

Project Time Management

Study Notes



Points to Note

- Please read chapter 6 from Project Management Institute, A Guide to the Project Management Body of Knowledge, (*PMBOK® Guide*) – Fifth Edition, Project Management Institute, Inc., 2013 (pages 141-192).
- The study notes explain topics that are important for PMP® exam preparation, and you can expect several questions from these topics.
- Pay close attention to all the terms used. It is very important to understand all the concepts discussed in this chapter.
- Try to relate the concepts to real life examples.
- After reading the study notes, please answer the chapter test questions in this knowledge area. The chapter questions improve your understanding of the concepts discussed in the study notes.



What is Project Time Management?

- *Project Time Management includes processes required to manage the timely completion of the project.
- Processes involved in the project time management include:
 - Plan Schedule Management
 - Define Activities
 - Sequence Activities
 - Estimate Activity Resources
 - Estimate Activity Durations
 - Develop Schedule
 - Control Schedule
- Each of these processes occur at least once in every project and in one or more project phases (if the project is divided into phases).

Please refer to *PMBOK® Guide* - Fifth Edition, figure 6-1, page 143. This provides an overview of the processes in Project Time Management.

*This definition is taken from the Glossary of the Project Management Institute, A Guide to the Project Management Body of Knowledge, (*PMBOK® Guide*) – Fifth Edition, Project Management Institute, Inc., 2013



Plan Schedule Management

- *Process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.
- Guides and directs how the project schedule will be managed throughout the project.
- Some of the main inputs are:
 - Project Management Plan
 - Project Charter
- Tools and Techniques used are:
 - Expert judgment
 - Analytical techniques
 - Meetings
- Schedule management plan is the only output of this process
- *The schedule management plan is a component of the project management plan that establishes the criteria and the activities for developing, monitoring, and controlling the schedule.
- The schedule management plan could be either formal or informal, highly detailed or broadly framed.

*These definitions are taken from the Glossary of the Project Management Institute, A Guide to the Project Management Body of Knowledge, (PMBOK® Guide) – Fifth Edition, Project Management Institute, Inc., 2013



Define Activities

- *Process of identifying and documenting the specific actions to be performed to produce the project deliverables.
- Activities are smaller decomposed components of the project work packages, which represent the work necessary to complete the work package.
- Tools and Techniques used in Define Activities process:
 - Decomposition
 - Rolling wave planning
 - Expert judgment
- Outputs of Define Activities process are:
 - Activity list
 - Activity attributes
 - Milestone list

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Decomposition

- *A technique used for dividing and subdividing the project scope and project deliverables into smaller, more manageable parts.
- Subdivides the project work packages into activities
- Provides better management control
- Leads to activities, the lowest level of the work packages in the Define Activities process
- Leads to the work package, the lowest level in the Work Breakdown Structure (WBS) in the Create WBS process, where the deliverables are identified
- Process can involve team members. This can lead to better and more accurate results.

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Sequence Activities

- Identifies and documents relationships among project activities
- Uses logical relationships
- Can be performed by using manual or automated techniques or project management software
- *Some important inputs are:
 - Schedule management plan
 - Activity list
 - Activity attributes
 - Milestone list
 - Project scope statement
- Tools and Techniques used for the Sequence Activity process are:
 - Precedence diagramming method (PDM)
 - Dependency determination
 - Leads and lags



Precedence Diagramming Method (PDM)

- *A technique used for constructing a schedule model in which activities are represented by nodes and are graphically linked by one or more logical relationships to show the sequence in which the activities are to be performed.
- Activity–On-Node (AON) is one of the methods representing precedence diagram. It is used by most project management software packages
- Includes four types of dependencies or logical relationships:
 - Finish-to-start (FS)
 - Finish-to-finish (FF)
 - Start-to-start (SS)
 - Start-to-finish (SF)
- Most commonly used precedence relationship: the finish-to-start (FS)
- Does not use dummy activities
- Does not allow for loops or conditional branches

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Activity on Node

- Activity on Node (AON) or Precedence Diagramming Method (PDM) showcases the interdependencies among various project activities.
- This technique is used to draw the project schedule network diagrams; e.g. Critical Path Network Diagram to identify the Critical path and the float for each activity
- In an AON diagram, each rectangle box represents a node and a project activity. These rectangular boxes are connected using arrows to the succeeding activity box thereby portraying the project dependencies.
- Activity on Node uses four types of dependencies.
 - Finish to Start (FS): The end of one activity is required for the start of the next one. This is the most common dependency
 - Finish to Finish (FF): The end of the first activity is required for the second activity to finish
 - Start To Start (SS): The second activity starts only after the first activity has started
 - Start to Finish (SF): second activity cannot be finished until first activity starts.



