management can be viewed as minimizing potential negative risks while maximizing potential positive risks.

6 main processes:

- Planning risk management

- Identifying risks

- Performing qualitative risk analysis

- Performing quantitative risk analysis

- Planning risk responses

- Controlling risk

Risk management — 6 main processes

Planning
Process: Plan risk management
Outputs: Risk management plan
Process: Identify risks
Outputs: Risk register
Process: Perform qualitative risk analysis
Outputs: Project documents updates
Process: Perform quantitative risk analysis
Outputs: Project documents updates
Process: Plan risk responses
Outputs: Project management plan updates, Project documents updates

Monitoring and controlling
Process: Control risk
Outputs： Work performance information, change requests,
project documents updates, and organizational assets updates.

Project start　　　　　　　　　　　　　　　　　　**Project finish**

2. Planning risk management

A r**isk management plan** documents the procedures for managing

risk throughout the project.

Tools: hold several planning meetings

Review(Inputs):

project documents

corporate risk management policies

risk categories

lessons-learned reports from past projects

templates for creating a risk management plan

2. Planning risk management

Table 11-2. Topics Addressed in a Risk Management Plan

- Methodology
- Roles and responsibilities
- Budget and schedule
- Risk categories
- Risk probability and impact
- <u>Revised stakeholders' tolerances</u>
- Tracking
- Risk documentation

2. Planning risk management

In addition to a risk management plan:

- **Contingency plans**：are predefined actions that the project team will take if an identified risk event occurs

- **Fallback plans**：are developed for risks that have a high impact on meeting project objectives, and are put into effect if attempts to reduce the risk are not effective

- **Contingency reserves / allowances**：are provisions held by the project sponsor or organization to reduce the risk of cost or schedule overruns to an acceptable level; **management reserves** are funds held for unknown risks

3. Common sources of risk on IT projects

- Several studies show that IT projects share some common sources of risk

- The Standish Group developed an IT success potential scoring sheet based on potential risks

Success Criterion	Relative Importance
User Involvement	19
Executive Management support	16
Clear Statement of Requirements	15
Proper Planning	11
Realistic Expectations	10
Smaller Project Milestones	9
Competent Staff	8
Ownership	6
Clear Visions and Objectives	3
Hard-Working, Focused Staff	3
Total	**100**

Table 11-3. IT Success Potential Scoring Sheet

3. Common sources of risk on IT projects

Some common risks:

- Market risk

- Financial risk

- Technology risk

- People risk

- Structure/process risk

3. Common sources of risk on IT projects

Risk breakdown structure

*It is also important to identify potential risks according to project management knowledge areas, such as scope, time, cost and quality.*

A **risk breakdown structure** is a hierarchy of potential risk categories for a project

- Similar to a work breakdown structure but used to identify and categorize risks

