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Crosswind Success Series:
PMP® Exam Bootcamp Manual

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11.4. Estimate Activity Durations (Planning Process Group)

During the Estimate Activity Durations process, the number of workdays (or hours) to complete each activity is estimated.

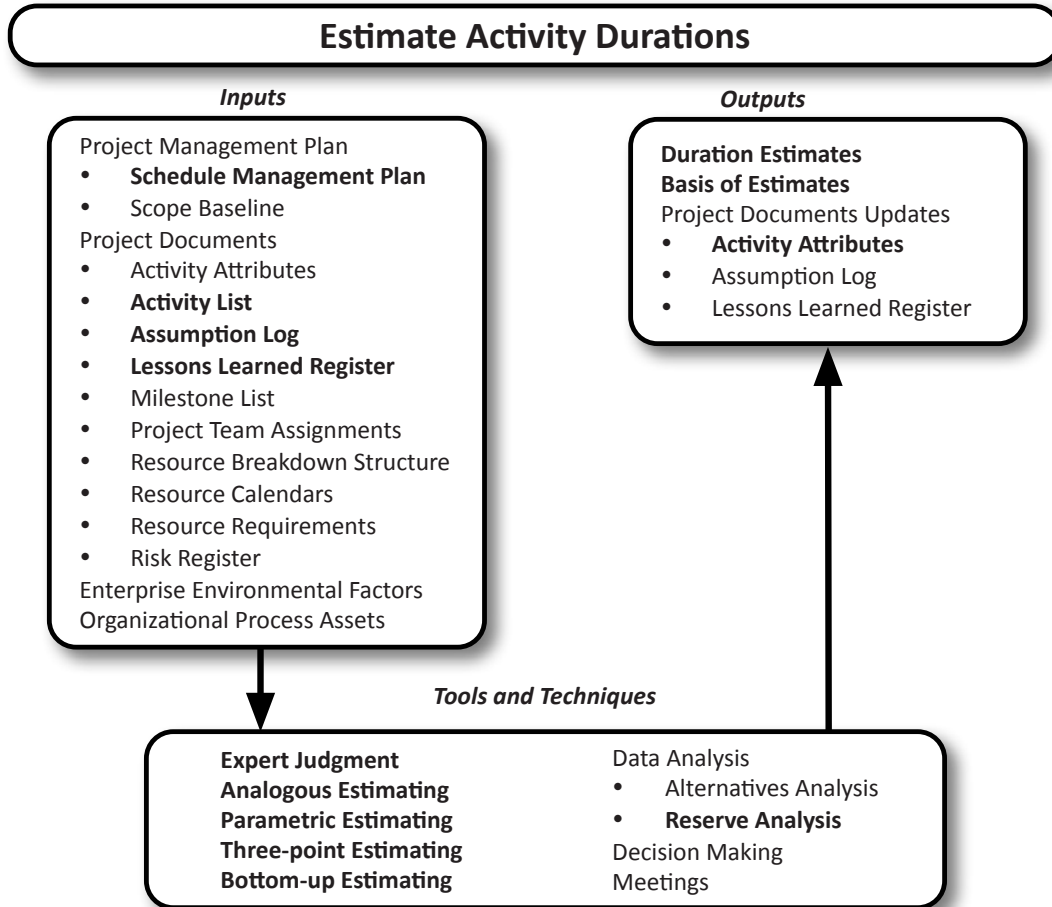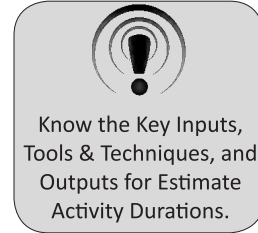That estimation then rolls up to create summary (high-level) estimates.

