Course Title

Project Engineering

Chapter 5

PROJECT RISK MANAGEMENT

Lecture 10 (Week 10)

Introduction to Project Risk, Nature and Types of Project Risk. Analysis of Major Source of Risk and Effective Risk Management.

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Learning Objective

The main objective of this lecture is to understand about:

- Project risk.
- Nature of project risk
- Types of project risk.
- Analysis major source of risks.
- Effective management of project risk

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5.1 INTRODUCTION TO PROJECT RISK

Initially the risks and uncertainties level of the project are high. As project proceeds its phases the risk and uncertainties decreases. However, the project risk is never defined as zero. Effective risk management is essential in project to avoid failure. Every project is risky, meaning there is a chance things won't turn out exactly as planned. Project outcomes are determined by many things, some that are unpredictable and over which project managers have little control.

Risk is a combination of the probability of a negative event and its consequences. If an event is inevitable but inconsequential, it does not represent a risk, because it has no impact. Alternatively, an improbable event with significant consequences may not be a high risk. These two factors are combined in what we experience as the possibility of loss, failure, danger, or peril.

$$\textbf{Project Risk} = \sum(\textbf{Events} * \textbf{Probabilities} * \textbf{Consequences}$$

Project risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on a project objective. [1] A risk has a cause and, if it occurs, an impact. For example, the cause may be having limited personnel assigned to the project. The risk event is that may take longer than planned or the personnel may not be adequate for the task. Project risk includes both threats to the project's objectives and opportunities to improve on those objectives.

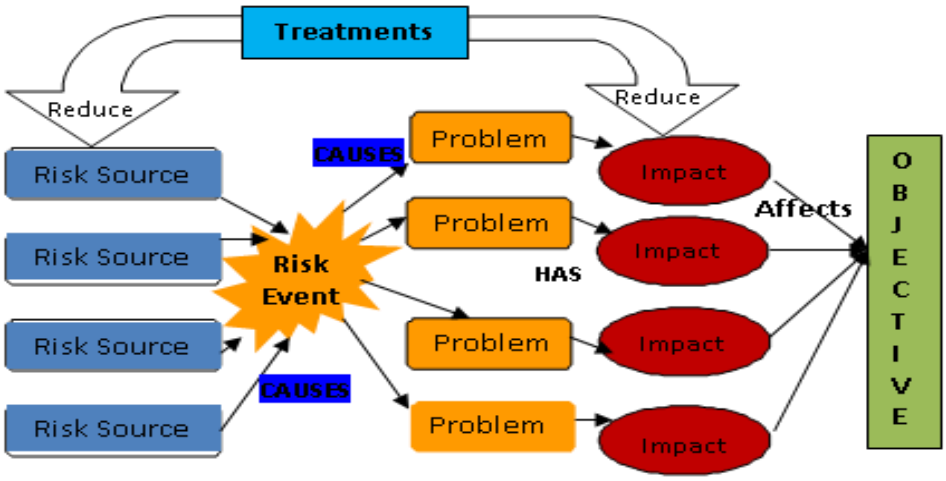
The risk concept is broken down into two main criteria: [2]

a) The probability, which is the possibility of an undesirable occurrence, such as a cost overrun, and
b) The impact, which is the degree of seriousness and the scale of the impact on other activities if the undesirable thing happens.

Using a mathematical description, a risk is described as follows:

$$R=P\times I$$

Where R is the degree of risk, within [0, 1] P is the probability of the risk occurring, within [0,1], I is the degree of impact of the risk, which is defined as being within [0,1]".



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5.2 NATURE OF PROJECT RISK

1. Nation/Region

- *Political situation*- war, revolution, civil disorders inconsistency of government policy.
- *Economical and Financial Situation* – GNP decreases, incompatible GNP, per capita, interest rate fluctuation, Inflation rate increasing, Currency exchange rate fluctuation, tax rate increasing.
- *Social Environment*- Language barrier, Religious inconsistency, Culture tradition differences, insecurity and crime, Pestilence, bribe and corruption, Popular in informal relationships, brotherhood.

2. Construction industry

- *Market fluctuations*- demanding decreasing structure changes.
- *Law and Regulations*- Incompatible arbitration system, complex planning approval and permit procedures, Import/export restrictions constraints on employment and materials availabilities, monetary restrictions.
- *Standards and codes*- inconsistencies in design/construction, differences in safety and health care, pollutions and nuisances.
- *Contract system*- Nonstandard contract form, difference in legal relationship between partners, unfamiliar with contract conditions for claims and litigations, differences in defective liabilities, special local requirements.