3. Common sources of risk on IT projects

Figure 11-4. Sample Risk Breakdown Structure
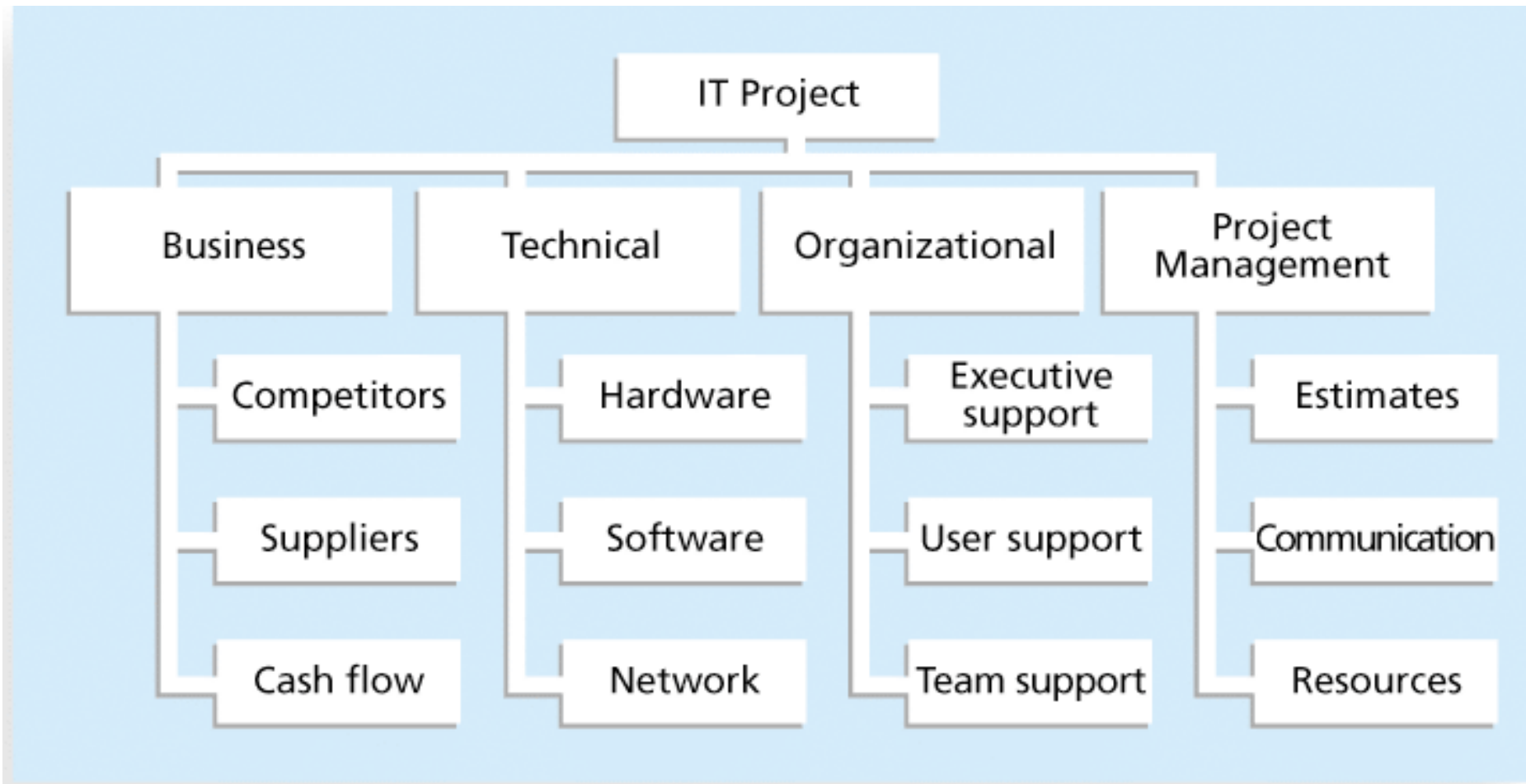
3. Common sources of risk on IT projects

Table 11-4. Potential Negative Risk Conditions Associated With Each Knowledge Area

Knowledge Area	Risk Conditions
Integration	Inadequate planning; poor resource allocation; poor integration management; lack of post-project review
Scope	Poor definition of scope or work packages; incomplete definition
Time	Errors in estimating time or resource availability; errors in determining the critical path; poor allocation and management of float; early release of competitive products
Cost	Estimating errors; inadequate productivity, cost, change, or contingency
Quality	Poor attitude toward quality; substandard design, materials, and workmanship; inadequate quality assurance program
Human resource	Poor conflict management; poor project organization and definition of responsibilities; absence of leadership
Communications	Carelessness in planning or communicating
Risk	Ignoring risk; unclear analysis of risk; poor insurance management
Procurement	Unenforceable conditions or contract clauses; adversarial relations
Stakeholders	Lack of consultation with key stakeholder

4. Identifying risks

Identifying risks is the process of understanding what potential events might *hurt* or *enhance* a particular project.

How:

Understanding common sources of risks, reviewing project's planning documents, activity cost and duration estimates, the scope baseline, stakeholder register, project documents, procurement documents, enterprise environmental factors, organizational process assets.

4. Identifying risks

Process: Identifying risks

Inputs:　project management plan;

　　　　　project document; agreement;

　　　　　purchase document；

　　　　　enterprise environmental factors;

　　　　　organizational process assets;

Output：risk register

Tools：　expert judgment；data collection;

　　　　　data analysis; interpersonal and team skills;

　　　　　list tips; meeting

4. Identifying risks

Suggestions for identifying risks

- Brainstorming

- Delphi technique

- Interviewing

- Root cause analysis

- SWOT

- Checklists

- Analysis of assumptions

- Diagrams

4. Identifying risks

The risk register is a document that contains results of various risk

management processes.

