Project Scheduling

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1. Introduction to Project Scheduling

- **Definition:**
  - Project Scheduling is the process of defining the planned start and finish dates for project activities to ensure timely project completion.
- **Importance of Project Scheduling:**
  - Provides a detailed timeline for project execution.
  - Ensures resource availability and allocation.
  - Monitors project progress against planned dates.
  - Identifies potential schedule risks and delays.

2. Key Scheduling Processes (PMBOK 6th Edition)

1. **Plan Schedule Management:**
   - Defines how the schedule will be planned, developed, managed, and controlled.
2. **Define Activities:**
   - Identifies specific actions required to complete project deliverables.
3. **Sequence Activities:**
   - Determines logical order of project tasks and identifies dependencies.
4. **Estimate Activity Durations:**
   - Estimates the time required to complete each activity using various estimation techniques.
5. **Develop Schedule:**
   - Combines activity durations, dependencies, and resources to create the project schedule.
6. **Control Schedule:**
   - Monitors project progress, manages schedule changes, and updates the schedule baseline.

3. Schedule Management Plan Components

- **Schedule Methodology:**
  - Techniques used to develop the schedule (e.g., Critical Path Method, Agile Approach).
- **Scheduling Tools and Techniques:**
  - Gantt Charts, Network Diagrams, Scheduling Software.
- **Schedule Baseline:**
  - Approved version of the schedule used for comparison.
- **Control Thresholds:**
  - Variance limits for schedule performance monitoring.
- **Performance Measurement Rules:**
  - Earned Value Management (EVM), Schedule Performance Index (SPI).

4. Defining Project Activities

- **Work Breakdown Structure (WBS):**
  - Provides the foundation for defining activities.
- **Activity List:**
  - Comprehensive list of all tasks required to complete the project.
- **Activity Attributes:**
  - Detailed information about each activity, including duration, resources, dependencies, and constraints.
- **Milestone List:**
  - Identifies significant project events or deliverables.

5. Activity Sequencing and Dependencies

- **Types of Dependencies:**
  - **Finish-to-Start (FS):** Task B starts after Task A finishes.
  - **Start-to-Start (SS):** Task B starts concurrently with Task A.
  - **Finish-to-Finish (FF):** Task B finishes after Task A finishes.
  - **Start-to-Finish (SF):** Task B finishes after Task A starts.
- **Mandatory vs. Discretionary Dependencies:**
  - **Mandatory (Hard Logic):** Required by contract or project scope.
  - **Discretionary (Soft Logic):** Preferred sequence based on best practices.
- **Internal vs. External Dependencies:**
  - **Internal:** Activities within the project.
  - **External:** Activities outside project control (e.g., regulatory approvals).

6. Network Diagram Techniques

- **Precedence Diagramming Method (PDM):**
  - Visual representation of task dependencies using nodes and arrows.
- **Activity-on-Node (AON):**
  - Nodes represent activities; arrows represent dependencies.
- **Critical Path Method (CPM):**
  - Identifies the longest path of tasks that determine the project duration.
  - Any delay in critical path tasks affects the overall project schedule.
- **Critical Path Analysis Steps:**
  1. Identify project tasks and dependencies.
  2. Create a network diagram.
  3. Calculate Early Start (ES) and Early Finish (EF) dates.
  4. Calculate Late Start (LS) and Late Finish (LF) dates.
  5. Determine Float/Slack:
     - Float = LS - ES or LF - EF

7. Schedule Network Analysis Techniques

- **Forward Pass Analysis:**
  - Calculates ES and EF dates, determining the earliest completion time.
- **Backward Pass Analysis:**
  - Calculates LS and LF dates, identifying slack or float.
- **Total Float:**
  - Amount of time a task can be delayed without impacting the project finish date.
- **Free Float:**
  - Time a task can be delayed without affecting the start of the next task.

8. Schedule Estimation Techniques

- **Analogous Estimating:**
  - Uses historical data from similar projects to estimate durations.
- **Parametric Estimating:**
  - Uses statistical data to calculate duration based on productivity rates.
- **Three-Point Estimating (PERT):**
  - $tE = (tO + 4tM + tP) / 6$
  - Where:
    - tO = Optimistic estimate
    - tM = Most likely estimate
    - tP = Pessimistic estimate

- **Bottom-Up Estimating:**
    - Estimates each work package individually and aggregates to calculate total duration.

9. Develop Project Schedule Techniques

- **Schedule Compression Techniques:**
    - **Crashing:** Adding more resources to reduce task duration (increases cost).
    - **Fast Tracking:** Performing tasks in parallel instead of sequentially (increases risk).
- **Leads and Lags:**
    - **Lead:** Allows successor task to start earlier than predecessor finishes.
    - **Lag:** Delays successor task start after predecessor finishes.
- **What-If Analysis:**
    - Evaluates potential impacts of schedule changes.
- **Monte Carlo Simulation:**
    - Uses random variables to simulate potential schedule outcomes.

10. Schedule Control and Performance Measurement

- **Earned Value Management (EVM):**
    - Measures project performance using metrics such as:
        - Schedule Variance (SV): SV = EV - PV
        - Schedule Performance Index (SPI): SPI = EV / PV
- **Variance Analysis:**
    - Identifies deviations from the schedule baseline.
- **Schedule Forecasting:**
    - Estimates future schedule performance using trend analysis.
- **Burndown Chart:**
    - Visual representation of remaining work against time.

11. Tools and Techniques for Schedule Management

- **Gantt Chart:**
    - Visual representation of tasks over time using bar charts.
- **PERT Chart:**
    - Network diagram that incorporates time estimates for each task.
- **Critical Chain Method (CCM):**
    - Focuses on resource constraints and buffers.
- **Resource Optimization Techniques:**
    - **Resource Leveling:** Adjusts task start/end dates based on resource availability.
    - **Resource Smoothing:** Adjusts schedule without altering critical path.

12. Key Terms and Definitions

- **Baseline:** Approved project schedule used for comparison.
- **Milestone:** Key project event or deliverable.
- **Float/Slack:** Amount of time a task can be delayed without affecting the project schedule.
- **Lead Time:** Time gained by starting a task earlier.
- **Lag Time:** Delay between tasks.