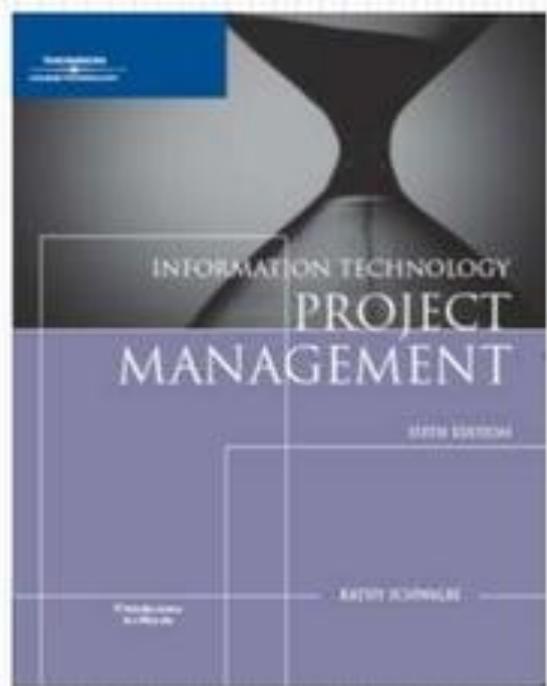


Chapter 11: Project Risk Management

**Information Technology
Project Management,
Fifth Edition**



Learning Objectives

- Understand what risk is and the importance of good project risk management
- Discuss the elements involved in risk management planning and the contents of a risk management plan
- List common sources of risks in information technology projects

Learning Objectives (continued)

- Describe the risk identification process, tools and techniques to help identify project risks, and the main output of risk identification: a risk register
- Discuss the qualitative risk analysis process 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 (continued)

- Explain the quantitative risk analysis process 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 what is involved in risk monitoring and control
- Describe how software can assist in project risk management

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 estimates
- Unfortunately, crisis management has higher visibility due to the obvious danger to the success of the project but it's risk management that helps a project have fewer problems to begin with.

Research Shows Need to Improve 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 (1.84 vs average of 2.29)
- A KLCI Research Group study (2001) shows the benefits of following good software risk management practices
 - 97% had procedures to identify and assess risk
 - 80% identified anticipating and avoiding problems as the primary benefit of risk management
 - 70% had defined s/w development processes
 - 64% has a Project Management Office