- An identification number for each risk event
- A rank for each risk event
- The name of the risk event
- The category under which the risk event falls
- Triggers for each risk
- Potential responses to each risk
- The risk owner
- The probability of the risk occurring
- The impact to the project if the risk occurs
- The status of the risk

4. Identifying risks

Table 11-5. Sample Risk Register

No.	Rank	Risk	Description	Category	Root Cause	Triggers	Potential Responses	Risk Owner	Probability	Impact	Status
R44	1										
R21	2										
R7	3										

- No.: R44
- Rank: 1
- Risk: New customer
- Description: We have never done a project for this organization before and don't know too much about them. One of our company's strengths is building good customer relationships, which often leads to further projects with that customer. We might have trouble working with this customer because they are new to us.
- Category: People risk
- Etc.

5. Performing qualitative risk analysis

Qualitative risk analysis involves assessing the likelihood and impact of identified risks to determine their magnitude and priority.

Risk quantification tools and techniques include:

Probability/impact matrixes

The Top Ten Risk Item Tracking

Expert judgment

5. Performing qualitative risk analysis

Probability/Impact Matrix

- A **probability/impact matrix** or **chart** lists the relative probability of a risk occurring on one side of a matrix or axis on a chart and the relative impact of the risk occurring on the other

- List the risks and then label each one as *high, medium, or low* in terms of its probability of occurrence and its impact if it did occur

5. Performing qualitative risk analysis

Figure 11-5. Sample Probability/Impact Matrix

5. Performing qualitative risk analysis

It may be useful to create a separate probability/impact matrix or chart for *negative risks* and *positive risks* to make sure that both types are adequately addressed.

Can also calculate *risk factors*:

Numbers that represent the overall risk of specific events based on their probability of occurring and the consequences to the project if they do occur.

Risk score = probability * impact

5. Performing qualitative risk analysis

Using probability/impact matrixes to calculate risk factors
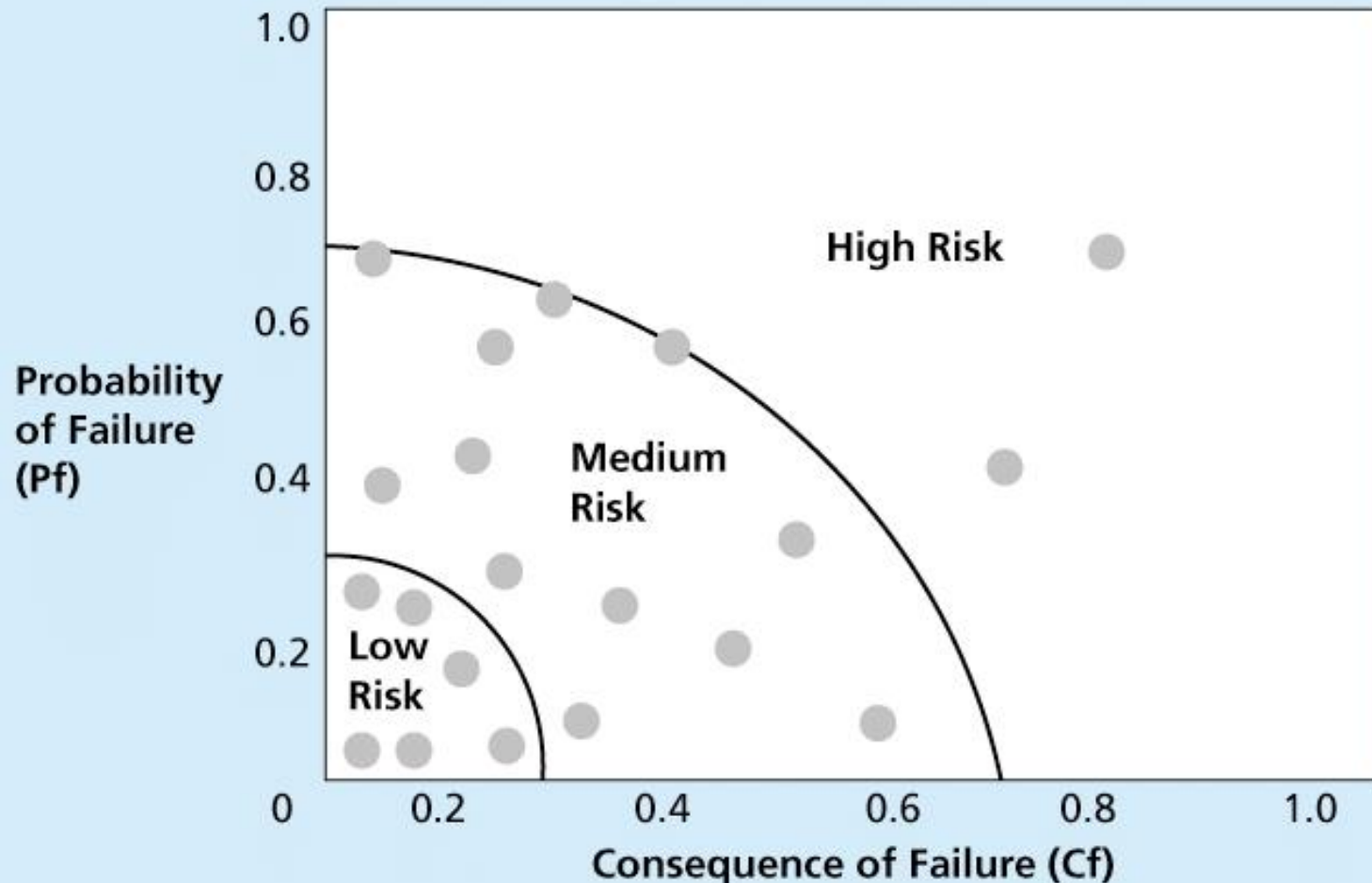
5. Performing qualitative risk analysis

