PROJECT RISK MANAGEMENT

**DEFINITION OF A RISK OR RISK EVENT**: A discrete occurrence that may affect the project for good or bad.

**DEFINITION OF A PROBLEM OR UNCERTAINTY**: An uncommon state of nature, characterized by the absence of any information related to a desired outcome.

**RISK FACTORS**: When looking at risk, one should determine:

- The probability that it will occur (what)
- The range of possible outcomes (impact or amount at stake)
- Expected timing (when) in the project life cycle
- Anticipated frequency of risk events from that source (how often)

**RISK AVERSE**: Someone who does not want to take risks.

**RISK TOLERANCES**: The amount of risk that is acceptable (tolerance level). For example, a risk that affects our reputation will not be tolerated, or a risk of a two-week delay is okay.

**DEFINITION OF RISK MANAGEMENT**: The process involved with identifying, analyzing, and responding to risk.
INPUTS TO RISK MANAGEMENT: What is needed in order to begin the risk process.

<table>
<thead>
<tr>
<th>Project background information</th>
<th>Detailed information about the project, what other companies are doing, articles and other such information will help you identify more risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical information</td>
<td>Will tell you risks from past projects</td>
</tr>
<tr>
<td>Past lessons learned</td>
<td>Will tell you what past teams would do if they could do their projects again. Will help you identify, mitigate and manage risks on your project</td>
</tr>
<tr>
<td>Project charter</td>
<td>Helps you see if the overall project objectives are generally risky or not. Helps identify risks based on what is and what is not included</td>
</tr>
<tr>
<td>Scope statement</td>
<td>Tells you the complexity of the project and helps you compare your team’s knowledge and experience to what is required</td>
</tr>
<tr>
<td>Team</td>
<td>The project manager cannot identify all the risks alone. A group approach and the ability to split up risk management activities make the risk management process more accurate and timely.</td>
</tr>
<tr>
<td>Stakeholders</td>
<td>They will be able to see risks that the team cannot. Their involvement helps continue proper stakeholder management</td>
</tr>
<tr>
<td>WBS</td>
<td>Risks are identified by task as well as by project</td>
</tr>
<tr>
<td>Network diagram</td>
<td>Shows path convergence (where paths converge) and thus helps to better analyze the risks of each task</td>
</tr>
<tr>
<td>Cost and time estimates</td>
<td>High-level time and cost requirements help identify time and cost risk.</td>
</tr>
<tr>
<td>Staffing plan</td>
<td>Helps you understand what resources are available</td>
</tr>
<tr>
<td>Organizational policies and templates</td>
<td>Provide a foundation or standardization for your risk activities</td>
</tr>
<tr>
<td>Procurement plan</td>
<td>There is a strong connection between contracts (or procurement) and risk. One of the ways to mitigate risk may be to have certain terms and conditions added to a contract or to have the entire risky work outsourced. You would give it to someone for whom it is less risky, and thus less costly.</td>
</tr>
<tr>
<td>Stakeholder risk tolerances</td>
<td>Knowing where and how much risk tolerance stakeholders have helps identify the impact of risks and which risk mitigation techniques you would use</td>
</tr>
</tbody>
</table>

RISK MANAGEMENT PROCESS: This is an important topic. The risk management process includes six steps:

1. Risk Management Planning
2. Risk Identification
3. Qualitative Risk Analysis
4. Quantitative Risk Analysis
5. Risk Response Planning
6. Risk Monitoring and Control
**STEP 1: RISK MANAGEMENT PLANNING:** Defined as “deciding how to approach and plan the risk management activities for a project.” The project manager, team, customer, stakeholders, experts and others will review any templates and procedures that exist for risk management, determine how risk management will be handled on the current project and develop the risk management plan. Therefore, risk management should be adjusted to the size, complexity, experience, skill level, etc., of the project and not done with just a standardized checklist.

**RISK MANAGEMENT PLAN:** Defines how the risk process will be structured and performed during the project life cycle.

A risk management plan includes the following:

- Methodology
- Roles and responsibilities- non-team members may be included
- Budgeting for the risk management process
- Timing- how often the risk process will be performed throughout the project
- Scoring and interpretation
- Thresholds – a method to determine which risks will and will not be acted upon
- Reporting formats
- Tracking

Because a risk management plan contains budget and schedules, it is an *input* to schedule development and cost budgeting.

**OUTPUTS FROM RISK PLANNING:**
- Risk management plan- described above

**STEP 2: RISK IDENTIFICATION:** Defined as determining which risks might affect the project and documenting their characteristics. All stakeholders as well as experts from other parts of the company or outside the company may be involved in identifying risks. Sometimes, the core team will begin the process and then the other members will become involved, making risk identification an iterative process.