3. Company

- *Employer/Owner*- Unclear requirements, funding shortages, disadvantaged contracts.
- *Architect*- Unclear detail design or specifications, unfamiliar with local standards and codes, Lack of interaction with construction method
- *Labor and Sub contractors*- Direct labor disturbances, unfavorable sub-contractors.

4. Internal

- Cash flow unbalance, human resources shortages, affecting other projects productivity decreases.

5. Materials and Equipment

- Unfavorable sub-suppliers, default supply of materials, equipment and plants.

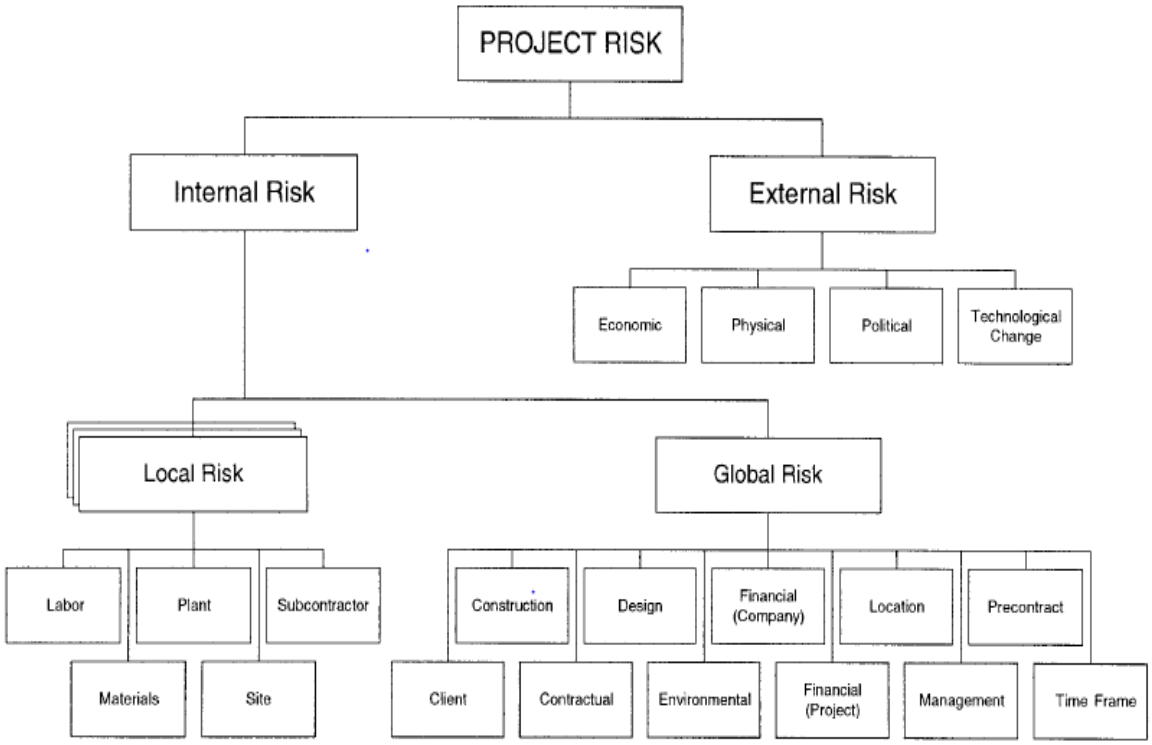
6. Force Majeure

- Earthquake, fire, flood, bad weather and other events which are very difficult to predict.

7. Project

- *Defective physical works* – natural force, poor design, lack of proper construction techniques, damages by human errors, defective materials, difficulty in quality control.
- *Schedule delay*- incomplete design, late construction site possession, bad weather, unforeseen ground conditions, disturbances in labor, materials supplying, and inefficient communications/coordination.
- *Cost Overrun*- - unclear boundaries of works, inaccurate estimation, inadequate insurances, labor/materials/ price fluctuations.

