

PROJECT ENGINEERING

Chapter 5- Project Risk Analysis and Management

-Er. Sandip Duwadi
Asst. Professor
Pashchimanchal Campus

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Project Risk Analysis and Management

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Risk

- Risk is the combination of the probability of a negative event and its consequences.
- If an event inevitable but non consequential, it doesnot represent a risk because it has no impact.
- In general risk is a function of uniqueness of a project and the experience of the project team.
- Risk = f(uniqueness, experience of project team)

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Risk

Project risk = Σ (events * probabilities * consequences)

- It is a uncertain event or condition that, if occurs, has a positive or negative effect on the project objective.
- A risk has a cause and if it occurs, a consequence.
- The project risk includes both threats to the projects' objective and opportunities to improve on those objectives.

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Types of Project Risk

1. Construction Risk

a. Completion Risk

- Completion 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.
- Such delays or cost increases may delay the loan repayments and cause interest and debt to accumulate.
- They may also jeopardize contracts for the sale of the projects output and supply the contract of raw materials.

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2. Operation Phase Risk

a) Resource/ Reserve Risk

- This is the risk that for mining project , rail project, power station or toll road there are inadequate outputs that can be processed or serviced to produce an adequate return.
- For example, this is the risk that there are insufficient reserves for mine, passengers for railway, fuel for power station or vehicles for toll road.

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b) Operating Risk

- These are general risk that may affect the cash flow of the project by increasing the operating costs or affecting the projects capacity to continue to generate the quantity and quality of the planned output over life.
- Operating risk include the level of experience of operator, inefficiencies of operations or shortage of supply of skilled manpower.

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c) Market/ off-Take risk

- Obviously the loan can only be paid if the product generated can be turned in to cash.
- Market risk is the risk that a buyer can not be found for the product at a price sufficient to provide adequate cash flow to service the debt.
- The best mechanism to minimize the market risk before lending takes place is an acceptable forward sales contract entered into the financially sound purchaser.

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3. Risk common to both construction and Operation Phases

a) Participants/ Credit Risk

- This risk is associated with the sponsors or the borrowers themselves.
- The question is whether they have sufficient resources to manage the construction and operation of project and to efficiently resolve the problems that may rise.
- To minimize this risk, the financiers need to satisfy themselves that the participants have the necessary human resources, experience in past project of its nature.

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b) Technical Risk

- This is the risk of technical difficulties in the construction and operation of the projects' plant and equipment, including latent defects.
- financiers usually minimize this risk by preferring tried and tested technologies to new unproven technologies.

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c) Currency Risk

It includes

- i) a depreciation in loan currencies may increase the cost of construction where significant construction items are sourced off shore
- ii) Depreciation in the revenue currencies may cause a cash flow problem in operating phase.

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d) Regulatory/ Operational Risk

- These are the risk that government licenses and approval required to construct or operate the project will not be issued (or will only be issued subject to onerous conditions)
- or that the project will subject to excessive taxation, royalty payments or rigid requirements as to local supply or distribution.

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e) Political Risk

- This is the danger of political or financial instability in the host country caused by insurrections, strikes suspension of foreign exchange etc.
- It also includes the risk that a government may be able to avoid its contractual obligations through sovereign immunity doctrines.

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f) Force Majeure Risk

- This is the risk of events which render the construction or operations of the project impossible, either temporarily (eg minor floods) or permanently (complete destruction by fire)

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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 more information gathered and technical feasibility .
- For example if the client adds additional system to the project, the project team needs to conduct the feasibility of the project.

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2. Design errors and omissions

- In any project , it is possible that someone does unintentional errors or omits the project as planned.
- Due to the complexity 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 documents, improperly sized equipment, design calculation errors.

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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 responsibilities.
- The noticeable examples of this source of risk are ineffective project communication, different expectations and lack of common direction.

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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 form of project time line and budget.

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5. Insufficient Skilled Staff

- A manager must ensure that a project team has enough skilled staff to execute the project according to its objectives.
- Lack of skilled staff potentially causes many problems in for see able future
- This source of risk significantly affects the project at the implementation stage since this stage requires considerable technical knowledge, effective project management expertise and problem solving skill.

