

SUBJECT

# RISK ANALYSIS

**SESSION 1** What is risk analysis?

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## **What is risk analysis?**

Risk analysis is the process of defining and analyzing the dangers to individuals, businesses, and government agencies posed by potential natural and human-caused adverse events.

Risk analysis is the process of defining and analyzing the dangers to individuals, businesses and government agencies posed by potential natural and human-caused adverse events. In IT, a risk analysis report can be used to align technology-related objectives with a company's business objectives. A risk analysis report can be either quantitative or qualitative.

In quantitative risk analysis, an attempt is made to numerically determine the probabilities of various adverse events and the likely extent of the losses if a particular event takes place.

Qualitative risk analysis, which is used more often, does not involve numerical probabilities or predictions of loss. Instead, the qualitative method involves defining the various threats, determining the extent of vulnerabilities and devising countermeasures should an attack occur.

## **Risk Analysis Techniques**

### **Risk Analysis Techniques**

#### **1. Brainstorming**

Is used extensively in formative project planning and can also be used to advantage to identify and postulate risk scenarios for a particular project. It is a simple but effective attempt to help people think creatively in a group setting without feeling inhibited or being criticized by others.

The rules are that each member must try to build on the ideas offered by preceding comments. No criticism or disapproving verbal or nonverbal behaviors are allowed. The intent is to encourage as many ideas as possible, which may in turn, trigger the ideas of others.

## **2. Sensitivity Analysis**

Sensitivity analysis seeks to place a value on the effect of change of a single variable within a project by analyzing that effect on the project plan. It is the simplest form of risk analysis. Uncertainty and risk are reflected by defining a likely range of variation for each component of the original base case estimate. In practice such an analysis is only done for those variables which have a high impact on cost, time or economic return, and to which the project is most sensitive.

Some of the advantages of sensitivity analysis include impressing management that there is a range of possible outcomes, decision making is more realistic, though perhaps more complex. And the relative importance of each variable examined is readily apparent. Some weaknesses are that variables are treated individually, limiting the extent to which combinations of variables can be assessed, and a sensitivity diagram gives no indication of anticipated probability of occurrence.

## **3. Probability Analysis**

Probability analysis overcomes the limitations of sensitivity analysis by specifying a probability distribution for each variable, and then considering situations where any or all of these variables can be changed at the same time. Defining the probability of occurrence of any specific variable may be quite difficult, particularly as political or commercial environments can change quite rapidly.

As with sensitivity analysis, the range of variation is subjective, but ranges for many time and cost elements of a project estimate should be skewed toward overrun, due to the natural optimism or omission of the estimator.

## **4. Delphi Method**

The basic concept is to derive a consensus using a panel of experts to arrive at a convergent solution to a specific problem. This is particularly useful in arriving at probability assessments relating to future events where the risk impacts are large and critical. The first and vital step is to select a panel of individuals who have experience in the area at issue. For best results, the panel members should not know each other identity and the process should be conducted with each at separate locations.

The responses, together with opinions and justifications, are evaluated and statistical feedback is furnished to each panel member in the next iteration.

The process is continued until group responses converge to a specific solution.

## **5. Monte Carlo**

The Monte Carlo method, simulation by means of random numbers, provides a powerful yet simple method of incorporating probabilistic data. Basic steps are:

- a. Assess the range of the variables being considered and determine the probability distribution most suited to each.
- b. For each variable within its specific range, select a value randomly chosen, taking account of the probability distribution for the occurrence of the variable.
- c. Run a deterministic analysis using the combination of values selected for each one of the variables.
- d. Repeat steps 2 and 3 a number of times to obtain the probability distribution of the result. Typically between 100 and 1000 iterations are required depending on the number of variables and the degree of confidence required.

## **6. Decision Tree Analysis**

A feature of project work is that a number of options are typically available in the course of reaching the final results. An advantage of decision tree analysis is that it forces consideration of the probability of each outcome. Thus, the likelihood of failure is quantified and some value is placed on each decision. This form of risk analysis is usually applied to cost and time considerations, both in choosing between different early investment decisions, and later in considering major changes with uncertain outcomes during project implementation.

## **7. Utility Theory**

Utility theory endeavors to formalize management's attitude towards risk, an approach that is appropriate to decision tree analysis for the calculation of expected values, and also for the assessment of results from sensitivity and probability analyses. However, in practical project work Utility Theory tends to be viewed as rather theoretical.

## **8. Decision Theory**

Is a technique for assisting in reaching decisions under uncertainty and risk. All decisions are based to some extent on uncertain forecasts. Given the criteria selected by the decision-maker, Decision Theory points to the best possible course whether or not the forecasts are accurate.