Using probability/impact matrixes to calculate risk factors

概率/影响风险分析矩阵					
概率	风险值=概率*影响				
0.90	0.05	0.09	0.18	0.36	0.72
0.70	0.04	0.07	0.14	0.28	0.56
0.50	0.03	0.05	0.10	0.20	0.40
0.30	0.02	0.03	0.06	0.12	0.24
0.10	0.01	0.01	0.02	0.04	0.08
	0.05	0.10	0.20	0.40	0.80
	对项目目标的影响，如进度、范围、成本等				

5. Performing qualitative risk analysis

- **Top Ten Risk Item Tracking** is a qualitative risk analysis tool that helps to identify risks and maintain an awareness of risks throughout the life of a project

- Establish a periodic review of the top ten project risk items

- List the current ranking, previous ranking, number of times the risk appears on the list over a period of time, and a summary of progress made in resolving the risk item

5. Performing qualitative risk analysis

Table 11-6. Example of Top Ten Risk Item Tracking

MONTHLY RANKING

RISK EVENT	RANK THIS MONTH	RANK LAST MONTH	NUMBER OF MONTHS IN TOP TEN	RISK RESOLUTION PROGRESS
Inadequate planning	1	2	4	Working on revising the entire project management plan
Poor definition	2	3	3	Holding meetings with project customer and sponsor to clarify scope
Absence of leadership	3	1	2	After previous project manager quit, assigned a new one to lead the project
Poor cost estimates	4	4	3	Revising cost estimates
Poor time estimates	5	5	3	Revising schedule estimates

5. Performing qualitative risk analysis

Watch List

- A **watch list** is a list of risks that are low priority, but are still identified as potential risks

- Qualitative analysis can also identify risks that should be evaluated on a quantitative basis

6.Performing quantitative risk analysis

Performing Quantitative Risk Analysis

- Often follows qualitative risk analysis, but both can be done together

- Large, complex projects involving leading edge technologies often require extensive quantitative risk analysis

  - ✓ Strategic importance
  - ✓ Contract provisions
  - ✓ Stakeholders' regulations

6.Performing quantitative risk analysis

The main techniques for quantitative risk analysis include:

- Data gathering

- Analysis and modeling techniques

  a. Decision tree analysis

  b. Simulation

  c. Sensitivity analysis

- Expert judgment

6.Performing quantitative risk analysis

Decision Trees and Expected Monetary Value (EMV)

- A **decision tree** is a diagramming analysis technique used to help select the best course of action in situations in which future outcomes are uncertain

- **Estimated monetary value (EMV)** is the product of a risk event probability and the risk event's monetary value

- You can draw a decision tree to help find the EMV

6.Performing quantitative risk analysis

Figure 11-7. Expected Monetary Value (EMV) Example

Probability (P) times Outcome = EMV

Project 1:
- P=.20 * $300,000 = +$60,000
- P=.80 * −$40,000 = −$32,000

Project 2:
- P=.20 * −$50,000 = −$10,000
- P=.10 * −$20,000 = −$2,000
- P=.70 * $60,000 = $42,000