Project Management Maturity by Industry Group and Knowledge Area*

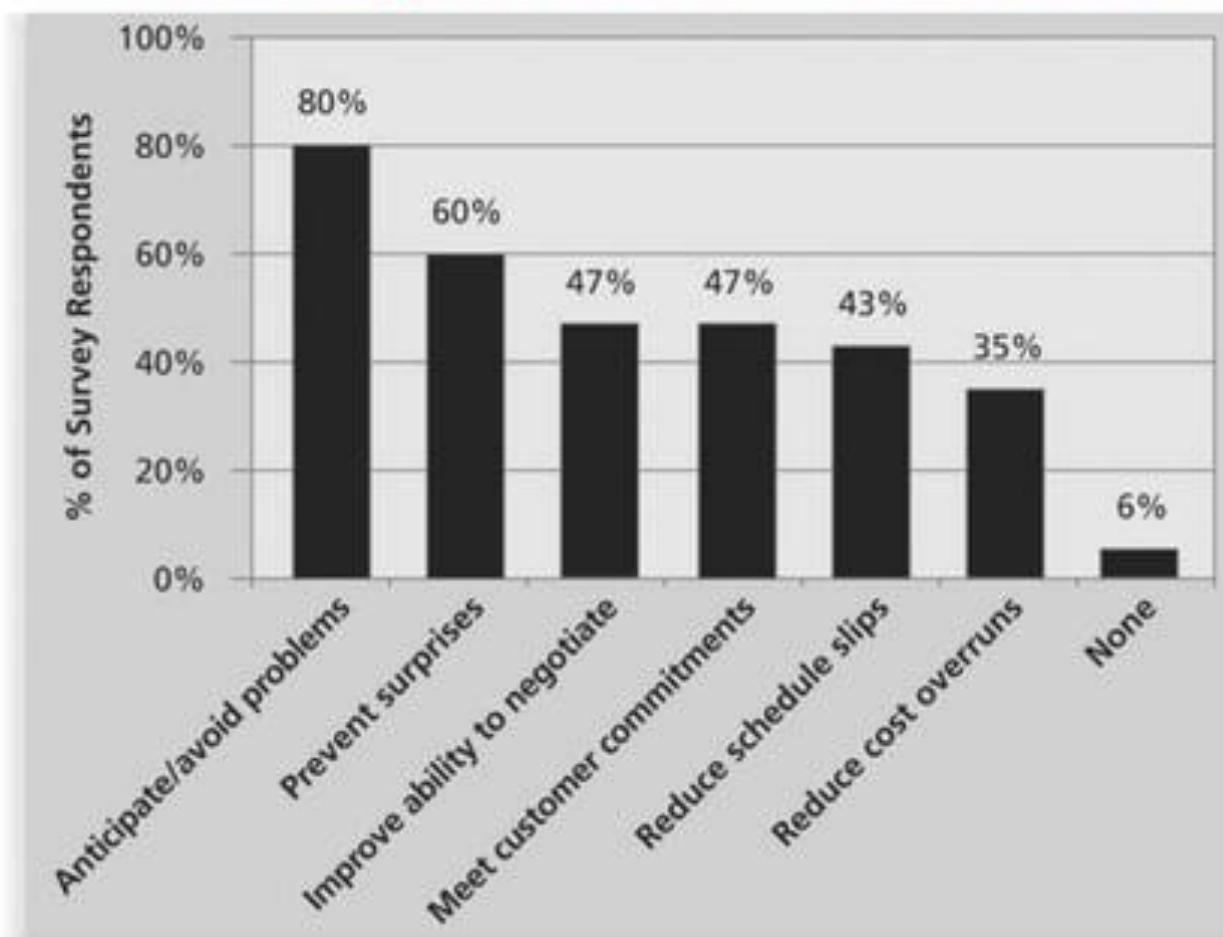
KEY: 1 = LOWEST MATURITY RATING

5 = HIGHEST MATURITY RATING

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

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

Benefits from Software Risk Management Practices*



*Kulik, Peter and Catherine Weber, "Software Risk Management Practices – 2001," KLCI Research Group (August 2001).

Negative Risk

- A dictionary definition of risk is “the possibility of loss or injury”
- Negative risk involves understanding potential problems that might occur in the project and how they might impede project success
- Negative risk management is like a form of insurance; it is an investment
- If IT projects are so risky, why do companies pursue them?

Risk Can Be Positive

- Positive risks are risks that result in good things happening; sometimes called opportunities
- A general definition of project **risk** is an uncertainty that can have a negative or positive effect on meeting project objectives
- The goal of project risk management is to minimize potential negative risks while maximizing potential positive risks

Best Practice

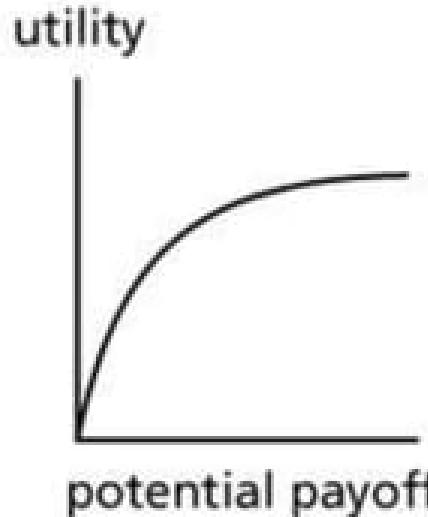
- Some organizations make the mistake of only addressing tactical and negative risks when performing project risk management
- David Hillson (www.risk-doctor.com) suggests overcoming this problem by widening the scope of risk management to encompass both *strategic risks* and *upside opportunities*, which he refers to as *integrated risk management*
 - *Ensure that project delivery is tied to organizational needs and vision*
 - *Allowing an appropriate level of risk to be taken intelligently with full awareness of the degree of uncertainty and its potential effects on objectives*

Risk Utility

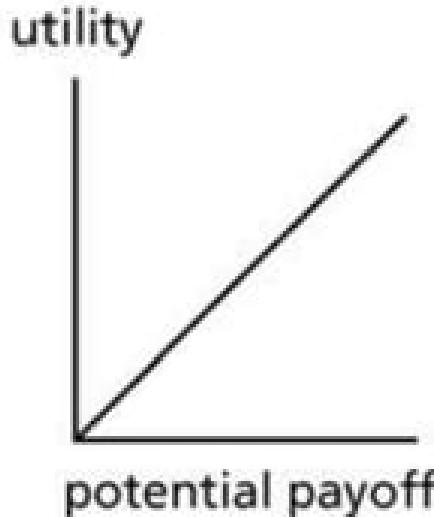
- Different organizations and people have different tolerances for risk
- **Risk utility** or **risk tolerance** is the amount of satisfaction or pleasure received from a potential payoff
 - Utility rises at a decreasing rate for people who are risk-averse
 - Those who are risk-seeking have a higher tolerance for risk and their satisfaction increases when more payoff is at stake
 - The risk-neutral approach achieves a balance between risk and payoff

Risk Utility Function and Risk Preference

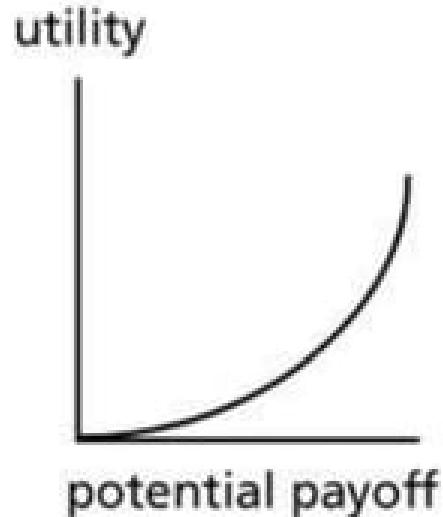
Risk-Averse



Risk-Neutral



Risk-Seeking



Project Risk Management Processes

- **Risk management planning:** deciding how to approach and plan the risk management activities for the project
- **Risk identification:** determining which risks are likely to affect a project and documenting the characteristics of each
- **Qualitative risk analysis:** prioritizing risks based on their probability and impact of occurrence

Project Risk Management Processes

- **Quantitative risk analysis:** numerically estimating the effects of risks on project objectives
- **Risk response planning:** taking steps to enhance opportunities and reduce threats to meeting project objectives
- **Risk monitoring and control:** monitoring identified and residual risks, identifying new risks, carrying out risk response plans, and evaluating the effectiveness of risk strategies throughout the life of the project