## **The Quality Risk**

This risk can best be expressed by the question: "What if the project fails to perform as expected during its operational life?" This may well be the result of less than satisfactory quality upon project completion, and is especially true if quality is not given due attention during the project life cycle. Since the in-service life of the resulting product is typically much longer than the period required to plan and produce that product, any quality shortcomings and their effects may surface over a prolonged period of time.

Consequently, of all the project objectives, conformance to quality requirement is the one most remembered long after cost and schedule performance have faded into the past. It follows that quality management can have the most impact on the long-term actual or perceived success of the project.

## **Risk Perceptions**

1. People do not, in fact, demand zero risk. They take risk every day, both consciously and subconsciously, and they are willing and able to take benefit/risk decisions, as in driving and speeding.
2. Peoples' judgment of degrees of risk is not, however, coincident with most methodologies for measuring risk statistically. The public may greatly underestimate familiar risks (e.g. driving) while greatly overestimating unfamiliar risks (e.g. buying a home near a nuclear facility).
3. A variety of emotional, not logical, factors control risk perceptions:
  - a. Primary is the sense of personal control and the ability to manage the risk
  - b. Secondary are qualities of familiarity and conversely, dread. The greater the unfamiliarity and potential for connection to gruesome, the more it is likely to be judged as highly risky and therefore unacceptable.
4. Once established, risk perceptions are extremely hard to change. New information may be absorbed by the intellect, but it is not readily absorbed at an emotional level.
5. Risk perceptions reside fundamentally at an emotional level.

## **Project Risk Qualitative Analysis**

There are two cycles of analysis that can be done on risks after they have been identified before Risk Planning occurs. The first is Qualitative Risk Analysis which includes methods for prioritizing the identified risks for further action, such as Quantitative Risk Analysis or Risk Response Planning. Organizations can improve the project's performance effectively by focusing on high-priority risks.

Qualitative Risk Analysis assesses the priority of identified risks using their probability of occurring, the corresponding impact on project objectives if the risks do occur, as well as other factors such as the time frame and risk tolerance of the project constraints of cost, schedule, scope, and quality. Stakeholder risk tolerances must be taken into account in this phase. Everyone knows that if you change one side of the triple constraint triangle (cost, schedule and scope/quality), then one of the other factors change. For example, if you add to the scope, either cost (hiring more engineers) or schedule will change. As the Project Manager, it is vital that you know which one of these factors drive the Stakeholders. It may be time to market (schedule), cost or functionality (scope/quality).

Definitions of the levels of probability and impact, and expert interviewing, can help to correct biases that are often present in the data used in this process. The time criticality of risk-related actions may magnify the importance of a risk. An evaluation of the quality of the available information on project risks also helps understand the assessment of the risk's importance to the project.

Qualitative Risk Analysis is usually a rapid and cost-effective means of establishing priorities for Risk Response Planning, and lays the foundation for Quantitative Risk Analysis (a much more rigorous and expensive process) if this is required. Qualitative Risk Analysis should be revisited during the project's life cycle to stay current with changes in the project risks.

Qualitative Risk Analysis requires outputs of the Risk Management Planning and Risk Identification processes. This process can lead into Quantitative Risk Analysis or directly into Risk Response Planning.

### **Risk Probability and Impact Assessment**

Risk probability assessment investigates the likelihood that each specific risk will occur. Risk impact assessment investigates the potential effect on a project

objective such as time, cost, scope, or quality, including both negative effects for threats and positive effects for opportunities.

Probability and impact are assessed for each identified risk. Risks can be assessed in interviews or meetings with participants selected for their familiarity with the risk categories on the agenda. Project team members and, perhaps, knowledgeable persons from outside the project, are included. Expert judgment is required, since there may be little information on risks from the organization's database of past projects. Using outside experts to help in the assessment is very helpful since they are experts and they are not as biased as the project team. I have found this technique to be very useful.

The level of probability for each risk and its impact on each objective is evaluated during the interview or meeting. Explanatory detail, including assumptions justifying the levels assigned, is also recorded. Risk probabilities and impacts are rated according to the definitions given in the risk management plan. Sometimes, risks with obviously low ratings of probability and impact will not be rated, but will be included on a watch-list for future monitoring.

### **Probability and Impact Matrix**

Risks can be prioritized for further quantitative analysis and response, based on their risk rating. Ratings are assigned to risks based on their assessed probability and impact. Evaluation of each risk's importance and, hence, priority for attention is typically conducted using a look-up table or a probability and impact matrix. Such a matrix specifies combinations of probability and impact that lead to rating the risks as low, moderate, or high priority.

Descriptive terms or numeric values can be used, depending on organizational preference. The organization should determine which combinations of probability and impact result in a classification of high risk, moderate risk and low risk.

Usually, these risk rating rules are specified by the organization in advance of the project, and included in organizational process assets. Risk rating rules can be tailored in the Risk Management Planning process to the specific project.

