PROJECT MANAGEMENT

Unit IV – Project Execution and Control

4.1 Project Execution: Introduction

Project execution (also called project implementation) is the phase where the plans made during project planning are actually carried out. The team performs the work, and the project manager monitors and controls everything to ensure the project stays on track.

> **Definition**
> *"Project execution is the process of completing the project work as defined in the project management plan in order to satisfy the project's specifications and objectives."*

During execution, the project manager's role shifts from planning to directing, managing, and controlling. Most of the project budget is spent during this phase. This is also when most issues and risks are encountered.

Key Activities During Project Execution

- Assigning tasks to team members and monitoring their progress.
- Managing day-to-day communication among team members and stakeholders.
- Identifying and resolving problems and risks as they arise.
- Ensuring deliverables meet the defined quality standards.
- Managing changes to the project scope, schedule, or budget through a change control process.
- Conducting team meetings and status reviews.

4.2 Task Assignment, Tracking, and Monitoring

Task Assignment

Task assignment is the process of formally allocating specific activities from the project plan to individual team members or groups. Effective task assignment ensures that:

- Each task has a clearly identified owner who is responsible for completing it.
- Tasks are assigned to people who have the right skills and capacity.
- No team member is overloaded while others are idle (resource levelling).
- Each team member understands exactly what they need to do, by when, and to what quality standard.

Tools used for task assignment include: MS Project, Jira, Trello, Asana, and similar project management software.

Task Tracking

Task tracking is the process of regularly checking and recording the actual progress of each task against the planned schedule. The project manager must know at all times:

- **What has been completed?** Compare completed tasks with the plan.
- **What is currently in progress?** Check actual percentage completion of tasks.
- **What is behind schedule?** Identify tasks that are delayed and understand why.
- **What are the blockers?** Identify issues that are preventing progress.

Tracking is usually done through daily stand-up meetings (in Agile), weekly status reports, or automated dashboards in project management tools.

Project Monitoring

Project monitoring is the broader process of continuously observing and measuring the overall project performance against the project management plan. Monitoring covers:

- **Schedule Monitoring:** Is the project on time? Are any milestones at risk?
- **Budget Monitoring:** Is the project within budget? Are costs higher than planned?
- **Quality Monitoring:** Are deliverables meeting the required quality standards?
- **Risk Monitoring:** Are new risks emerging? Are existing risks increasing in probability?
- **Scope Monitoring:** Is scope creep occurring? Are changes being properly controlled?

Tools for Tracking and Monitoring

- Gantt Charts – to visualise schedule progress.
- Burndown/Burnup Charts (Agile) – to show work completed vs remaining.
- Earned Value Management (EVM) – to measure cost and schedule performance.
- Status Reports – regular written summaries of project progress.
- Dashboards – real-time visual displays of key project metrics.
- Issue Log – a document tracking all identified problems and their resolution status.

4.3 Project Control

Project control is the process of comparing the actual project performance with the planned performance, identifying variances (differences), and taking corrective action to bring the project back on track. Without control, even the best plan will fail.

> **Definition**
> *"Project control is the process of measuring project performance, comparing it against the project plan, and implementing corrective actions to address any deviations from the plan."*

4.3.1 Schedule Control

Schedule control involves monitoring the project timeline to ensure activities are completed on time. It identifies schedule variances and takes corrective action.

- **Schedule Variance (SV):** The difference between the work actually done and the work planned. SV = Earned Value (EV) – Planned Value (PV). If SV is negative, the project is behind schedule.
- **Schedule Performance Index (SPI):** SPI = EV ÷ PV. If SPI < 1, the project is behind schedule. If SPI > 1, the project is ahead of schedule.

Corrective actions for schedule delays include:

- Crashing (adding more resources to critical path activities).
- Fast tracking (performing parallel activities).
- Reducing scope (with stakeholder approval).
- Re-sequencing activities.