Project 1's EMV = $60,000 − $32,000 = $28,000
Project 2's EMV = −$10,000 − $2,000 + $42,000 = $30,000
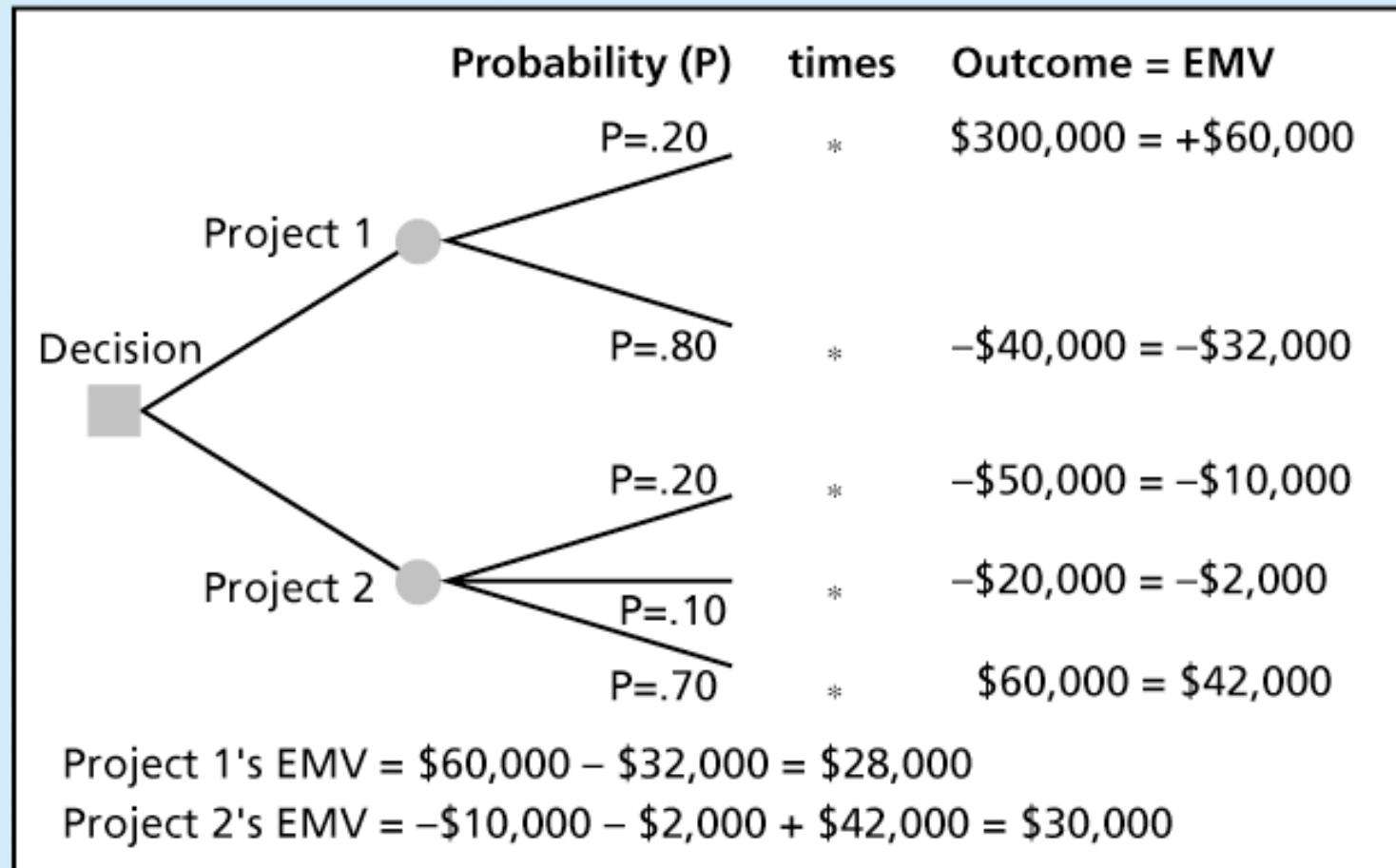
6.Performing quantitative risk analysis

Simulation

- Simulation uses a representation or model of a system to analyze the expected behavior or performance of the system