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6. Force Majeure

- This is the source of risk that is uncontrollable. It includes act of god, insurrections or civil disorder, war or military operations, national or local emergency.
- All of these will adversely affect the project. In worst case the impact will be stoppage of work.

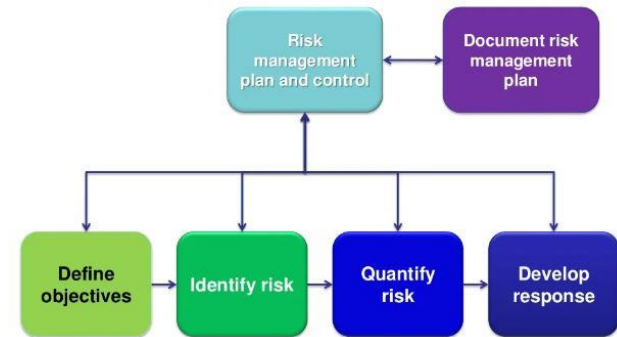
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7. New Technology

- It often plays an important role in project risk analysis, since it can force project team to change the strategy of the project or revise technology used in the project.
- New and unproven technology is a major concern in the project since it is hard for a project team to predict potential risk
- The impact of this source of risk includes significantly increased project costs and time.

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Risk Management Process



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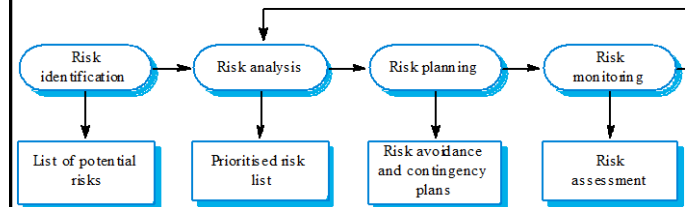
Effective Management of Project Risk

Risk Management

- Risk management is the systematic application of the risk management process of the project.
- The process consist of risk management planning, identification, analysis, responding and monitoring and control.
- The objective of risk management is to maximize the probability and impact of positive events and minimize the probability and consequences of events adverse to project objectives.

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Risk Management



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1. Risk Management Planning

- As part of work plan development, project development team members assign project team members to create a project 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 the spreadsheet that shows the risk and responses in an abbreviated form.

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2. Risk Identification

- It involves identifying the potential project risks and documenting their characteristics. Risk identification results in a deliverable ---- the project risk list.
- The assigned team members identify the potential risk and opportunities using:
 - ❖ The sample risk list
 - ❖ Their own knowledge of the project
 - ❖ Consultation with others who have significant knowledge of the project or its environment.

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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 assess 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)

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Impact Value	Technical impact (TI)	Cost Impact (CI)	Schedule Impact (SI)
0.1 (Low)	Minimal	Within budget	Negligible
0.3 (Minor)	Small Reduction in performance	Cost Increase (1-10%)	Minor slip (<1 month)
0.5 (Moderate)	Moderate reduction in performance	Cost increase (10-25 %)	Moderate slip (1-3 month)
0.7 (Significant)	Significant Reduction in performance	Cost increase (25-50%)	Significant slip (> 3 months)
0.9 (high)	Technical goals might not be achieved	Cost increase in excess of 50 %	Large slip (unacceptable)

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TOOLS and TECHNIQUES OF PERFORM QUALITATIVE RISK ANALYSIS

Probability	Threats Risk Score = Probability x Impact					Opportunities High (RED) / Med (YEL) / Low (GRN)				
0.90 Very Likely	0.05	0.09	0.18	0.38	0.72	High	High	High	Med	Low
0.70 Likely	0.04	0.07	0.14	0.28	0.56	High	High	Med	Med	Low
0.50 Possible	0.03	0.05	0.10	0.12	0.40	High	High	Med	Low	Low
0.30 Unlikely	0.02	0.03	0.06	0.12	0.24	High	Med	Med	Low	Low
0.10 Very Unlikely	0.01	0.01	0.02	0.04	0.08	Med	Low	Low	Low	Low
	0.05	0.10	0.20	0.40	0.80	Very High	High	Med.	Low	Very Low

Example Impact Definitions – May Be Tailored to Each Project Objective
Impact on an Objective (e.g. Cost, Schedule, Scope, Quality)

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Quantitative risk analysis

- It is a way of numerically estimating the probability of 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.