5.3 TYPES OF PROJECT RISKS



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Every project is different and it is not possible to compile an exhaustive list of risks or to rank them in order of priority. What is a major risk for one project may be quite minor for another. In a vacuum, one can just discuss the risks that are common to most projects and possible avenues for minimizing them. However, it is helpful to categorize the risks according to the phases of the project within which they may arise:

(1) The design and construction phase;
(2) The operation phase; or
(3) Either phase.

1. **Construction Phase Risk**

Completion Risk

This phase carries the greatest risk for the financier. Construction carries the danger that the project will not be completed on time, on budget or at all because of technical, labor, and other construction difficulties. The elements which restricts project to be completed can be financial, contractual, operational, and environmental and can be caused by both internal and external sources.

Common risks in completion include: [5]

- Safety hazards that lead to worker accidents and injuries
- Managing change orders
- Incomplete drawings and poorly defined scope
- Unknown site conditions and poorly written contracts
- Unexpected increases in material costs
- Labour shortages and damage or theft to equipment and tools
- Natural disasters and issues with contractor and suppliers.
- Availability of building materials and poor project management

2. Operation Phase Risk

Resource/Reserve Risk

The risk that a firm or organization will be unable to operate at the same level of capacity and/or operate profitably in the future due to the decline (or exhausting) of the quantity and/or quality of the economic reserves of a core product or commodity. [6]This is the risk that for a mining project, rail project, power station or toll road there are inadequate inputs that can be processed or serviced to produce an adequate return.

Operating Risk

Operational risk is the risk of loss resulting from ineffective or failed internal processes, people, systems, or external events that can disrupt the flow of business operations. The losses can be directly or indirectly financial. [7]These are general risks that may affect the cash-flow of the project by increasing the operating costs. Operating risks include, for example, the level of experience and resources of the operator, inefficiencies in operations or shortages in the supply of skilled labor.

Market/Off-Take Risk

Market risk is the risk that a buyer cannot be found for the product at a price sufficient to provide adequate cash-flow to service the debt. The best mechanism for minimizing market risk before lending takes place is an acceptable forward sales contact entered into with a financially sound purchaser.

3. Construction and Operation Phase Risk

Participants /Credit Risk

These are the risks associated with the sponsors or the borrowers themselves. The question is whether they have sufficient resources to manage the construction and operation of the project and to efficiently resolve any problems which may arise. To minimize these risks, the financiers need to satisfy themselves that the participants in the project have the necessary human resources, experience in past projects of this nature and are financially strong.

Technical Risk

Technical risks are those events or issues associated with the scope definition, research and development (R&D), design, construction, and operation that could affect the actual level of performance vs. that specified in the project mission need and performance requirements documents. [8]Examples of technical risks include new and changing technology and changing regulatory requirements. Financiers usually minimize this risk by preferring tried and tested technologies to new unproven technologies.

Political Risk

This is the danger of political or financial instability in the host country caused by events such as insurrections, strikes, suspension of foreign exchange, creeping expropriation and outright nationalization.

Force Majeure Risk

This is the risk of events which render the construction or operation of the project impossible, either temporarily (e.g. minor floods) or permanently (e.g. complete destruction by fire).

5.4 ANALYSIS OF MAJOR SOURCE OF RISK

1. Change in project scope and requirements

As a project progresses, a project team may later find that a planned project scope and requirements need to be revised due to changes in user requirements, more information gathered, and technical feasibility. As the project needs to be revised according to new scope and requirements, the impacts are typically in form of inefficiency, disruption, delay and increased cost. This source of project risk often occurs in later stage of the project.

2. Design errors and omissions

In any project, it is possible that someone does unintentional errors or omits to implement the project as planned. Due to the complex of the project and tight time frame, a project team may misunderstand due to ineffective communication. The examples of this source of risk are deficiency design document, improperly sized equipment, design calculation errors. Therefore, the impact includes delay of the project and additional costs.

3. Inadequately defined roles and responsibilities

This source of project risk is deemed a common source in any typical project because of changes in project management structure and ambiguous roles and responsibility. Inadequately

defined roles and responsibilities can cause substantial and various project risks at any stage from the starting of the project to the ending of the project. The noticeable examples of this source of risk are ineffective project communication, different expectation, and lack of common direction. The impact includes overall project inefficiency, disruption and delay.