- **Monte Carlo analysis** simulates a model's outcome many times to provide a statistical distribution of the calculated results

- To use a Monte Carlo simulation, you must have three estimates (most likely, pessimistic, and optimistic) plus an estimate of the likelihood of the estimate being between the most likely and optimistic values

6.Performing quantitative risk analysis

Steps of a Monte Carlo Analysis

1. Assess the range for the variables being considered

2. Determine the probability distribution of each variable

3. For each variable, select a random value based on the probability distribution

4. Run a deterministic analysis or one pass through the model

5. Repeat steps 3 and 4 many times to obtain the probability distribution of the model's results

6.Performing quantitative risk analysis

Figure 11-8. Sample Monte Carlo Simulation Results for Project

Schedule
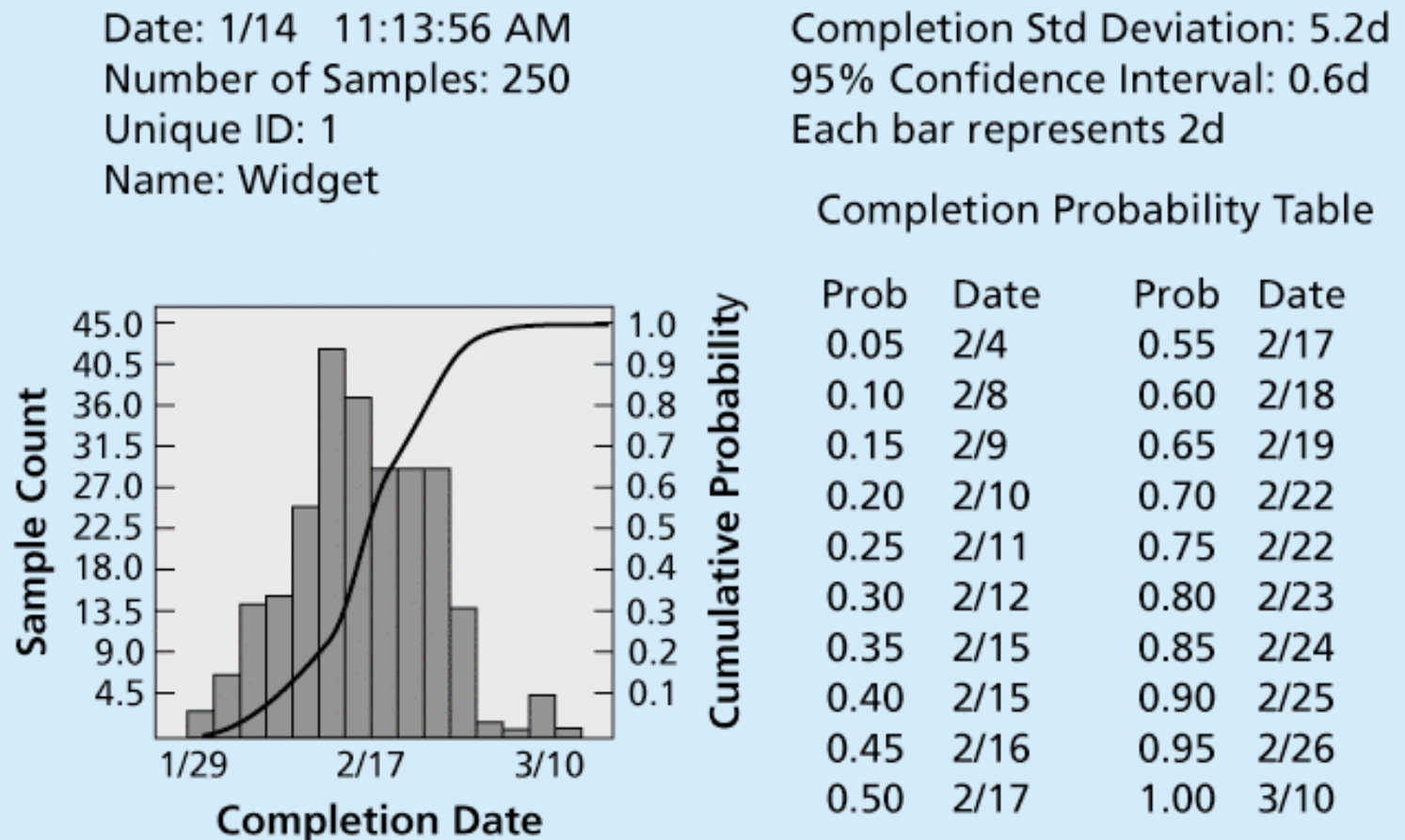
6.Performing quantitative risk analysis