An organization can rate a risk separately for each objective (e.g., cost, time, and scope). In addition, it can develop ways to determine one overall rating for each risk. Finally, opportunities and threats can be handled in the same matrix using definitions of the different levels of impact that are appropriate for each.

The risk score helps guide risk responses. For example, risks that have a negative impact on objectives if they occur (threats), and that are in the high-risk zone of the matrix, may require priority action and aggressive response strategies. Threats in the low-risk zone may not require proactive management action beyond being placed on a watch list or adding a contingency reserve.

Similarly for opportunities, those in the high-risk zone that can be obtained most easily and offer the greatest benefit should, therefore, be targeted first. Opportunities in the low-risk zone should be monitored. Earned Monetary Value (EMV) is a good technique to use here.

### **Risk Data Quality Assessment**

A qualitative risk analysis requires accurate and unbiased data if it is to be credible. Analysis of the quality of risk data is a technique to evaluate the degree to which the data about risks is useful for risk management. It involves examining the degree to which the risk is understood and the accuracy, quality, reliability, and integrity of the data about the risk.

The use of low-quality risk data may lead to a qualitative risk analysis of little use to the project. If data quality is unacceptable, it may be necessary to gather better data.

### **Risk Categorization**



Risks to the project can be categorized by sources of risk (e.g., using the RBS), the area of the project affected (e.g., using the WBS), or other useful category (e.g., project phase) to determine areas of the project most exposed to the effects of uncertainty. Grouping risks by common root causes can lead to developing effective risk responses.

### **Risk Urgency Assessment**

Risks requiring near-term responses may be considered more urgent to address. Indicators of priority can include time to affect a risk response, symptoms and warning signs, and the risk rating.

### **Inputs**

Risk Management Plan  
Cost Management Plan  
Schedule Management Plan  
Risk Register  
Enterprise Environmental Factors  
Organizational Process Assets

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### **Tools**

Data Gathering and Representation Techniques  
Quantitative Risk Analysis and Modeling Techniques  
Modeling and Simulation  
Expert judgement

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### **Data Gathering and Representation Techniques**

Interviewing- create pessimistic, optimistic, realistic values  
Probability Distributions - show probability of event occurring

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### **Quantitative Risk Analysis and Modeling Techniques**

Sensitivity Analysis- how sensitive project to risk? TORANDO DIAGRAMS  
EVM- Expected Monetary Value Analysis

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### **EVM - Expected Monetary Value**

Assigns a most likely MONETARY value. Use DECISION TREES

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### **Modeling and Simulation**

Monte Carlo Analysis also used in Time Management

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### **Outputs**

Project Document Updates

### **What is the risk management process?**

1. Establish Objectives
2. Identify Loss Exposure
3. Measure Loss Exposure
4. Develop Plan
5. Implement Plan
6. Regularly Review Plan

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### **With which of the following insurance policies do most people insure their real and personal property?**

Most people insure their real and personal property with a homeowner's insurance policy. This policy also provides some extra living expense and liability coverage, and can be quite flexible when endorsements for special situations are attached to the basic policy.

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**The question of whether or not an individual has acted reasonably is usually a question of \_\_\_\_\_.**

The question of whether or not an individual has acted reasonably is usually a question of fact. Violating the reasonable person standard can result in a court imposing legal liability for a person's direct acts or omissions of actions.

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### **What plays an important role in risk management?**

1. Loss prevention
2. Risk avoidance
3. Loss reduction

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### **What will insurance companies pay for rebuilding at the same location?**

Replacement cost with no deduction for depreciation.

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### **What will insurance companies pay if no rebuilding is done?**

Actual cash value of the loss.

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### **What are two problems firms face with international operations?**

1. Valuation of property in foreign countries may prove to be a problem due to currency fluctuations.
2. Lack of local insurance facilities.

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### **What are the three steps in estimating income lost?**

1. Expected and Post-loss Income
2. Potential Income Loss
3. Estimated Income Loss

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### **What are the types of liability losses?**

1. Workers compensation
2. Product liability
3. Environmental impairment liability
4. Employment practices liability

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### **What is workers compensation?**

Claims arise from injury to a firm's employees while they are at work.

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### **What is product liability?**

Occurs when a firm's products allegedly injure the public.

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### **What is environmental impairment liability?**

Arises from violating federal or state statutes designed to protect the environment, or from lawsuits from parties claiming injury caused by a firm's improper handling of toxic substances.

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### **What is employment practices liability?**

Describes the loss potential arising from lawsuits from employees or job applicants alleging wrongful hiring, promotion, demotion, termination, and sexual harassment.

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### **What is maximum possible loss?**

Total financial harm a loss could cause under worst circumstances.

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### **What is maximum probable loss?**

Maximum damage a peril might cause under average circumstances.