4.3.2 Budget Control

Budget control involves monitoring actual costs and comparing them to the approved budget. The goal is to prevent cost overruns.

- **Cost Variance (CV):** CV = EV – Actual Cost (AC). If CV is negative, the project is over budget.
- **Cost Performance Index (CPI):** CPI = EV ÷ AC. If CPI < 1, the project is getting less value per dollar spent (over budget).

Corrective actions for budget overruns include:

- Reducing scope or quality (with stakeholder agreement).
- Negotiating for additional budget.
- Finding more cost-effective resources or methods.
- Reviewing estimates and re-planning remaining work.

4.3.3 Quality Control

Quality control (QC) involves inspecting and testing project deliverables to ensure they meet the quality standards defined during planning.

- **Inspection:** Reviewing completed work (documents, code, products) for defects.
- **Testing:** Running tests (unit tests, integration tests, user acceptance tests) to verify software functionality.
- **Quality Audits:** Independent reviews of project processes to ensure standards are being followed.
- **Statistical Sampling:** Testing a sample of outputs rather than inspecting every item.
- **Control Charts:** Graphs that show whether a process is within acceptable quality limits over time.

Quality issues found during QC lead to defect correction, rework, or process improvement.

4.4 Earned Value Management (EVM)

Earned Value Management (EVM) is a powerful project management technique that integrates scope, schedule, and cost to measure project performance objectively. It tells the project manager not just how much has been spent, but also how much value has been created for that spending.

Definition
"Earned Value Management (EVM) is a project management methodology that combines scope, schedule, and cost data to assess project performance and progress, enabling project managers to forecast future performance."

Key EVM Terms

- **Planned Value (PV):** The authorised budget assigned to the scheduled work. Also called the Budgeted Cost of Work Scheduled (BCWS). It answers: "How much work should have been done by now?"
- **Earned Value (EV):** The value of work actually completed, expressed in terms of the budget. Also called the Budgeted Cost of Work Performed (BCWP). It answers: "How much work has actually been done?"
- **Actual Cost (AC):** The total cost actually spent on the completed work. Also called the Actual Cost of Work Performed (ACWP). It answers: "How much money has actually been spent?"
- **Budget at Completion (BAC):** The total approved budget for the entire project.

EVM Performance Metrics

Metric	Formula	Interpretation
Schedule Variance (SV)	SV = EV – PV	Negative = behind schedule; Positive = ahead
Cost Variance (CV)	CV = EV – AC	Negative = over budget; Positive = under budget
Schedule Performance Index (SPI)	SPI = EV ÷ PV	< 1 = behind schedule; > 1 = ahead
Cost Performance Index (CPI)	CPI = EV ÷ AC	< 1 = over budget; > 1 = under budget
Estimate at Completion (EAC)	EAC = BAC ÷ CPI	Forecast of total project cost
Estimate to Complete (ETC)	ETC = EAC – AC	Cost needed to finish remaining work
Variance at Completion (VAC)	VAC = BAC – EAC	Forecast surplus or deficit at end

EVM Example

A project has a total budget of ₹5,00,000 (BAC). After 50% of the planned time:

- Planned Value (PV) = ₹2,50,000 (50% of budget should be completed).

- Earned Value (EV) = ₹2,00,000 (only 40% of budget worth of work is complete).
- Actual Cost (AC) = ₹2,80,000 (spent more than planned).
- Schedule Variance (SV) = EV – PV = 2,00,000 – 2,50,000 = ₹–50,000 (behind schedule).
- Cost Variance (CV) = EV – AC = 2,00,000 – 2,80,000 = ₹–80,000 (over budget).
- CPI = EV ÷ AC = 2,00,000 ÷ 2,80,000 = 0.71 (for every ₹1 spent, only ₹0.71 of value is delivered).
- EAC = BAC ÷ CPI = 5,00,000 ÷ 0.71 = ₹7,04,225 (the project will cost much more than planned).

