UNIT 7
RISK ANALYSIS IN CAPITAL INVESTMENT DECISIONS

1. DEFINITION OF RISK

Risk, in the context of capital investment, is the variability or dispersion of the actual returns (cash flows) a project generates compared to the expected returns. It is the quantifiable probability that the project's actual outcome will deviate from the forecasted outcome, potentially resulting in financial loss.

Risk is simply the chance that things won't go according to plan. If you forecast a 20% return, the risk is the possibility that you might end up with 10% (or less) instead, or even a loss. The more spread out the possible outcomes are, the riskier the project is considered.

2. PROJECT RISK MANAGEMENT (PRM)

Project Risk Management is the systematic process of identifying, analyzing, planning, and controlling risks throughout the life cycle of a project.

The Four-Step PRM Process

Phase	Action	Goal
Risk Identification	Determine which risks might affect the project and document their characteristics.	Create a comprehensive Risk Register.
Risk Analysis	Quantify the risk (Probability Impact). Assess the probability of occurrence and the potential severity of impact.	Prioritize risks (e.g., using a High/Medium/Low matrix).
Risk Response Planning	Develop options and actions to enhance opportunities and reduce threats to project objectives.	Create detailed strategies for each major risk.
Risk Monitoring & Control	Track identified risks, monitor residual risks, identify new risks, execute response plans, and evaluate the effectiveness of the process.	Ensure risk exposure stays within acceptable limits.

3. TYPES OF RISK

Risks affecting a project can be classified broadly based on their source and manageability.

A. Systematic (Non-Diversifiable) Risk

- Risk inherent to the entire market or economy. It affects a large number of assets, projects, or sectors simultaneously. It cannot be eliminated or reduced through diversification within a single market.
- These are **"macro" risks** that affect *everyone*. No matter how well you manage your specific project, a global recession (for example) will still hurt your sales.

- Changes in GDP, inflation, interest rate fluctuations, major political shifts, natural disasters.

B. Unsystematic (Diversifiable) Risk

- Risk specific to a particular company, industry, or project. Since this risk is unique, it can be mitigated or virtually eliminated through diversification (investing in multiple different, unrelated projects or companies).
- These are **"micro" risks** that are *within your control* or specific to your business. If your project relies on a single supplier, that's an unsystematic risk you can fix by finding a second supplier.
- Labour strikes, supply chain failure for a single component, product recalls, mismanagement, successful launch of a competitor's product.

C. Other Important Categories

Risk Category	Explanation	Example
Technical Risk	Risk related to the successful functionality of the technology or engineering (e.g., system failure, design flaw).	A new manufacturing machine breaks down frequently.
Commercial Risk	Risk related to the market and sales (e.g., competition, pricing pressure, demand forecast inaccuracy).	Customers prefer a competitor's product despite yours being better.
Economic/Financial Risk	Risk related to cost overruns, changes in foreign exchange, or credit availability.	A key raw material price suddenly doubles.

4. METHODS OF RISK ADJUSTED APPRAISAL

These methods modify the Net Present Value (NPV) calculation to account for the perceived riskiness of the project.

i. Risk-Adjusted Discount Rate (RADR)

- The required rate of return (K) is increased (or "loaded") by a premium (RP) proportional to the project's risk. Riskier projects use a higher discount rate, which results in a lower Present Value (PV) for the same future cash flows.
- **Formula:**

$$\text{RADR} = \text{Risk-Free Rate} + \text{Risk Premium(RP)}$$

- Instead of using your normal cost of capital (e.g., 10%), you might use 15% for a very risky project. This higher rate is a penalty that makes it harder for the project to be approved, reflecting the danger involved.

ii. Certainty Equivalent (CE) Approach

- This method adjusts the cash flows themselves to their "certainty equivalent" before discounting. It asks: "How much certain cash flow would the investor accept today instead of the uncertain future cash flow?" The adjusted cash flows are then discounted using the risk-free rate (Rf).
- You reduce the estimated cash flows immediately. If you expect $1,000 but are only 80% sure, you might treat it as a certain $800 ($\alpha$=0.8). This adjusted, lower cash flow is then discounted at the lowest possible rate (the risk-free rate), as the risk has already been removed from the cash flow itself.

iii. Adjusted Payback Period

- Management sets a shorter target payback period for projects deemed riskier.
- If the standard recovery time is 4 years, a high-risk project must recover its cost in 2 or 3 years. This emphasizes liquidity and reduces the amount of time the investment is exposed to uncertainty.

5. ADVANCED TECHNIQUES OF RISK ANALYSIS

These techniques involve mathematical modelling to explore the full range of potential outcomes.

i. Sensitivity Analysis

- A technique that examines how the NPV or IRR changes when only **one** key input variable (like sales volume, unit price, or cost of capital) is changed, while all other variables are held constant.
- The goal is to identify the variables that are most sensitive (i.e., cause the largest change) to the project's profitability.
- This answers the question: "What is the point of breakdown?" You test variables one by one: "What happens to my profit if the price drops by 10%? What happens if the cost of labour increases by 20%?" The variable that hurts the most is the one you need to watch closest.

ii. Scenario Analysis

- An extension of sensitivity analysis where multiple key input variables are changed simultaneously to reflect various plausible future states of the world. Typical scenarios include the "Base Case (Most Likely)," "Worst Case (Pessimistic)," and "Best Case (Optimistic)."
- The goal is to determine the project's NPV and IRR under a few complete and coherent conditions.
- Instead of testing one thing at a time, you build a few complete "stories" about the future. For example, the "Worst Case" scenario might assume high costs, low sales, and delayed completion all at once, giving you a comprehensive view of downside risk.

iii. Monte Carlo Simulation

- A sophisticated quantitative technique where probability distributions are assigned to uncertain variables (e.g., sales growth, operating costs). A computer then runs thousands of iterative trials, randomly selecting values from these distributions to calculate the NPV/IRR for each trial.
- The result is a probability distribution of potential NPVs, allowing the decision-maker to estimate the probability of achieving a negative NPV (i.e., the probability of failure).
- It's like running a computer game version of your project thousands of times. Since no one knows the exact future price or cost, the computer randomly picks realistic numbers (based on known probabilities) for each variable in each "run," and then tells you the odds of the project succeeding or failing.

6. DECISION TREE ANALYSIS (DTA)

Decision Tree Analysis is a diagrammatic tool used to represent various sequential decision points and the probabilistic outcomes (chance events) that follow each decision, especially in multi-stage projects. It calculates the Expected Monetary Value (EMV) for each path to determine the optimal sequence of decisions.

A decision tree is a visual map of 'if-then' statements for your project. You start with a decision ("Should I invest?"). That decision leads to a possibility ("Will the market be strong?"), which has a probability (e.g., 60% chance). You map out all possible routes—from initial decision to final profit—and then, by working backward, you use the EMV calculation to determine which initial decision gives you the highest *average* expected profit.

Components

1. **Decision Node (Square □):** Represents a point where a choice must be made (e.g., launch project, abandon project, wait).
2. **Chance Node (Circle ◯):** Represents a point where an uncertain event will occur (e.g., market success or market failure), and probabilities are assigned to each possible outcome.
3. **Branches (Lines):** Connect nodes and represent either a chosen decision or a possible outcome.
4. **Payoff (Value):** The final monetary outcome (e.g., NPV) at the end of each path.

Application in Project Management

DTA is particularly useful for projects involving:

- **Staged Investments:** Projects where management can decide to continue, expand, or abandon the project after an initial phase.
- **R&D Projects:** Where the initial research success dictates the next investment decision.