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### **What are the various federal environmental protection acts?**

1. Superfund
2. Superfund (Amendment of 1986)
3. Clean Air Act (Amended in 1990)
4. Water Pollution Control Act
5. Environmental Protection Act (EPA)

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### **What is a flow chart?**

1. A graphical representation of processes
2. Represents the production and distribution process
3. Helps reveal the consequential impact of losses

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### **Direct losses typically lead to what?**

Indirect losses.

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### **What is criminal act?**

State and federal laws define it as a wrong against society.

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### **What is a tort?**

Involves unreasonable conduct towards another person.

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### **What is negligence?**

Doing something a reasonable person would not do, resulting in injury to another person.

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**Assume three parties - Alex, Jake, and Michael - are responsible for injuring Janet. Alex's actions contributed 10 percent to Janet's injuries. Michael's actions contributed 40 percent to Janet's injuries. Jake and Michael have no assets to compensate Janet. Under the rule of joint and several liability, who will have to pay the claim?**

Alex will have to pay the claim because Jake and Michael have no assets to compensate Janet.

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**In some cases, a court will allow a plaintiff recovery for compensatory damages and \_\_\_\_\_.**

Punitive damages.

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**What are the categories of loss?**

1. Bodily injuries
2. Personal injuries
3. Property damages

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**What is bodily injuries?**

Wages lost while the plaintiff was recovering from an injury.

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**What is personal injury?**

Suffered when a person is deprived of his or her rights.

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**What is property damages?**

Destruction and loss of use of tangible personal property.

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**For recovery under the comparative negligence rule, assume the plaintiff, Moe D'Laun, a landscape architect, sustains \$100,000 damage in an automobile accident. Assume a court decides the plaintiff, Moe, was 30 percent responsible for the accident. Under the comparative negligence rule, Moe would recover \$70,000. Under the contributory negligence rule, how much would Moe recover?**

\$0, because both parties are at fault, neither will be allowed recovery from the other.

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**What is the doctrine of comparative negligence?**

A modification and allows plaintiffs some recovery despite contributing to their own injuries.

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**What is contributory negligence?**

The contributory negligence states that even slight negligence on a plaintiff's part can relieve a grossly negligent defendant of responsibility for an accident.

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**In some states, state laws prevent insurers from covering punitive damages. State true or false?**

True.

In a few states, state laws prevent insurers from covering punitive damages as punishing an insurance company may not satisfy the courts' purpose of punishing wrongdoers.

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**What is the doctrine of last clear chance?**

A plaintiff's negligence contributes to the loss, nothing may be collected if the court applies the contributory negligence rule.

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**What is assumption of risk?**

It involves establishing that the plaintiff knowingly assumed the risk of injury.

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### **What are some questions you should ask during the risk management process?**

1. What kinds of events can harm my business?
2. How much damage can be done?
3. What actions should I take to deal with these problems?
4. Did I make the right decisions?
5. Did my choices prove to be too expensive?
6. Have circumstances in my business changed sufficiently?
7. Do my past decisions still apply?

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### **Why do risk managers analyze flow charts?**

1. to graphically view the production or distribution process
2. to spot production bottlenecks
3. to spot sole-source suppliers
4. to spot concentrations of valuable property
5. to reveal consequential impact of losses

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### **What does legal liability insurance provide protection against?**

The financial impact of lawsuits.

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### **What is the plaintiff?**

The party claiming injury.

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### **What is the defendant?**

The party from whom recovery is sought.

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### **What does a plaintiff have to prove to establish a case of negligence?**

1. The defendant had a legal duty to protect the plaintiff.
2. The defendant failed to perform that duty.
3. That the plaintiff was hurt.
4. The plaintiff suffered an injury as a result of the defendant's failure to perform that duty.

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### **What does tort liability include?**

1. Intent
2. Negligence
3. Strict liability

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### **What is mediation a form of?**

Alternative dispute resolution.

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### **Which action does not constitute an intentional interference with a person?**

Negligence - A person's careless conduct that causes injury.

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### **What is defamation?**

A communication is defamatory if it "tends to harm the reputation of another as to lower him in the estimation of the community or to deter third persons from associating or dealing with him." Liability for defamation requires the statements to be false. The law recognizes two forms of defamation: libel (publication of statement by written or printed words) and slander (communication of statement by spoken words or gestures).

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### **What is assault and battery?**

A victim is entitled to recover damages to compensate for the mental disturbance and physical illness or injury sustained. It is also a crime subject to state criminal law.

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### **What is false imprisonment?**

A person who intentionally confines another within fixed boundaries (for example, by being locked in a room), by physical force, threat of physical force, or other forms of duress.

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### **What is intentional infliction of emotional distress?**

To recover, the plaintiff must prove the defendant's intent to cause (or reckless disregard of the probability of causing) emotional distress, and the plaintiff's suffering extreme and severe emotional distress caused by the defendant's conduct