4. Inaccurate cost and schedule estimates

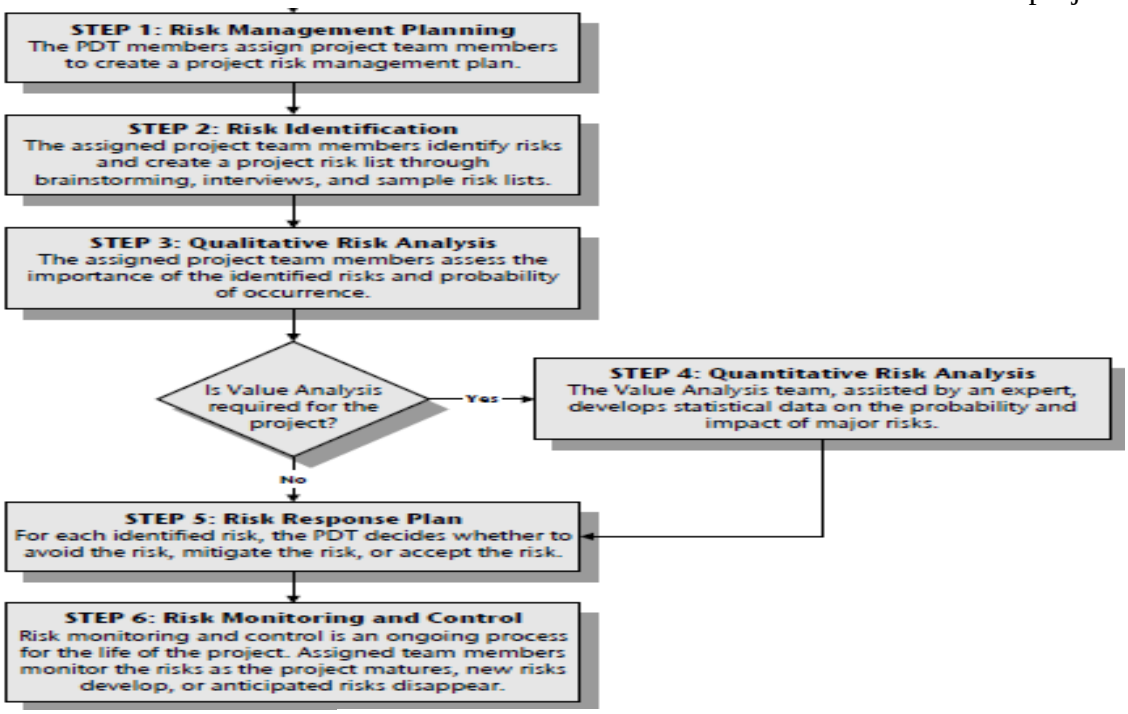
This source of risk results from ineffective project planning at the early stage of the project. If the cost and schedule of the project are not accurately planned and estimated, the entire project will be in the wrong direction and many issues will be escalated. The example of risk resulting from inaccurate cost and schedule estimates includes incorrect from project timeline and budget. The impact includes poor coordination, ineffective use of resources, delay of the project and increased project cost.

5. Force majeure

This is the source of risk that is uncontrollable. Force majeure includes Acts of God, insurrection or civil disorder, war or military operations, national or local emergency, acts or omissions of Government or any competent authority, industrial disputes of any kind, fire, lightning, explosion, flood, subsidence, and inclement weather. All of these will adversely affect that project. In worst case, the impact is the complete stoppage of work.

5.5 EFFECTIVE MANAGEMENT OF PROJECT RISK

Risk management is the systematic process of planning for, identifying, analyzing, responding to, and monitoring project risk. [1]It involves processes, tools, and techniques that will help the project manager maximize the probability and consequences of positive events and minimize the probability and consequences of adverse events. Project risk management is most effective when first performed early in the life of the project and is a continuing responsibility throughout the project.



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1. Risk Management Planning

As part of work plan development, project development team (PDT) members assign project team members to create a project risk management plan. At this point, the assigned project team members begin to create the risk management plan. The risk management plan identifies and establishes in the project plan the activities of risk management for the project. To prepare the risk management plan, the assigned project team members use a spreadsheet that shows the risks and responses in an abbreviated form.

2. Risk Identification

Risk identification is identifying and defining potential risks that could impact the success of a project. The risk identification process includes defining the project scope, identifying potential risks, assessing the likelihood and impact of each risk, and developing mitigation plans for the most critical risks. [10]Risk management plan and risk break down structures are required for the risk identification process. The various sources are analyzed in order to identify the associated risk with the project through risk identification.