Smart project managers begin looking for risks as soon as a project is first discussed. However, the major risk identification effort occurs during planning. Risk identification cannot be completed until a WBS has been created and the project team knows “what is the project.” Because risk identification can occur during the initiation and planning
phases, it is often said that risk identification happens at the *onset* of the project. Risks may be identified at the beginning of the project, during each project phase and before approval of a major scope change. Risks may also be identified during all phases of the project including initiating, planning, executing, controlling and closing. In other words, although the major risk identification effort occurs at the onset of the project, risks should continue to be identified throughout the project.

*RISK CATEGORIES*: Risk categories are lists of common categories of risk (sources of risk) experienced by the company or on similar projects. Such a list may be an input to risk identification, but using such a list of categories is not the entire risk identification process. The categories help analyze and identify risks on each project.

* *See Additional Handout*

There are many ways to classify or categorize risk:

- Technical, quality or performance risks
- Project management risks
- Organizational risks
- External risks

A prior version of the *PMBOK* included another way to classify risks.

- **External**- Regulatory, environmental, government, market shifts
- **Internal**- Time, cost, unforeseen conditions, scope changes, inexperience, poor planning, people, staffing, materials, equipment
- **Technical**- Changes in technology
- **Unforeseeable**- Only a small portion of risks (some say about 10%) are actually unforeseeable
If you look at categories of risks as “where do risks come from,” sources of risks might be different than the list above. Below are some examples of risk.

- **Schedule risk** – “The hardware will arrive later than planned causing a delay in task XYZ of three days.”

- **Cost risk** – “Because the hardware will arrive later than planned, we may need to extend our lease on the staging area at a cost of $20,000.”

- **Quality risk** – “The concrete may not dry before winter weather sets in causing us to not meet our quality standard of concrete strength.”

- **Performance or scope of work risk** – “We might not have correctly defined the scope of work for the computer installation. If that proves true we will have to add tasks at a cost of $20,000.”

- **Resource risk** – “Dave is such an excellent designer that he may be called away to work on a new project. This will result in our schedule slipping between 100 to 275 hours.”

- **Customer satisfaction (stakeholder satisfaction) risk** – “There is a chance that the customer will not be happy with the XYZ deliverable and not tell us, causing at least a 20% increase in communication problems.”

**INFORMATION-GATHERING TECHNIQUES**

Below are several methods to identify risk:

- **Brainstorming**: Usually done in a meeting where one idea helps generate another

- **Delphi technique**: a multi-session data gathering technique

- **Interviewing**: Also called expert interviewing on the exam and consists of the team or project manager interviewing an expert to identify risks on the project or a specific element of work

- **Strengths, weaknesses, opportunities and threats analysis**: An analysis that looks at the project to identify its strengths, etc. and thereby identify risks.
TYPES OF RISK: Risks can be classified under two main types:

1. Business – Risk of a gain or loss

2. Pure (insurable) Risk – Only a risk of loss (e.g. fire, theft, personal injury)

OUTPUTS FROM RISK IDENTIFICATION

- **Risks**
- Risk Triggers – *warnings signs or alerts*. A project manager should determine what are the early warning signs (indirect manifestations of actual risk events) for each risk on a project so that they will understand when to take action.

STEP 3: **QUALITATIVE RISK ANALYSIS**: Is a subjective analysis of risks to:

- Determine which risk events warrant a response
- Determine the probability and impact of all risks identified in step 2, in a subjective manner
- Determine which risks to analyze more fully in risk quantification or to skip risk quantification in favor of going directly to risk response planning. (This decision depends on many factors, including the importance of the project and the potential effect of the project on the performing organization.)
- Document non-critical, or non-top risks
- Determine the overall ranking of the project

PROBABILITY AND IMPACT: One of the ways to help rank risks is to analyze the probability of a risk occurring and the effect (or impact or consequences) of the risk on the project.

- Determine the probability of each risk occurring – usually in the form of taking an educated guess (e.g. Low, Medium, High or 1 to 10)
- Determine the consequences (amount at stake, or impact) of each risk occurring – in the form of taking an educated guess (e.g., Low, Medium, High, or 1 to 10)

**ASSUMPTION TESTING**: or what assumptions have been made. Before the project manager can use the risk information collected, assumptions made must be identified and tested. Too many unknown guesses make the data unreliable. Remember an assumption is: “What are we taking for granted?”