Project Risk Management Summary

Planning

Process: **Risk Management Planning**

Outputs: Risk management plan

Process: **Risk Identification**

Outputs: Risk register

Process: **Qualitative Risk Analysis**

Outputs: Updates to the risk register

Process: **Quantitative Risk Analysis**

Outputs: Updates to the risk register

Process: **Risk Response Planning**

Outputs: Updates to the risk register and project management plan, risk-related contractual agreements

Monitoring and Controlling

Process: **Risk Monitoring and Controlling**

Outputs: Recommended corrective and preventive actions, requested changes, and updates to the risk register, project management plan, and organizational process assets

Project Start

Project Finish

Risk Management Planning

- The main output of risk management planning is a **risk management plan**—a plan that documents the procedures for managing risk throughout a project
- The project team should review project documents, corporate risk management policies, lessons-learned reports from past projects and understand the organization's and the sponsor's approaches to risk
 - Important to clarify roles and responsibilities, prepare budget and schedule estimates for risk-related work and identify risk categories for consideration
- The level of detail will vary with the needs of the project

Topics Addressed in a Risk Management Plan

- **Methodology:** How will risk management be performed on this project? What tools and data sources are available and applicable?
- **Roles and Responsibilities:** Who are the individuals responsible for implementing specific tasks and providing deliverables related to risk management?
- **Budget and Schedule:** What are the estimated costs and schedules for performing risk-related activities?
- **Risk Categories:** What are the main categories of risks that should be addressed on this project? Is there a risk breakdown structure for the project?
- **Risk Probability and Impact:** How will the probabilities and impacts of risk items be assessed? What scoring and interpretation methods will be used for the qualitative and quantitative analysis of risks?
- **Risk Documentation:** What reporting formats and processes will be used for risk management activities?

Contingency and Fallback Plans, Contingency Reserves

- In addition to a risk management plan, many projects also include:
 - **Contingency plans** – predefined actions that the project team will take if an identified risk event occurs
 - Expecting new release of a s/w package, must plan to use older version if delayed
 - **Fallback plans** - 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
 - College grad has main plan and contingency plans of where to live after graduation but needs fallback plan to possibly live at home
 - **Contingency reserves or allowances** - provisions held by the project sponsor or organization to reduce the risk of cost or schedule overruns to an acceptable level
 - Project falling behind schedule due to inexperience with new technology, use these funds to hire outside trainer

Common Sources of Risk in Information Technology Projects

- Several studies show that IT projects share some common sources of risk
- The Standish Group developed an IT success potential scoring sheet (next slide) based on potential risks
 - If a potential project does not receive a minimum score, the organization might decide not to work on it or to take actions to reduce the risks before it invests too much time or money
 - The Standish Group developed specific questions for each success criterion to help decide the number of points to assign to a project
 - User Involvement: Do I have the right users? Did I involve the users early on? Do I make involvement easy? ...

Information Technology Success Potential Scoring Sheet

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

- The number of questions corresponding to each success criterion determines the number of points each positive response is assigned
 - Ex: User involvement: $19/5$ (or 3.8) points per question answered positively