4.5 Project Reporting and Communication

Effective communication is critical to project success. Research shows that poor communication is the leading cause of project failure. The project manager must ensure that the right information reaches the right people at the right time in the right format.

> **Definition**
> *"Project communication management includes the processes required to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, and disposition of project information."*

Types of Project Reports

- **Status Report:** A regular (weekly/monthly) summary of project progress. It includes what was accomplished, what is planned next, any issues or risks, and the overall health of the project (on time, on budget, on scope).
- **Progress Report:** Focuses specifically on comparing actual work completed against the planned work for a given period.
- **Variance Report:** Highlights deviations from the project plan, including schedule variance and cost variance using EVM metrics.
- **Forecast Report:** Predicts future project performance based on current trends (e.g., EAC, ETC).
- **Exception Report:** Generated only when significant deviations from the plan occur, requiring management attention.
- **Final Project Report:** A comprehensive report produced at project closure, documenting the project's history, achievements, lessons learned, and final costs.

Communication Management Plan

The Communication Management Plan defines:

- Who needs what information (stakeholder communication requirements).
- What information will be communicated (scope, schedule, budget, risks, issues).
- When the information will be communicated (daily, weekly, monthly).

- How the information will be communicated (email, meetings, dashboards, reports).
- Who is responsible for producing and distributing each type of communication.

Communication Channels Formula

As more people join a project, communication complexity increases significantly. The formula for the number of communication channels is:

Number of Communication Channels = N × (N – 1) ÷ 2, where N is the number of people.

Example: A project with 5 people has 5 × 4 ÷ 2 = 10 communication channels. A project with 10 people has 10 × 9 ÷ 2 = 45 channels. This is why large project teams need structured communication plans.

4.6 Risk Management – Principles and Concepts

Risk management is a critical process in project management. Every project faces uncertainty, and risks are events or conditions that could affect the project positively or negatively. Proactive risk management reduces the impact of threats and maximises the benefit of opportunities.

Risk Definition
"A project risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives such as scope, schedule, cost, or quality." – PMBOK Guide

Key Risk Concepts

- **Threat:** A risk that would have a negative impact on the project if it occurs (e.g., a key team member resigns).
- **Opportunity:** A risk that would have a positive impact if it occurs (e.g., a new technology that could reduce development time).
- **Risk Probability:** The likelihood that a risk event will occur (expressed as a percentage or Low/Medium/High).
- **Risk Impact:** The severity of the effect on the project if the risk occurs (expressed as Low/Medium/High or on a numeric scale).
- **Risk Score:** Risk Score = Probability × Impact. Used to prioritise risks.
- **Risk Appetite:** The amount of risk an organisation is willing to accept in pursuit of its objectives.
- **Risk Threshold:** The specific level of risk above which action must be taken.
- **Residual Risk:** The risk that remains after risk response actions have been implemented.
- **Secondary Risk:** A new risk that arises as a direct result of implementing a risk response.

Principles of Risk Management

- Risk management should be proactive, not reactive.

- All identified risks should be documented in a Risk Register.
- Risks should be reviewed and updated regularly throughout the project.
- Risk management should involve the entire team, not just the project manager.
- Both threats (negative risks) and opportunities (positive risks) should be managed.

4.7 Risk Identification

Risk identification is the process of finding and documenting all risks that could affect the project. It is done at the start of the project but must be repeated throughout the project lifecycle as new risks can emerge at any time.

Common Sources of Project Risks

- **Technical Risks:** Risks related to technology choices, system complexity, integration issues, or new/unproven technology.
- **Schedule Risks:** Risks of delays due to optimistic estimates, dependencies on external parties, or resource unavailability.
- **Cost Risks:** Risks of budget overruns due to incorrect estimates, changing requirements, or inflation.
- **Resource Risks:** Risks of key team members leaving, skills gaps, or insufficient staffing.
- **Stakeholder Risks:** Risks of changing requirements, lack of stakeholder engagement, or conflicting priorities.
- **External Risks:** Risks from outside the project – market changes, regulatory changes, natural disasters, vendor failures.
- **Organisational Risks:** Risks from within the organisation – management changes, shifting priorities, funding cuts.