**DATA PRECISION RANKINGS**: How well is the risk understood? What is the extent of the understanding of the risk?

- Data available about the risk
- Quality of the data
- Reliability and integrity of the data

**RISK RATING MATRIX**: In order to sort or rate risks so determination can be made as to which risks will move on through the risk process, a risk rating matrix may be used. Such a matrix results in a consistent evaluation of low, medium, or high (or some other scale) for the project and for all projects, an improvement in the quality of the data, and the risk process being more repeatable between projects.

**OUTPUTS FROM QUALITATIVE RISK ANALYSIS**: The results of qualitative analysis of the risk of a project may include:

- Risk rating for the project
- List of prioritized risks
- List of risks created for additional analysis in risk quantification or risk response planning
- Non-critical or non-top risks documented for later revisiting during risk monitoring and control
Risk Qualification provides information so that:

- The project can be compared to the overall risks of other projects
- The project could be selected, continued or terminated
- Resources could be moved between projects
- A full benefit/cost analysis of the project may be able to be completed
- Trends in project risk identified if risk qualification is repeated

**STEP 4: QUANTITATIVE RISK ANALYSIS**: Is a numerical analysis of the probability and consequences (amount at stake or impacts) of the highest risks on the project to:

- Determine which risk events warrant a response
- Determine overall project risk (risk exposure)
- Determine the quantified probability of meeting project objectives – e.g. “We only have an 80% change of completing the project within the six months required by the customer: to “We only have 75% change of completing the project within the $80,000 budget.”
- Determine cost and schedule reserves
- Identify risks requiring the most attention
- Create realistic and achievable cost, schedule or scope targets

Risk quantification involves the following activities:

- Further investigation into the highest risks on the project
- Determine the type of probability distribution that will be used – e.g. triangular, normal, beta, uniform, or log normal distributions
- Interviewing experts
• Sensitivity analysis – determining which risks have the most impact on the project

• Monte Carlo simulation (simulation) – described later

• Decision tree analysis – described later

**EXPECTED MONETARY VALUE (OR EXPECTED VALUE):** The product of two numbers, probability and consequences (impact or the amount at stake). Questions can ask, “What is expected value of a task or of a series of tasks?”

Expected value questions can also be asked in conjunction with decision trees.

**EXERCISE:** Test yourself! Complete the following chart.

<table>
<thead>
<tr>
<th>Task</th>
<th>Probability</th>
<th>Consequences</th>
<th>Expected Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10%</td>
<td>$20,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>B</td>
<td>30%</td>
<td>$45,000</td>
<td>$13,500</td>
</tr>
<tr>
<td>C</td>
<td>68%</td>
<td>$18,000</td>
<td>$12,240</td>
</tr>
</tbody>
</table>

**DECISION TREE:** Know the following:

• A decision tree takes into account future events in trying to make a decision today.

• It calculated the expected value (probability times consequences) in more complex situations than the expected value previously presented

• It involves mutual exclusivity
**EXERCISE**: A company is trying to determine if prototyping is worthwhile on the project. They have come up with the following consequences of whether the equipment works or fails when it is used. Based on the information provided below, what is the expected value of your decision?

- **Prototype**:
  - Setup cost $200,000
  - Failure: 35% probability and $120,000 impact
  - Pass: no impact

- **Do Not Prototype**:
  - Setup cost $0
  - Pass: no impact
  - Failure: 70% probability and $450,000 impact

- **Decision**: if one just looks at the setup cost of prototyping, it would seem like an unwise decision to spend money on prototyping. However, the analysis proves differently. Taking into account only one failure, the decision is that it would be cheaper to do the prototyping. The answer is $242,000, or to prototype.

<table>
<thead>
<tr>
<th>Option</th>
<th>Probability</th>
<th>Impact</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prototype</td>
<td>35%</td>
<td>$120,000</td>
<td>$242,000</td>
</tr>
<tr>
<td>Do not prototype</td>
<td>70%</td>
<td>$450,000</td>
<td>$315,000</td>
</tr>
</tbody>
</table>
**MONTE CARLO SIMULATION**: this simulation “performs” the project many times, uses the network diagram, and estimates to simulate the cost or schedule results of the project.