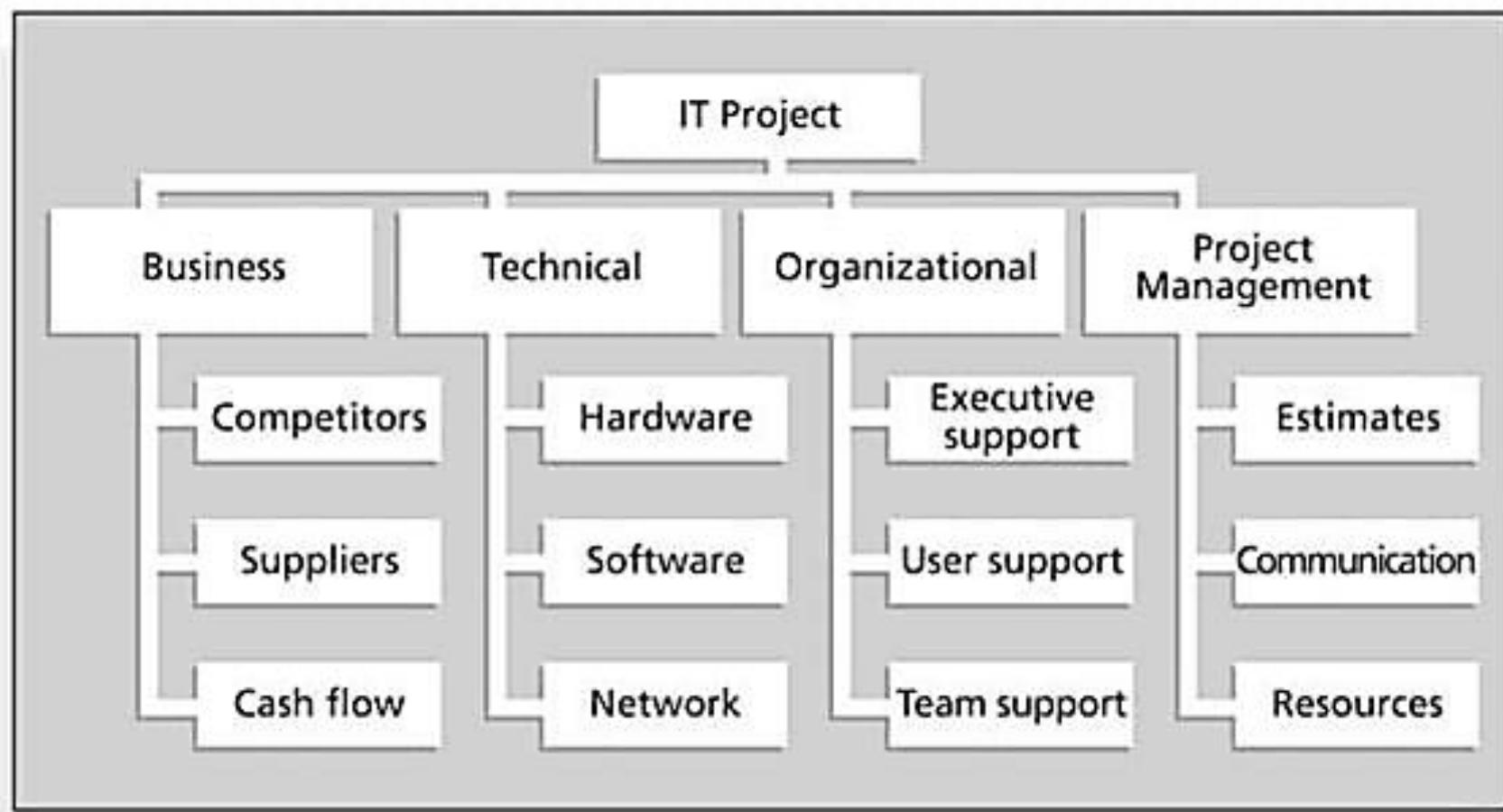
Broad Categories of Risk

- Many organizations develop their own risk questionnaires. Some of the categories of risk might include:
 - **Market risk** – Will the new service or product be useful to the organization or marketable to others? Will the users accept it? Will someone else create a better product?
 - **Financial risk** – can the organization afford to undertake the project? Will the project meet NPV, ROI and payback estimates?
 - **Technology risk** – is the project technically feasible? Is it leading edge or bleeding edge technology?
 - **People risk** – Are people with appropriate skills available to help complete the project? Does senior management support the project?
 - **Structure/process risk** – What is the degree of change the new project will introduce into user areas and business procedures? With how many other systems does a new project/system need to interact?

Risk Breakdown Structure

- 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
- In addition to identifying risk based on the nature of the project or products produced, it is also important to identify potential risks according to project management knowledge areas

Sample Risk Breakdown Structure



Potential Negative Risk Conditions Associated With Each Knowledge Area

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

Risk Identification

- **Risk identification** is the process of understanding what potential events might hurt or enhance a particular project
 - This is an ongoing process throughout the project lifecycle as things change
 - You can not manage risks that you don't identify
- Risk identification tools and techniques include:
 - Brainstorming
 - The Delphi Technique
 - Interviewing
 - SWOT analysis

Brainstorming

- **Brainstorming** is a technique by which a group attempts to generate ideas or find a solution for a specific problem by amassing ideas spontaneously and without judgment
- An experienced facilitator should run the brainstorming session
- Be careful not to overuse or misuse brainstorming
 - Psychology literature shows that individuals produce a greater number of ideas working alone than they do through brainstorming in small, face-to-face groups
 - Group effects often inhibit idea generation

Delphi Technique

- The **Delphi Technique** is used to derive a consensus among a panel of experts who make predictions about future developments
 - Developed by the RAND Corporation for the US Air Force in the late 1960s
- Provides independent and anonymous input regarding future events
- Uses repeated rounds of questioning and written responses and avoids the biasing effects possible in oral methods, such as brainstorming
 - Requires a panel of experts for the particular area in question

Interviewing

- **Interviewing** is a fact-finding technique for collecting information in face-to-face, phone, e-mail, or instant-messaging discussions
 - Useful to have a prepared set of questions as a guide to the interview
- Interviewing people with similar project experience is an important tool for identifying potential risks

SWOT Analysis

- **SWOT analysis** (strengths, weaknesses, opportunities, and threats) can also be used during risk identification
- Project teams focus on the broad perspectives of potential risks for particular projects
 - What are the company's strengths and weaknesses related to this project
 - What opportunities and threats exist
- Helps identify the broad negative and positive risks that apply to a project

Other Risk Identification Methods

- An influence diagram is a simple visual representation of a decision problem. Influence diagrams offer an intuitive way to identify and display the essential elements, including decisions, uncertainties, and objectives, and how they influence each other.



- This simple influence diagram shows how decisions about the marketing budget and product price influence expectations about its uncertain market size and market share. These, in turn, influence costs and revenues, which affect the overall profit.
- The product manager, VP of marketing, and market analyst may work together to draw such a diagram to develop a shared understanding of the key issues. The diagram provides a high-level qualitative view under which the analyst builds a detailed quantitative model.

Other Risk Identification Methods

Marketing budget

A decision is a variable that you, as the decision maker, have the power to control.

Market share

A chance variable is uncertain and you cannot control it directly.

Profit

An objective variable is a quantitative criterion that you are trying to maximize (or minimize).

Unitsales

A general variable is a deterministic function of the quantities it depends on.



An arrow denotes an influence. A influences B means that knowing A would directly affect our belief or expectation about the value of B. An influence expresses knowledge about relevance. It does not necessarily imply a causal relation, or a flow of material, data, or money.