Risk Identification Techniques

- **Brainstorming:** The team comes together to generate a list of potential risks freely. All ideas are captured without judgement.
- **Delphi Technique:** Anonymous input from experts is gathered in multiple rounds until a consensus is reached. Reduces bias.
- **SWOT Analysis:** Identifying Strengths, Weaknesses, Opportunities, and Threats related to the project.
- **Checklist Analysis:** Using a standard checklist of common risks from previous similar projects.
- **Interviews:** Interviewing experienced team members, stakeholders, and subject matter experts.
- **Root Cause Analysis:** Working backwards from a potential problem to identify its root causes.

- **Assumption Analysis:** Reviewing all project assumptions and identifying what could go wrong if an assumption proves to be false.

Risk Register

The output of risk identification is the Risk Register. This is a document that records all identified risks. It includes:

- Risk ID – a unique identifier for each risk.
- Risk Description – a clear description of the risk event and its potential cause.
- Category – type of risk (Technical, Schedule, Cost, etc.).
- Probability – likelihood of the risk occurring.
- Impact – severity of effect on the project.
- Risk Score – Probability × Impact.
- Risk Owner – the person responsible for monitoring and managing the risk.
- Response Plan – the planned action if the risk occurs.

4.8 Risk Analysis and Prioritisation

After risks are identified, they must be analysed to understand their likelihood and potential impact, and then prioritised so the team can focus its risk management efforts on the most important risks first.

Qualitative Risk Analysis

Qualitative risk analysis is a quick and subjective method of assessing risks using descriptive scales (Low, Medium, High) for both probability and impact. It is the most commonly used method.

A Probability-Impact Matrix (Risk Matrix) is used:

Probability \ Impact	Low Impact	Medium Impact	High Impact
High Probability	Medium	High	Very High (Critical)
Medium Probability	Low	Medium	High
Low Probability	Very Low	Low	Medium

Risks in the "High" and "Critical" zones must be addressed immediately. Risks in "Low" zones are monitored but may not need active response plans.

Quantitative Risk Analysis

Quantitative risk analysis uses numerical data and statistical methods to estimate the probability and impact of risks in monetary or time terms. It is used for large, complex, or high-stakes projects.

- **Expected Monetary Value (EMV):** EMV = Probability × Impact (in money). Used to calculate contingency reserves. Example: A risk with 40% probability and ₹1,00,000 impact has EMV = ₹40,000.

- **Monte Carlo Simulation:** A computer simulation that runs thousands of scenarios using probability distributions to estimate the range of possible project outcomes (cost, time).
- **Decision Tree Analysis:** A diagram that maps out possible decisions and their consequences, helping to choose the best response strategy.
- **Sensitivity Analysis:** Identifies which risks have the greatest impact on project objectives by varying one factor at a time.

Risk Prioritisation

After analysis, risks are ranked and prioritised. High-priority risks (high probability AND high impact) get immediate attention and detailed response plans. Lower-priority risks are monitored regularly but may only need a general watchlist.

4.9 Risk Response Planning and Implementation

Risk response planning is the process of developing strategies and actions to address each identified risk. The goal is to reduce the probability or impact of threats and to increase the probability or impact of opportunities.