**Monte Carlo Simulation:**

- Evaluates the project, not the tasks
- Provides the probability of completing the project on any specific day, or for any specific amount of cost
- Provides the probability of any task actually being on the critical path
- Provides a percent probability that each task will be on the critical path
- Takes into account path convergence (places in the network diagram where many paths converge into one task)
- Translates uncertainties into impacts to the total project
- Can be used to assess cost and schedule impacts
- Is usually done with a computer-based Monte Carlo program because of the intricacies of the calculations
- Results in a probability distribution

**OUTPUTS FROM QUANTITATIVE RISK ANALYSIS**: When completed, quantitative risk analysis results in:

- A prioritized list of quantified risks
- Forecasts of potential project costs or schedule
- A listing of the possible project completion dates and costs with their confidence levels
- A probability of achieving the required project cost or schedule objectives
- Trends in risk as risk qualification is repeated through the project
- A documented list of non-critical, non-top risks
**Step 5: RISK RESPONSE PLANNING:** This step involves figuring out - What are we going to do about it? It involves finding ways to make the negative risk smaller or eliminate it entirely, as well as finding ways to make positive risks more likely or greater in impact. All risk on a project cannot be eliminated. During this step:

- Strategies are agreed upon in advance by all parties
- Primary and backup strategies are selected
- Risks are assigned to individuals or groups to take responsibility
- Strategies are reviewed over the life of the project for appropriateness as more information about the project becomes known

**RISK OWNER:** Each risk must be assigned to someone who will help develop the risk response and who will be assigned to carry it out or “own” the risk. The risk owner is then free to take predetermined action when risks occur, resulting in faster action and less cost, time and other impacts on the project.

**RISK RESPONSE STRATEGIES:** developing options and determining actions to enhance opportunities and reduce threats. This may involve changing the planned approach to completing the project – e.g. changing to the WBS, quality plan, schedule and budget. These strategies cannot eliminate all risk. In each case, communication of risks and strategies is necessary as apart of the strategy.

The choices include:

- **AVOIDANCE** – eliminate the threat by eliminating the cause
- **MITIGATION** - reduce the probability or the consequences of an adverse risk and increase the probability or consequences of an opportunity
- **ACCEPTANCE** – Do nothing and say, “if it happens, it happens” Active acceptance may involve the creation of contingency plans and passive acceptance may leave actions to be determined as needed. A decision to accept a risk must be communicated to stakeholders.
• TRANSFERENCE (DEFLECTION, ALLOCATION): Make another party responsible for the risk through purchasing of insurance, performance bonds, warranties, guarantees or outsourcing the work. Here is where the strong connection between risk and procurement (or contracts) begins. One must complete risk assessment before a contract can be signed! Transference of risk is included in the terms and conditions of the contract.

When selecting risk strategies, it is important to remember:

• Strategies must be timely

• The effort selected must be appropriate to the severity of the risk – avoid spending more money preventing the risk than the impact of the risk would cost if it occurred

• One response can be used to address more than one risk

• Involve the team, stakeholders and experts in selecting a strategy

<table>
<thead>
<tr>
<th>Description of strategy</th>
<th>Name of risk response strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove a task from the project</td>
<td>Avoidance</td>
</tr>
<tr>
<td>Assign a team member to visit the seller’s manufacturing facilities frequently to learn about a problem with delivery as early as possible</td>
<td>Mitigation of the impact</td>
</tr>
<tr>
<td>Notify management that there would be a major increase if a risk occurs because no action is being taken to prevent the risk</td>
<td>Acceptance</td>
</tr>
<tr>
<td>Remove a troublesome resource from the project</td>
<td>Avoidance</td>
</tr>
<tr>
<td>Provide a team member who is less experienced with additional training</td>
<td>Mitigation of the probability</td>
</tr>
<tr>
<td>Train the team on conflict resolution strategies</td>
<td>Mitigation of the impact</td>
</tr>
<tr>
<td>Outsource difficult work to a more experienced company</td>
<td>Transference</td>
</tr>
<tr>
<td>Ask the client to handle some of the work</td>
<td>Transference</td>
</tr>
<tr>
<td>Decide to prototype a risky piece of equipment</td>
<td>Mitigation of the probability</td>
</tr>
</tbody>
</table>
OUTPUTS FROM RISK RESPONSE PLANNING

**INSURANCE**: a response to certain risks such as fire, property, or personal injury (e.g. pure risks) is to purchase insurance. Insurance exchanges an unknown risk for a known risk because the consequences of the risk are known.

**CONTRACTING**: hiring someone outside your company to complete the work when it would decrease project risk. NOTE: you cannot remove all the risk from a project by sub-contracting. For example, if there is a risk of damage in transport for a project component, hiring someone else to do the transportation will not make the move risk-free.

**RESIDUAL RISK**: some risks will remain after risk mitigation or risk response planning. Though these risks may have been accepted, they should be properly documented and revised through the project. What was thought of as an acceptable risk during planning may not have the same ranking during executing.

**SECONDARY RISKS**: Included in risk response planning should be an analysis of the new risks created by the risk response strategies selected. Frequently, what is done to mitigate one risk will cause other risks to occur. For example, a risk of fire can be allocated to an insurance company but also cause risk of cash flow problems. Cash flow should then be analyzed.