Risk Register

- The main output of the risk identification process is a list of identified risks and other information needed to begin creating a risk register
- A **risk register** is:
 - A document that contains the results of various risk management processes and that is often displayed in a table or spreadsheet format
 - A tool for documenting potential risk events and related information
- **Risk events** refer to specific, uncertain events that may occur to the detriment or enhancement of the project
 - Negative risks: delays in completing work as scheduled, increases in estimated costs, supply shortages, litigation, strikes, etc.
 - Positive risks: completing work sooner and/or cheaper than planned, collaborating with suppliers to produce better products, good publicity, etc.

Risk Register Contents

- An identification number for each risk event
- A rank for each risk event
- The name of each risk event
- A description of each risk event
- The category under which each risk event falls
- The root cause of each risk

Risk Register Contents (continued)

- Triggers for each risk; **triggers** are indicators or symptoms of actual risk events
 - Cost overruns on early activities, defective products
- Potential responses to each risk
- The **risk owner** or person who will own or take responsibility for each risk
- The probability and impact of each risk occurring
- The status of each risk

Sample Risk Register

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

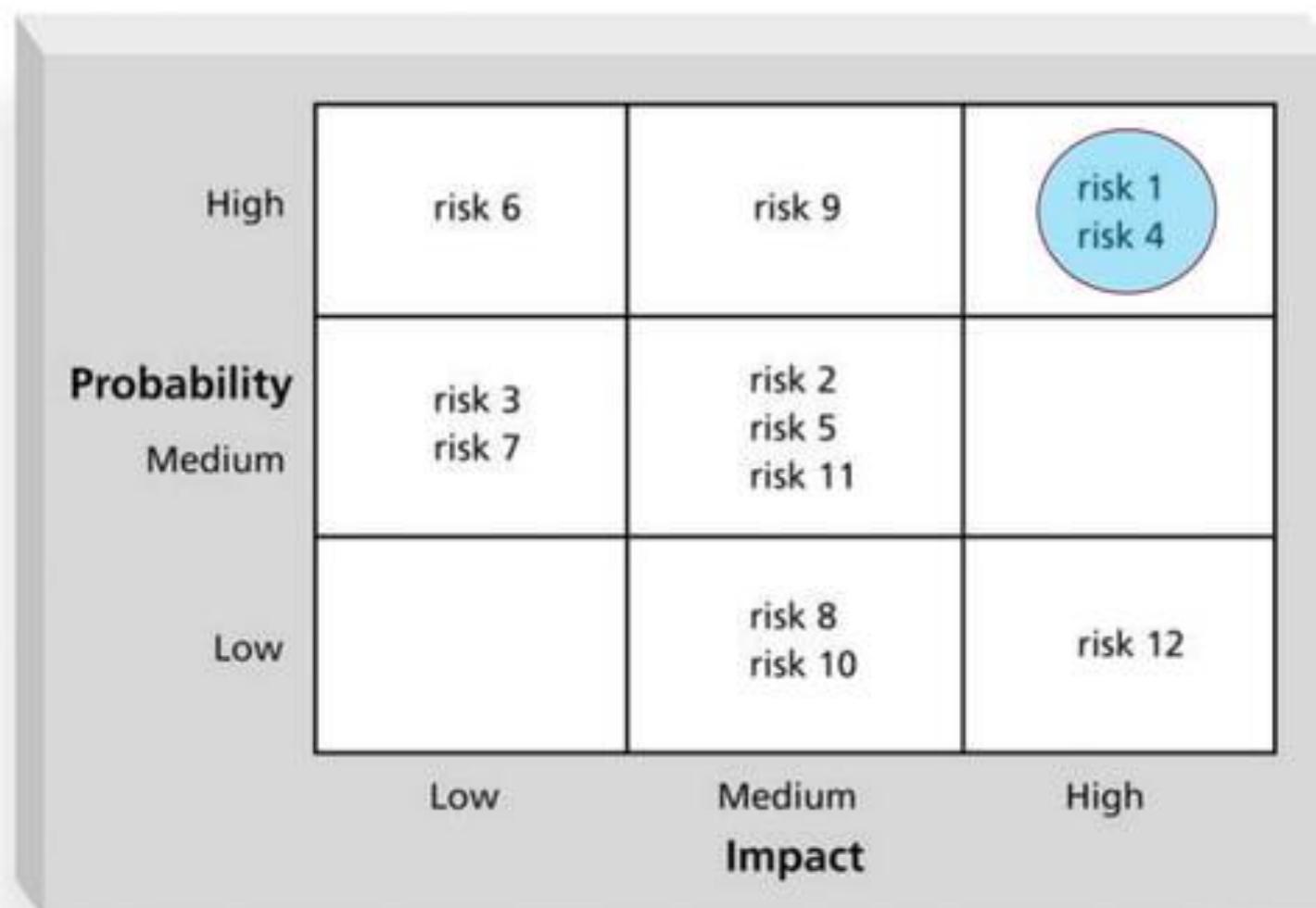
Qualitative Risk Analysis

- After identifying risks, the next step is to understand which risks are most important
- Assess 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

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
- Deal first with those risks in the high probability/high impact cell