Conditional Diagramming Methods

- Allows non-sequential loops or conditional branches
- Example:
 - GERT (graphical evaluation and review techniques)
 - System dynamics



Types of Dependencies

- Mandatory dependencies:
 - Also referred to as hard logic
 - Required as per contract or inherent in the nature of the work
 - Usually involve physical limitations (e.g., you cannot build the ceiling until walls are constructed)
 - Are determined by the project management team during the activity sequencing process
- Discretionary dependencies:
 - Also referred to as preferred logic, preferential logic, or soft logic
 - Are determined by the project management team during the activity sequencing process
 - Should be used with care and well documented, since they may limit later scheduling options
- External dependencies:
 - Are determined by the project management team during the activity sequencing process
 - *Involve a relationship between project and non-project activities such as activities outside the project team's control (e.g., dependence on external sources for deliveries, environmental factors governed by statutes, etc.)
- Internal dependencies:
 - Are determined by the project management team during the activity sequencing process
 - Involve a precedence relationship between project activities



Project Schedule Network Diagrams

- Is the main output of Sequence activities
- *A graphical representation of the logical relationships among the project schedule activities.
- Can be produced manually or using project management software
- Can have full project details, or have one or more summary activities

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Estimate Activity Resources

- Estimates the type and quantities of material, human resource, equipment, or supplies required to perform each activity.
- Identifies the quality, type, and characteristics of resources required to complete the activity.
- Coordinates closely with Estimate Costs process
- *Some important inputs are:
 - Schedule management plan
 - Activity list
 - Activity attributes
 - Resource calendars
 - Risk register
 - Activity cost estimates
- *Tools and Techniques used are:
 - Expert judgment
 - Alternative analysis
 - Published estimating data
 - Bottom-up estimating
 - Project management software

Project Management Institute, A Guide to the Project Management Body of Knowledge, (*PMBOK® Guide*) – Fifth Edition, Project Management Institute, Inc., 2013, Page 161



Outputs of Estimate Activity Resources

- Activity Resource Requirements
 - *The types and quantities of resources required for each activity in a work package
 - Determines the estimated resources for each work package and each work period by aggregating their requirements like the types and the quantities
 - Will be documented by including basis of estimates and the assumptions made

- Resource Breakdown Structure
 - *Is a hierarchical representation of resources by category and type
 - Helps organize and report project schedule data with resource utilization information

- Project Document Updates
 - The project documents that may be updated include:
 - Activity list
 - Activity attributes
 - Resource calendars

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Estimate Activity Durations

- Process of estimating the number of work periods needed to complete individual activities with estimated resources.
- Provides the amount of time each activity will take to complete.
- Uses information on the activity scope of work, required resource types, estimated resource quantities, and resource calendars, as well as historical information.
- Is progressively elaborated with duration estimates becoming progressively more accurate and of better quality
- Should take into consideration the input data's quality and availability
- All assumptions and data used for supporting the duration estimating are documented
- Tools and Techniques used are:
 - Expert judgment
 - Analogous estimating
 - Parametric estimating
 - Three-point estimating
 - Group decision-making techniques
 - Reserve analysis



Historical Information

- Available from:
 - Project files: Records of previous project results that are detailed enough to help in duration estimating.
 - Commercial duration estimating databases: Available for standard tasks.
 - Team members' past experience: Individual members of the project team, who worked on prior similar projects, and who might be able to recollect details of estimates from those projects for possible application in the current project.



Analogous Estimating (Top-Down Estimating)

- *A technique for estimating the duration or cost of an activity or a project using historical data from a similar activity or project.
- It is a gross value estimating approach
- Used when there is a limited amount of any in-depth information about the project.
- Uses historical information and expert judgment
- Less costly and less time consuming than other techniques
- Generally less accurate
- Most reliable when:
 - Previous activities are similar in fact and not just in appearance.
 - Individuals preparing the estimates have the needed experience.

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Parametric Estimating

- *An estimating technique in which an algorithm is used to calculate cost or duration based on historical data and project parameters.
- Uses a statistical relationship between historical information and other variables to calculate an estimate for activity parameters
- Determines how many times the specific work category is going to be performed in the given activity
- Can be applied to a total project or segments of a project
- Activity durations=Quantity of work to be performed x Labor hours per unit of work

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Three-Point Estimating

- With limited information to find out activity durations, the **three-point estimating** technique is used to find a distribution of the durations for different scenarios.
- Three estimates are produced based on prior experience or best-guesses:
 - O = the optimistic estimate
 - M = the most likely estimate
 - P = the pessimistic estimate.
- The two commonly used formulae for calculating the expected duration, E , are triangular and beta distribution formula, which are given below:
 - *Beta Distribution formula:* $E = (O + 4M + P) / 6$
 - *Triangular Distribution formula:* $E = (O + M + P) / 3$