There are several techniques organizations can use to identify risks including brainstorming, root cause analysis, SWOT analysis, and expert judgment.

Risk Register (RR)

Risk register is a record to document the results of the risk management process. It contains the following information.

- List of identified risks with description
- List of potential responses
- Root causes of risk
- Updated risk categories

3. Qualitative and Quantitative Risk Analysis

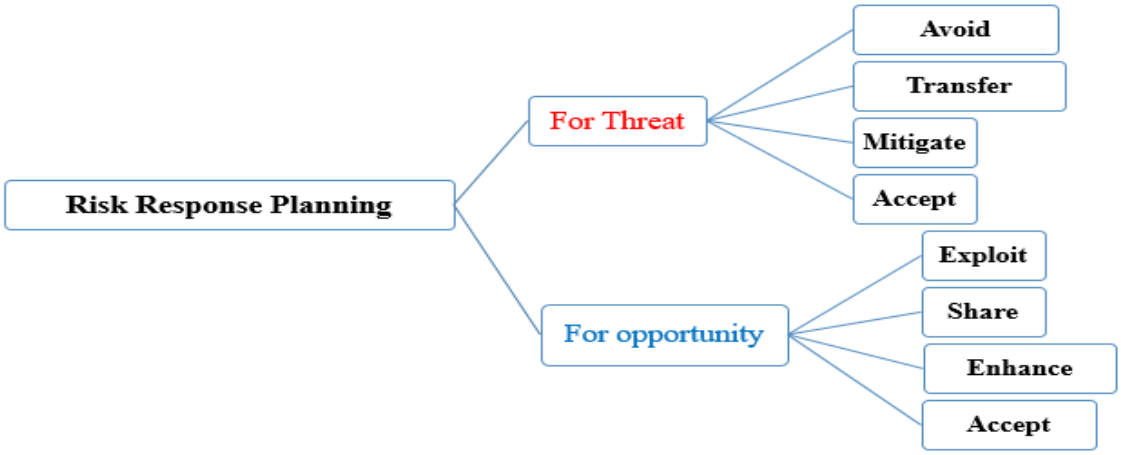
Qualitative risk analysis assesses the importance of the identified risks and develops prioritized lists of these risks for further analysis or direct mitigation. The team assesses each identified risk for its probability of occurring and its impact on project objectives. Team members sort the identified risks into high, moderate, and low risk categories for each project objective (time, cost, scope).Qualitative risk analysis is quick but subjective.

On the other hand, Quantitative risk analysis is a way of numerically estimating the probability that a project will meet its cost and time objectives. Quantitative analysis is based on a simultaneous evaluation of the impact of all identified and quantified risks. Quantitative risk analysis involves statistical techniques that are most easily used with specialized software. Quantitative risk analysis is objective and has more detail, contingency reserves and go/no go decisions, but it takes more time and is more complex. [11]

4. Risk Response Planning

Risk response planning addresses the matter of how to deal with risk. Risk response must be proportional to the severity of the risk, cost effective, timely, and realistic and accepted as well as owned by all concerned parties of the risk management. Risk response planning focuses on

the high-risk items evaluated in the qualitative and/or quantitative risk analysis. It identifies and assigns parties to take responsibility for each risk response.



Avoidance:

The team changes the project plan to eliminate the risk or to protect the project objectives from its impact. The team might achieve this by changing scope, adding time, or adding resources.

Transference:

The team transfers the financial impact of risk by contracting out some aspect of the work. Transference reduces the risk only if the contractor is more capable of taking steps to reduce the risk and does so.

Mitigation:

The team seeks to reduce the probability or consequences of a risk event to an acceptable threshold. They accomplish this via many different means that are specific to the project and the risk.

Acceptance:

The project manager and the project team decide to accept certain risks. They do not change the project plan to deal with a risk, or identify any response strategy other than agreeing to address the risk if and when it occurs.

5. Risk Monitoring and Controlling

Risk monitoring and control keeps track of the identified risks, residual risks, and new risks. It also ensures the execution of risk response plans, and evaluates their effectiveness. Risk monitoring and control continues for the life of the project. The list of project risks changes as the project matures, new risks develop, or anticipated risks disappear. Risk monitoring and control is carried out by Risk Reassessment, Risk audits, Reserve Analysis and Status meetings.

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