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Risk projection

Risks	Category	Probability	Impact	RMAM
Size estimate may be significantly low	PS	60%	2	
Larger number of users than planned	PS	30%	3	
Less reuse than planned	PS	70%	2	
End-users resist system	BU	40%	3	
Delivery deadline will be tightened	BU	50%	2	
Funding will be lost	CU	40%	1	
Customer will change requirements	PS	80%	2	
Technology will not meet expectations	TE	30%	1	
Lack of training on tools	DE	80%	3	
Staff inexperienced	ST	30%	2	
Staff turnover will be high	ST	60%	2	
...				

Impact values:
1—catastrophic
2—critical
3—marginal
4—negligible

Table prior to sorting

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The basics of risk management

- Identify the risk
- Analyse the probability the risk will occur and the potential impact of the risk
- Determine the overall severity of the risk
- Determine which risks are the most important for further action
- Document a response plan for the risk
 - Accept the risk
 - Avoid the risk
 - Monitor the risk
 - Transfer the risk



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Risk Response Planning

- Risk response planning focuses on the high risk items in qualitative and/or quantitative risk analysis.
- It identifies and assigns parties to take responsibility for each risk response.
- The project manager identifies which strategy is best for each risk and then designs specific actions to implement that strategy.
- These strategies and action include:

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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 the scope, adding time or adding resources.

Transference:

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

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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 project and the risk.

Acceptance:

- The project manager and the project team decide to accept certain risks.
- They donot change the project plan to deal with a risk or identify any response strategy other than agreeing to address the risk and when it occurs.

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Risk Management Activities



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Strategies of Risk Management

► Positive Risks (or Opportunities)

Exploit
Share
Enhance
Acceptance



► Negative Risks (or Threats)

Avoid
Transfer
Mitigate
Acceptance



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Risk Monitoring and Control

- 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 its effectiveness.
- Risk monitoring and control continues for the life of the project.
- The list of project risks changes as the project matures, new risk develop or anticipated risks disappear.
- Risk monitoring and control is carried out by following methods:

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Risk reassessment:

- It reviews the project risk at project team meetings.
- Major reviews are made at major milestones. Risk ratings and prioritization may change during the life of the project.
- These changes may require additional qualitative and quantitative risk analysis.

Risk audits

- Examine and document the effectiveness of the risk response planning in controlling risk and effectiveness of the risk owner

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Variance and trend analysis

- Used for monitoring overall project cost and schedule performance against a baseline plan.
- Significant deviations indicate that updated risk identification and analysis should be performed.

Reserve analysis

- As execution progresses, some risk events may happen with positive or negative impact on cost or schedule or contingency reserves.
- Reserve analysis compares available reserves with the risk remaining at the time and determines whether the reserves are sufficient.

Status Meetings

- Risk management can be addressed regularly by including the subject in project meetings.

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Risk Management Plan

- It is the document prepared after the risk management planning meetings which shows the way, mechanisms, and methods of performing risk identifications, risk analysis, response planning and risk monitoring and controlling mechanisms.

Risk Register

- It is a record to document the results of the risk management process. it contains the following information
 - List of identified risk with description
 - List of potential responses
 - Root cause of risk
 - Updated risk categories.

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Contingency Plan

- A contingency plan is developed in advance to respond to risks that arise during the project.
- Planning would reduce the cost of an action the risk occurs.
- Risk triggers such as missing intermediate milestones should be defined and tracked.
- The most usual risk acceptance response is to establish a contingency allowance or reserve including amount of time , money or resources to account for known risks.

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