Develop Schedule

- *The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model.
- Iterative process
- Determines the project activities' scheduled start and finish dates
- Determines the milestones' scheduled start and finish dates
- Tools and Techniques used are:
 - Schedule network analysis
 - Critical path method
 - Critical chain method
 - Resource optimization techniques (like Resource leveling and Resource Smoothing)
 - Modeling techniques (like What-If Scenario and Simulation)
 - Leads and lags
 - Schedule compression
 - Scheduling tool

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Constraints and Milestones

Constraints:

- *A limiting factor that affects the execution of a project, program, portfolio, or process
- Factors that will limit a management team's options for a defined course of action.
- An internal or external restriction that will affect the project
- Internal to the project - Dates imposed on any planned activity, used to restrict the start or finish dates for the tasks, “start no earlier than” and “finish no later than” types, etc.
- External to the project - Market window on a technology project, weather restrictions on outdoor activities, government-mandated compliance requirements, etc.

Key event or major milestone schedule:

- *A summary-level schedule that identifies the major schedule milestones
- Denotes identified deliverables and their specified dates of completion, as requested by project sponsor, customer, or other stakeholders
- Once scheduled, milestones may be difficult to shift

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Mathematical Analysis

- Involves calculating theoretical early and late start and finish dates
- Popular techniques:
 - Critical Path Method (CPM):
 - *Used to estimate the minimum project duration and determine the amount of scheduling flexibility on the logical network paths within the schedule model.
 - Used to calculate early and late start and finish dates for each activity based on specified sequential network logic and activity duration estimates
 - Project Evaluation and Review Technique (PERT):
 - *A technique for estimating that applies a weighted average of optimistic (O), pessimistic (P), and most likely (M) estimates when there is uncertainty with the individual activity estimates.
 - The two commonly used formulae for calculating the expected duration, E , are triangular and beta distribution formula, which are given below:
 - *Beta Distribution formula: $E = (O + 4M + P) / 6$*
 - *Triangular Distribution formula: $E = (O + M + P) / 3$*

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Schedule Compression

- *Techniques used to shorten the schedule duration without reducing the project scope
- Techniques used are:
 - Crashing:
 - *A technique used to shorten the schedule duration for the least incremental cost by adding resources.
 - Will only work for those activities on the critical path where additional resources will reduce the activity's duration
 - Does not always produce a viable alternative
 - Could increase either risk or cost, or both risk and cost of the project
 - Fast tracking:
 - *A schedule compression technique in which activities or phases normally done in sequence are performed in parallel for at least a portion of their duration.
 - Works only if activities overlap
 - Can result in rework and increased risk

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Simulation, Resource Leveling, and Critical Chain Method

Simulation:

- Involves calculating multiple project durations with different sets of activity assumptions to assess the feasibility of the project schedule under adverse conditions, such as delay in major component delivery, strike, etc. Monte Carlo analysis is the most common simulation technique.

Resource Leveling

- *A technique in which start and finish dates are adjusted based on resource constraints with the goal of balancing demand for resources with the available supply.
- Done because mathematical analysis produces a preliminary early-start schedule that requires more than the allocated resources during certain time periods
e.g., Rule of thumb – “allocate scarce resources to critical path activities first.”
- Often results in a project duration that is longer than the preliminary schedule. (Also called “resource based method”).

Critical Chain Method:

- *A schedule method that allows the project team to place buffers on any project schedule path to account for limited resources and project uncertainties.

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Resource Smoothing

- *A technique which adjusts the activities of a schedule model such that the requirement for resources on the project do not exceed certain predefined resource limits.
- In this technique:
 - Project's critical path is not changed
 - Completion date may not be delayed
- Activities within their free and total float may only be delayed

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Project Schedule

- Should have at least a planned start date and a planned finish date for each activity.
- A targeted schedule can also be made with a defined target start and end date for every activity.
- Can be presented in detail or in summary form (referred to as master schedule or milestone schedule)
- Often presented graphically or in tabular form
- Graphically presented using:
 - Milestone charts
 - Bar charts
 - Project schedule network diagrams



Schedule Updates, Schedule Baseline, and New Target Schedules

- Schedule Updates:
 - Any modifications to the project schedule
- Schedule baseline:
 - *The approved version of a schedule model that can be changed only through formal change control procedures and is used as a basis for comparison to actual results.
 - Component of the project management plan, which is accepted and approved by appropriate stakeholders
 - Has a baseline start date and baseline finish date. It is an updated version of the project schedule and is developed from the schedule network analysis
 - Can be changed to incorporate the approved change requests related to project scope changes/resources/duration estimates
- New target schedules:
 - If there are small changes to the project schedule, then the schedule baseline is kept constant – but new target schedules may be used.
 - If the project schedule gets delayed severely, then a new target schedule has to be developed, which forecasts the start and finish dates needed for providing realistic data for directing work, and measuring performance and progress.

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