- **Sensitivity analysis** is a technique used to show the effects of changing one or more variables on an outcome

- For example, many people use it to determine what the monthly payments for a loan will be given different interest rates or periods of the loan, or for determining break-even points based on different assumptions

- Spreadsheet software, such as Excel, is a common tool for performing sensitivity analysis

6.Performing quantitative risk analysis

Units Sold	Revenue	Expense
0	$0	$25,000
500	6,000	29,000
1,000	12,000	33,000
1,500	18,000	37,000
2,000	24,000	41,000
2,500	30,000	45,000
3,000	36,000	49,000
3,500	42,000	53,000
4,000	48,000	57,000
4,500	54,000	61,000
5,000	60,000	65,000
5,500	66,000	69,000
6,000	72,000	73,000
6,500	78,000	77,000
7,000	84,000	81,000
7,500	90,000	85,000
8,000	96,000	89,000
8,500	102,000	93,000
9,000	108,000	97,000
9,500	114,000	101,000
10,000	120,000	105,000
10,500	126,000	109,000
11,000	132,000	113,000
11,500	138,000	117,000
12,000	144,000	121,000
12,500	150,000	125,000
13,000	156,000	129,000
13,500	162,000	133,000
14,000	168,000	137,000
14,500	174,000	141,000

Sales Price per Unit: $12

Manufacturing Cost per Unit: $8

Fixed Monthly Expense: $25,000

Break-Even Point (Units Sold): 6,250
Revenue at Break-Even Point: $75,000

7. Planning risk responses

Developing a response to risks involves developing options and defining strategies for reducing negative risks and enhancing positive risks.

■ After identifying and quantifying risks, who must decide how to respond to them？

名称	特点	情景
回避Avoid	改变计划或范围	去掉WBS中有风险的工作包或由第三方来消除
缓解Mitigate	降低概率或后果	雇佣有经验的雇员
转移Transference	转给第三方	购买保险或第三方担保
积极接受Acceptance	准备备用计划 准备应急储备金	有风险不能回避和减轻，准备备用计划
被动接受Acceptance	什么都不作	

7. Planning risk responses

Table 11-7. General Risk Mitigation Strategies for Technical, Cost, and Schedule Risks

TECHNICAL RISKS	COST RISKS	SCHEDULE RISKS
Emphasize team support and avoid stand-alone project structure	Increase the frequency of project monitoring	Increase the frequency of project monitoring
Increase project manager authority	Use WBS and CPM	Use WBS and CPM
Improve problem handling and communication	Improve communication, project goals understanding, and team support	Select the most experienced project manager
Increase the frequency of project monitoring	Increase project manager authority	
Use WBS and CPM		

7. Planning risk responses

Negative risks:

- Risk avoidance

- Risk acceptance

- Risk transference

- Risk mitigation

- Reporting risk

Positive risks:

- Risk exploitation

- Risk sharing

- Risk enhancement

- Risk acceptance

- Reporting risk

7. Planning risk responses

Residual risks are risks that remain after all of the response strategies have been implemented.

Secondary risks are a direct result of implementing a risk response.

Main outputs: risk-related contractual agreements, updates to the project management plan and other project documents, and updates to the risk register.

8. Controlling risks

Controlling risks involves executing the risk management processes to respond to risk events and ensuring that *risk awareness* is an ongoing activity performed by the entire project team throughout the entire project.

Workarounds are unplanned responses to risk events that must be done when there are no contingency plans

8. Controlling risks

Tools and techniques:

- risk reassessment

- risk audits

- variance and trend analysis

- technical performance measurements

- reserve analysis

- status meeting or periodic risk reviews

8. Controlling risks

Outputs:

- Work performance information

- Change requests

- Updates to the project management plan and other project documents

- Organizational process assets

Chapter Summary

- Project risk management is the art and science of identifying, analyzing, and responding to risk throughout the life of a project and in the best interests of meeting project objectives

- Main processes include:

  - Plan risk management

  - Identify risks

  - Perform qualitative risk analysis

  - Perform quantitative risk analysis

  - Plan risk responses

  - Control risks