Sample Probability/Impact Matrix

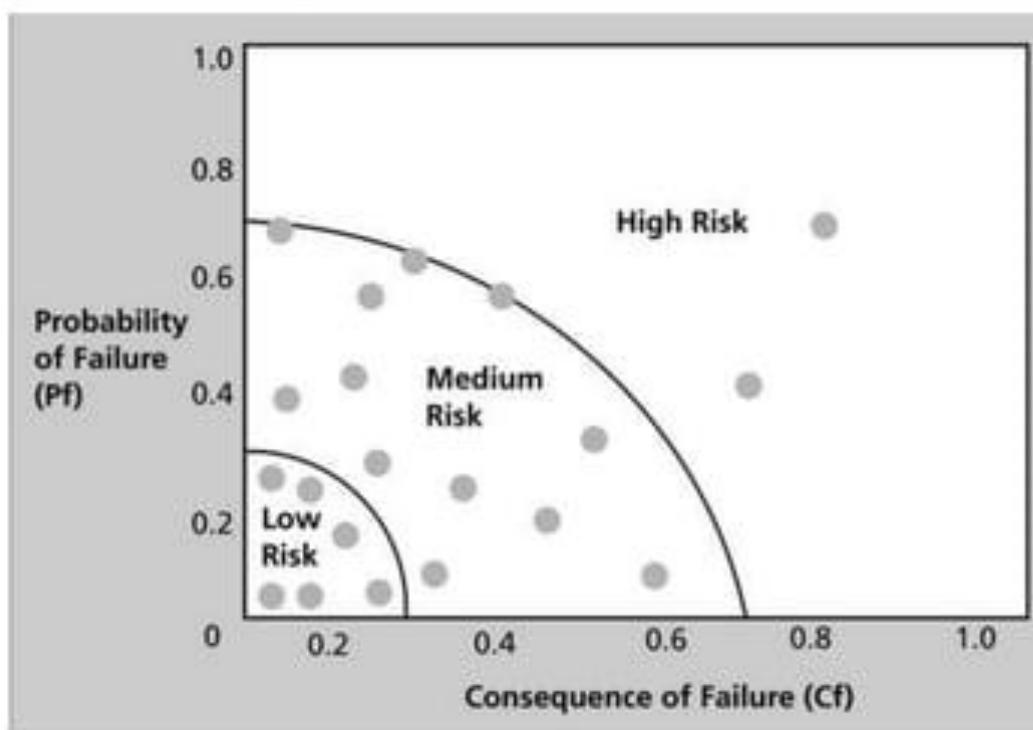


Risk factors

- 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
 - Probabilities of a risk occurring can be estimated based on several factors based on the unique nature of each project
 - For example: technology not being mature, technology too complex, inadequate support base for developing the technology
 - The impact of a risk could include factors such as the availability of fallback solutions or the consequences of not meeting performance, cost and schedule estimates

High-, Medium-, and Low-Risk Technologies

- Example of how risk factors were used to graph the probability of failure and consequence of failure for proposed technologies in a research study to help design more reliable aircraft
- Based on this chart, the recommendation was made to invest in low- to medium-risk technologies and not pursue high-risk technology



Top Ten Risk Item Tracking

- **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

Top Ten Risk Item Tracking

- Keeps management and the customer aware of the major influences that could prevent or enhance the project's success
- By involving the customer, the project team may be able to consider alternative strategies for addressing the risks
- It's a means of promoting confidence in the project team by demonstrating to management and the customer that the team is aware of the significant risks, has a strategy in place and is effectively carrying out that strategy

