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*) – Fourth Edition, Project Management Institute, Inc., 2008 (pages 129-164).

- 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?

- Processes required to manage timely completion of the project.
- Processes involved in the project time management include:
  - 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 figure 6-1, *PMBOK® Guide* Fourth Edition, page 131. This provides an overview of the processes in project time management.

Define Activities

- Process to identify specific actions that need to be performed to produce 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
  - Templates
  - Expert judgment
- Outputs of Define Activities process are:
  - Activity list
  - Activity attribute
  - Milestone list

Decomposition

- 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.

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
- Tools and Techniques used for the Sequence Activity process are:
  - Precedence diagramming method (PDM)
  - Dependency determination
  - Applying leads and lags
  - Schedule network templates

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.)

Precedence Diagramming Method (PDM)

- Used in the Critical Path Methodology (CPM) for constructing the project schedule network diagram
- Uses nodes to represent the activities and connects them with arrows that reflect dependencies and the logical relationships that exist between the activities
- Includes four types of dependencies or logical relationships:
  - Finish-to-start (FS)
  - Finish-to-finish (FF)
  - Start-to-start (SS)
  - Start-to-finish (SF)
- Uses, most commonly, the finish-to-start (FS) precedence relationship
- Is also called Activity–On-Node (AON) and is used by most project management software packages
- Does not use dummy activities
- Does not allow for loops or conditional branches

Conditional Diagramming Methods

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

Schedule Network Templates

- Can be used to expedite preparation of networks of project activities
- Includes entire project or only a portion of it
- Portions of a project schedule network diagram are referred to as a subnetwork or a fragment network.

Project Schedule Network Diagrams

- Is the main output of Sequence activities
- Schematic displays of the project's schedule activities and the logical relationships among them (also referred to as dependencies)
- Can be produced manually or using project management software
- Can have full project details, or have one or more summary activities

Estimate Activity Resources

- Estimates the type and quantities of material, people, equipment, or supplies required to perform each activity.
- Is closely coordinated with the Estimate Costs process
- Tools and Techniques used are:
  - Expert judgment
  - Alternatives analysis
  - Published estimating data
  - Bottom-up estimating
  - Project management software

Outputs of Estimate Activity Resources

- Activity Resource Requirements
  - Identifies the types and quantities of resources required for each activity in a work package
  - Determines the estimated resources for each work package 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 structure of resources by type and category
  - Organizes and reports project schedule data with resource utilization information
- Project Document Updates
  - The project documents that may be updated include:
    - Activity list
    - Activity attributes
    - Resource calendars

Estimate Activity Durations

- Process that requires the estimate of the amount of work effort required and the amount of resources to be applied for approximating the work periods needed to complete the activity.
- 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-Points estimating
  - 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)

- An estimating technique
- Uses the parameters from a previous, similar project as the basis for estimating the same parameter for a future project
- It is a gross value estimating approach
- Uses historical information and expert judgment
- Less costly and 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.

Parametric Estimating

- 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

Develop Schedule

- Analyzes activity sequences, durations, resource requirements, and schedule constraints to create the project schedule
- 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 leveling
  - What-if scenario analysis
  - Applying leads and lags
  - Schedule compression
  - Scheduling tool

Constraints and Milestones

Constraints:

- 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's performance
- 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:

- Summarizes schedules that identify significant or major milestones in the project
- Denotes identified deliverables and their specified dates of completion, as requested by project sponsor, customer, or other stakeholders
- Once scheduled, the milestones may be difficult to shift

Mathematical Analysis

- Involves calculating theoretical early, and late start and finish dates
- Popular techniques:
  - Critical Path Method (CPM):
    - Used to determine the amount of flexibility in scheduling various logical network paths in the project schedule network
    - Used to determine the minimum total duration of the project
    - Used to calculate a single deterministic early and late start and finish date for each activity based on specified sequential network logic and activity duration estimates
  - Project Evaluation and Review Technique (PERT):
    - A technique that is used to estimate the activity duration by applying a weighted average of optimistic (to), pessimistic (tp), and most likely (tm) estimates, when there is uncertainty with the individual activity estimates.
    - Analysis calculates the expected activity duration (te) as indicated below:

$$t_e = \frac{t_o + 4t_m + t_p}{6}$$

Schedule Compression

- Shortens the project schedule to meet the imposed dates, schedule's constraints, or other objectives without changing the scope of the project

- Techniques used are:

  - Crashing:
    - A technique by which cost and schedule tradeoffs are analyzed to determine how to obtain the greatest amount of compression for the least incremental cost
    - Will only work for those activities where additional resources will reduce the 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 technique of performing activities in parallel that would normally be done in sequence
    - Works only if activities overlap
    - Can result in rework and increased risk

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.
- Common techniques:
  - Monte Carlo analysis
  - What-if analysis (using logic network to compute different scenarios)

Resource Leveling Heuristics

- 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 network analysis technique that modifies the project schedule to account for limited resources.

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, Re-baselining, and New Target Schedules

- Schedule Updates:
  - Any modifications to the project schedule
- Schedule baseline:
  - Component of the project plan, which is accepted and approved by the project management team
  - 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
  - Provides the basis for measuring and reporting schedule performance
  - Can be changed to incorporate the approved change requests related to project scope changes/resources/duration estimates
- Re-baselining:
  - Performed if schedule delays are very severe
  - Used to provide realistic data to measure performance (done in only extreme cases, because all historical data will be lost).
- 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.

Three Point Estimate

- With limited information to find out activity durations, the **three-point estimation** 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**
  - ***L* = the least likely estimate.**
- These values are used to calculate an *E* value for the estimate and a standard deviation (SD) where:
  - $E = (O + 4M + L) / 6$
  - $SD = (L - O)/6$

Activity on Node

- Activity on Node (AON) or Precedence Diagramming Method (PDM) showcases the inter-dependencies 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.