**CONTINGENCY PLANNING**: Planning the specific actions that will be taken if a risk event occurs. These plans can be put in place later, if needed, without meetings or increased impact to the project caused by delayed actions.

**FALLBACK PLANNING**: specific actions that will be taken if the contingency plan is not effective.

**RISK RESPONSE PLAN**: A written document that captures the risks you identified and what you plan to do about them. The project manager should also record non-critical risks so that they can easily be revisited during the execution phase.

**REVISED PROJECT PLAN**: The efforts spent in risk management will result in changes to the project plan. Tasks could be added, removed, or assigned to different resources. This, planning is an iterative process.
**RESERVES**: Formulating the amount of time or cost that needs to be added to the project to account for risk. These are sometimes called management reserves (to account for “unknown unknowns” items you did not or could not identify in risk management) and contingency reserves (to account for “known unknowns” items you did identify in risk management). Reserves should be managed and guarded throughout the project life cycle.

**Exercise**: You are planning the manufacture of an existing product modification. Your analysis has come up with the following. What is the cost reserve that you would use?

- 30% probability of a delay in the receipt of parts with a cost to the project of $9,000
- 20% probability that the parts will be $10,000 cheaper than expected
- 25% probability that two parts will not fit together when installed, costing an extra $3,500
- 30% probability that the manufacture may be simpler than expected, saving $2,500
- 5% probability of a design defect causing $5,000 of rework

<table>
<thead>
<tr>
<th>Probability</th>
<th>Event Description</th>
<th>Cost Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>Delay in receipt of parts</td>
<td>+$2,700</td>
</tr>
<tr>
<td>20%</td>
<td>Parts cheaper than expected</td>
<td>-$2,000</td>
</tr>
<tr>
<td>25%</td>
<td>Parts will not fit together</td>
<td>+$875</td>
</tr>
<tr>
<td>30%</td>
<td>Manufacture may be simpler</td>
<td>-$750</td>
</tr>
<tr>
<td>5%</td>
<td>Design defect</td>
<td>+$250</td>
</tr>
</tbody>
</table>

**TOTAL** | **$1,075**

**Important Concepts or Questions to ask**:


- Would you select only one risk response strategy? **Answer**: no, you can choose a combination of choices.

- What risk management activities are done during the executing phase of the project? **Answer**: watching out for non-critical risks that become more important.

- What is the most important item to address in project team meetings? **Answer**: Risk.
How would risks be addressed in project meetings? **Answer:** By asking, “what is the status of risks? Any new risks? Any change to the order of importance?”

**STEP 6: RISK MONITORING AND CONTROL:** This step involves managing the project according to the risk responses plan and may include the following activities:

- Keeping track of the identified risks
- Implementing risk responses
- Looking for the occurrence of risk triggers
- Monitoring residual risks
- Identifying new risks
- Ensuring the execution of risk plans
- Evaluating the effectiveness of risk plans
- Developing new risk responses
- Communicating risk status and collecting risk status data
- Communicating with stakeholders about risks
- Determining if assumptions are still valid
- Revisiting low ranking or non-critical risks to see if risk responses need to be determined
- Taking corrective action to adjust to the severity of actual risk events
- Looking for any unexpected effects or consequences of risk events
- Re-evaluating risk identification, qualification and quantification when the project deviates from the project baseline
- Updating risk plans
• Making changes to the project plan when new risk responses are developed
• Creating a database of risk data that may be used throughout the organization on other projects

CONTINGENCY PLANS: planned responses to risks, or putting in place the contingency plans set up during risk response planning.

RISK RESPONSE AUDITS: examining and documenting the effectiveness of the risk response and the person managing (owning) the risk. This is an important step in order to see if the plans put in place are effective and if changes are needed.

RISK REVIEWS: Risk should be a major topic at team meetings to keep focus on risks and make sure plans remain appropriate. Remember that a result of such reviews may be additional risk analysis or qualification and quantification.

OUTPUTS FROM RISK MONITORING AND CONTROL

• Workarounds: Unplanned responses to risks, or dealing with risks that you could not or did not anticipate. Which do you think are more frequent, contingency plans or workarounds? Most project managers will say workarounds because that has been the projects manager’s experience. In fact, with proper risk management, workarounds become less frequent than contingency plans.

• Corrective actions -

• Changes to the project – it is important to realize that the risk management process will change the project plan during planning and during executing.

• Updates to the risk response plan – it is wise to always re-evaluate whether the plans need any correcting or adjusting after each unidentified or identified risk occurs.

• Other updates - to risk database, checklists, etc.