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

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

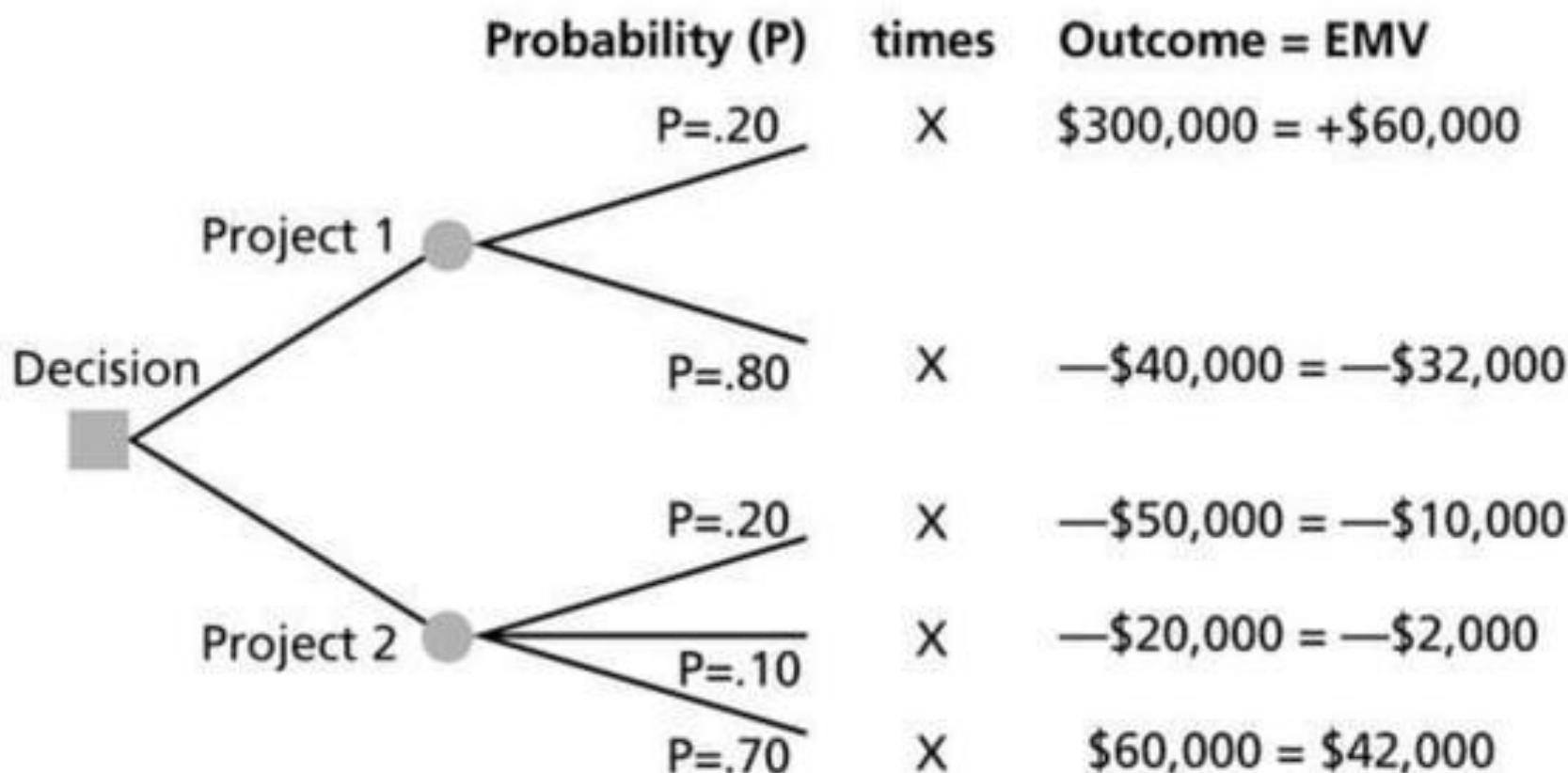
Quantitative Risk Analysis

- Often follows qualitative risk analysis, but both can be done together
- Large, complex projects involving leading edge technologies often require extensive quantitative risk analysis
- Main techniques include:
 - Decision tree analysis
 - Simulation
 - Sensitivity 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

Expected Monetary Value (EMV)



$$\text{Project 1's EMV} = \$60,000 - 32,000 = \$28,000$$

$$\text{Project 2's EMV} = -\$10,000 - 2,000 + 42,000 = \$30,000$$

Simulation

- Simulation uses a representation or model of a system to analyze the expected behavior or performance of the system
 - 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
- **Monte Carlo analysis** simulates a model's outcome many times to provide a statistical distribution of the calculated results
 - Predicts the probability of finishing by a certain date or that the cost will be equal to or less than a certain value

Steps of a Monte Carlo Analysis

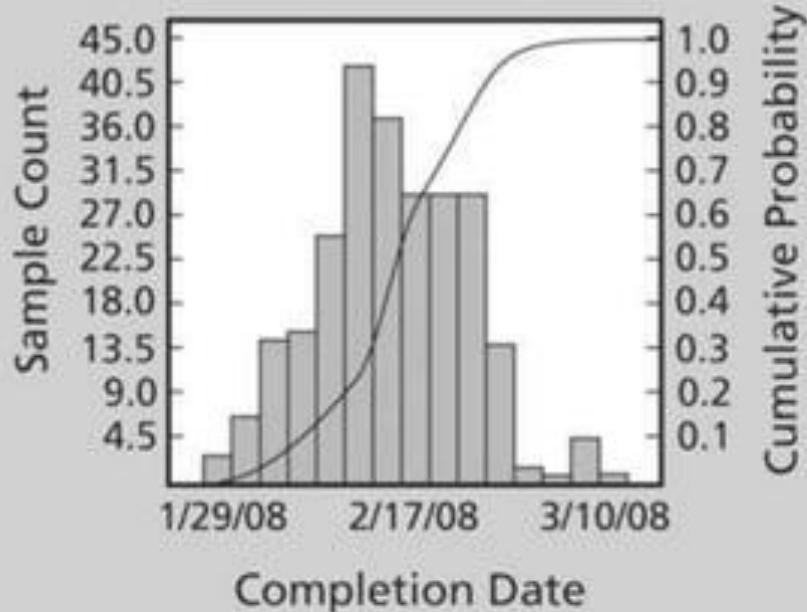
1. Assess the range for the variables being considered – gather most likely, optimistic and pessimistic time estimates for each task
2. Determine the probability distribution of each variable
 1. Optimistic 8 weeks, most likely 10 and pessimistic 15
3. For each variable, select a random value based on the probability distribution
 1. 20% chance between 8 and 10 weeks, 80% between 10 and 15
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 – usually between 100 to 1,000 iterations