Risk Response Strategies for Threats (Negative Risks)

- **Avoid:** Change the project plan to completely eliminate the risk. Example: If a particular technology is too risky, switch to a more reliable one. This is the most effective strategy but may not always be possible.
- **Transfer:** Shift the financial or legal consequences of the risk to a third party. Example: Buy insurance, use fixed-price contracts with vendors, or outsource high-risk work. The risk still exists but someone else bears the impact.
- **Mitigate:** Take action to reduce the probability or impact of the risk to an acceptable level. Example: Conduct more thorough testing to reduce the probability of defects. This is the most commonly used strategy.
- **Accept:** Acknowledge the risk and decide not to take any specific action unless it occurs. Used for low-priority risks. There are two types:
- Active Acceptance: Set aside a contingency reserve (extra budget or time) in case the risk occurs.
- Passive Acceptance: Monitor the risk but take no other action.

Risk Response Strategies for Opportunities (Positive Risks)

- **Exploit:** Take actions to ensure the opportunity definitely occurs. Example: Assign the best team members to a task to ensure it finishes early.
- **Share:** Share the opportunity with a third party who is better positioned to capture it. Example: Form a partnership with another company to jointly benefit from a new market opportunity.

- **Enhance:** Increase the probability or impact of the opportunity. Example: Add extra resources to a task that has the potential to finish well ahead of schedule.
- **Accept:** Take advantage of the opportunity if it occurs but make no active effort to pursue it.

Contingency Plans and Fallback Plans

- **Contingency Plan:** A pre-defined action plan that will be executed when a specific risk event actually occurs. It is prepared in advance for high-priority risks.
- **Fallback Plan:** A secondary response plan used if the primary contingency plan is found to be ineffective. It is a "backup of the backup".
- **Contingency Reserve:** Extra budget or time set aside to cover the costs associated with known risks materialising.
- **Management Reserve:** Additional budget held by management for unknown risks (risks that were not identified during planning).

4.10 Risk Monitoring and Review

Risk monitoring and review is the ongoing process of tracking identified risks, identifying new risks, executing risk response plans, and evaluating the effectiveness of risk management throughout the project lifecycle.

> **Definition**
> *"Risk monitoring and control is the process of tracking identified risks, monitoring residual risks, identifying new risks, executing risk response plans, and evaluating their effectiveness throughout the project life cycle."*

Key Risk Monitoring Activities

- **Risk Reviews:** Regularly scheduled meetings (weekly or at each milestone) where the team reviews the risk register, updates the status of existing risks, and checks if any new risks have emerged.
- **Risk Audits:** An independent examination of the risk management process to ensure it is being followed correctly and effectively.
- **Risk Reassessment:** At key points in the project, all risks are reassessed to check if their probability or impact has changed.
- **Variance and Trend Analysis:** Comparing actual project performance with the plan to identify trends that may indicate emerging risks.
- **Reserve Analysis:** Comparing the amount of contingency reserve remaining with the amount of risk remaining to ensure adequate reserves are maintained.
- **Status Meetings:** Regular project status meetings where risk status is always a standing agenda item.

Risk Triggers (Warning Signs)

A risk trigger (also called a risk symptom or warning sign) is an event or condition that indicates a risk is about to occur or has occurred. Identifying triggers helps the team activate contingency plans quickly.

- A team member reports they are struggling to meet a deadline (trigger for a schedule delay risk).
- A key supplier misses a delivery (trigger for a procurement risk).
- Actual costs exceed planned costs by 10% (trigger for a budget overrun risk).

Updating the Risk Register

The Risk Register must be a "live" document that is updated throughout the project. Updates include:

- Adding newly identified risks.
- Updating the probability and impact of existing risks as more information becomes available.
- Closing risks that are no longer relevant (their time window has passed).
- Recording the outcomes of risks that occurred and the effectiveness of the response.
- Updating response plans as the project context changes.

Risk Management Summary

Process	Description	Key Output
Risk Identification	Find all potential risks	Risk Register (initial)
Qualitative Analysis	Rate probability and impact	Prioritised risk list
Quantitative Analysis	Numerical risk assessment	Probability-based risk data (EMV, Monte Carlo)
Response Planning	Develop response strategies	Risk response plan, contingency reserves
Risk Monitoring	Track and update risks	Updated Risk Register, risk reports