Sample Monte Carlo Simulation Results for Project Schedule

Date: 1/14/08 11:13:56 AM
Number of Samples: 250
Unique ID: 1
Name: Widget

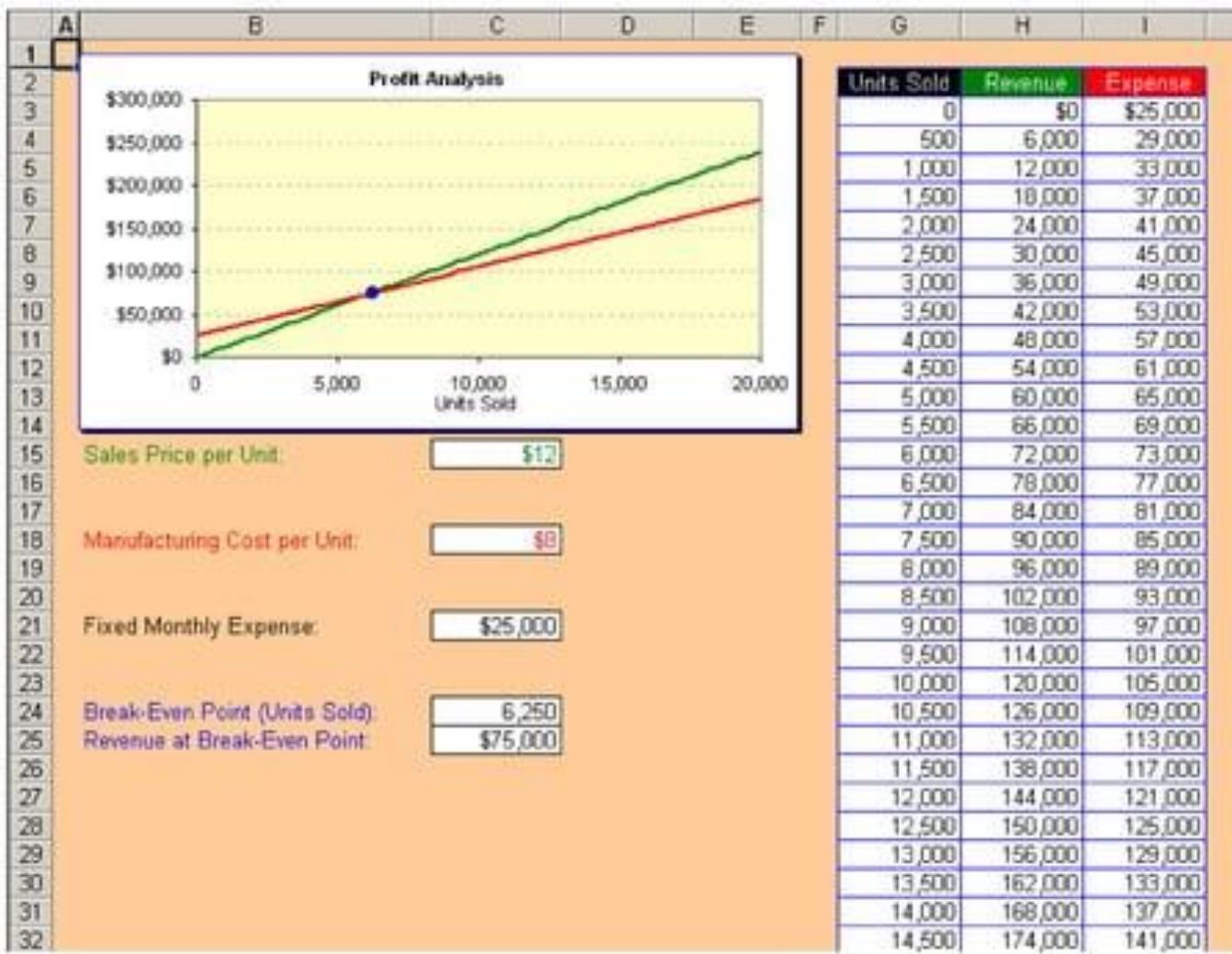
Completion Std Deviation: 5.2d
95% Confidence Interval: 0.6d
Each bar represents 2d

Completion Probability Table



Prob	Date	Prob	Date
0.05	2/4/08	0.55	2/17/08
0.10	2/8/08	0.60	2/18/08
0.15	2/9/08	0.65	2/19/08
0.20	2/10/08	0.70	2/22/08
0.25	2/11/08	0.75	2/22/08
0.30	2/12/08	0.80	2/23/08
0.35	2/15/08	0.85	2/24/08
0.40	2/15/08	0.90	2/25/08
0.45	2/16/08	0.95	2/26/08
0.50	2/17/08	1.00	3/10/08

Sample Sensitivity Analysis for Determining Break-Even Point



Risk Response Planning

- After identifying and quantifying risks, you must decide how to respond to them
- Four main response strategies for negative risks:
 - **Risk avoidance** – don't use h/w or s/w if unfamiliar with them
 - **Risk acceptance** – prepare for risk with backup plan or contingency reserves
 - **Risk transference** – to deal with financial risk exposure, a company may purchase special insurance for specific h/w needed for a project. If h/w fails, insurer has to replace it.
 - **Risk mitigation** – reduce probability of occurrence e.g., use proven technology, buy maintenance or service contract

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		

Response Strategies for Positive Risks

- Risk exploitation – do whatever you can to make sure the risk occurs, call press conference to advertise new product, take out ads, etc
- Risk sharing – allocating ownership of the risk to another party. Hire an outside firm to do your advertising and PR
- Risk enhancement – identify and maximize key drivers of the risk. Encourage your employees or users of your product to spread the word of your product
- Risk acceptance – don't take any action with regard to positive risk. Assume the product will speak for itself

Residual and Secondary Risks

- It's also important to identify residual and secondary risks
- **Residual risks** are risks that remain after all of the response strategies have been implemented
 - Even though used stable h/w platform, it still may fail
- **Secondary risks** are a direct result of implementing a risk response
 - Using stable h/w may have caused a risk of peripheral devices failing to function properly

Risk Monitoring and Control

- Involves executing the risk management process to respond to risk events
 - This is an ongoing activity – new risks identified, old risks disappear, weaken or get stronger
- **Workarounds** are unplanned responses to risk events that must be done when there are no contingency plans
- Main outputs of risk monitoring and control are:
 - Requested changes
 - Recommended corrective and preventive actions
 - Updates to the risk register, project management plan, and organizational process assets

Results of Good Project Risk Management

- Unlike crisis management, good project risk management often goes unnoticed
- Well-run projects appear to be almost effortless, but a lot of work goes into running a project well
- Project managers should strive to make their jobs look easy to reflect the results of well-run projects