Estimate Activity Durations

Inputs

Project Management Plan
- **Schedule Management Plan**
- Scope Baseline

Project Documents
- Activity Attributes
- **Activity List**
- **Assumption Log**
- **Lessons Learned Register**
- Milestone List
- Project Team Assignments
- Resource Breakdown Structure
- Resource Calendars
- Resource Requirements
- Risk Register

Enterprise Environmental Factors
Organizational Process Assets

Outputs

Duration Estimates
Basis of Estimates
Project Documents Updates
- **Activity Attributes**
- Assumption Log
- Lessons Learned Register

Tools and Techniques

Expert Judgment
Analogous Estimating
Parametric Estimating
Three-point Estimating
Bottom-up Estimating

Data Analysis
- Alternatives Analysis
- **Reserve Analysis**
Decision Making
Meetings

Figure 11-12: Estimate Activity Durations Data Flow Diagram
The source for the above figure is the Project Management Institute, *A Guide to the Project Management Body of Knowledge*, (*PMBOK® Guide*) – Sixth Edition, Project Management Institute Inc., 2017, Figure 6-12, Page 195

Estimate Activity Durations (Planning)		
Key Inputs	Schedule Management Plan	The schedule management plan is a component of the project management plan that details the delineation, evolution, monitoring, and control of the schedule. It delineates scheduling methodology, as well as the degree of expected accuracy needed to estimate the duration of the scheduled activities.

Estimate Activity Durations (Continued)		
Key Inputs (Cont.)	Activity List	The activity list enumerates the schedule activities stipulated for sequencing. Sequencing can be influenced by dependencies and other constraints. Activity attributes may delineate successor or predecessor, lead, lag, and logical associations that may influence the estimation of durations. Note that the activity list is a component of the schedule, but NOT of the WBS. A rule of thumb is to break down the activity list to the point where the activities are **4-80** hours in duration. Project managers commonly call activities "tasks," but according to Project Management Institute, Inc. standards, the term "activities" is generally more appropriate. If rolling wave planning or agile is used, the list must be reviewed regularly and updated as necessary.
	Assumption Log	The assumption log is a document that lists the assumptions and constraints identified during the creation of the project charter. An assumption is an idea or statement taken to be true. An example of an assumption is the statement "there will be a robust market for the product created as a result of this project once it is available to the public." Examples of constraints are the project completion deadline, the budget threshold, or the limit on the number of employees that can be dedicated to the project. It's important to identify assumptions and constraints as early as possible and to update them as the project evolves. Due to the risks inherent in assumptions and constraints, they may impact the project schedule.
	Lessons Learned Register	The lessons learned register is a record of the challenges, problems, and successes of the project (what worked and didn't). The register contains detailed and important project knowledge. It is updated to reflect new knowledge and can be helpful to increase the degree of accuracy for duration and work estimates.
Key Tools & Techniques	Expert Judgment	Expert judgment is judgment based on expertise acquired in a specific area. It is important to consider expertise related to the evolution, administration, and control of the schedule, estimation techniques, and knowledge of the industry or area of application and experience with previous projects similar to the current project.

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Estimate Activity Durations (Continued)		
Key Tools & Techniques (Cont.)	Analogous Estimating	Analogous estimating is a high-level estimation technique based on historical duration or cost data from a similar activity or project. The technique adjusts for known variances in complexity from the current activity or project under consideration and the historical activity or project. While this technique costs less and is not as time consuming as more detailed techniques, it is typically not as accurate.
	Parametric Estimating	Parametric estimating is an estimation technique in which an algorithm is used to calculate duration or cost based on historical duration or cost data and other variables from a similar activity or project. The quantitative technique uses a mathematical relationship between historical data and other variables. The accuracy of this technique is dependent on the underlying model.
	Three-point Estimating	Three-point estimating is an estimation technique in which the range for activity duration is averaged based on pessimistic, optimistic, and realistic (most likely) estimates. The **triangular distribution** formula is often used if the historical data is insufficient and the **beta distribution** formula is often used when the historical data is sufficient. Three-point estimating, unlike PERT estimating, does not apply a weighted average.
	Bottom-up Estimating	Bottom-up estimating is an estimation technique in which duration or cost is determined by rolling up estimates of each WBS component of the item being estimated.
	Reserve Analysis	Reserve analysis is used to determine the amount of contingency and management reserves required for the project. By analyzing the known unknowns (identified risks, typically with mitigation plans), contingency reserves can be determined to account for schedule uncertainties. Management reserves are budget reserves set aside to account for unknown unknowns (unforeseen work within the scope of the project).
Key Outputs	Duration Estimates	Duration estimates are quantitative estimates of activity durations. They are often expressed as a range of time or a probability of reaching a specific duration.

Estimate Activity Durations (Continued)		
Key Outputs (Cont.)	Basis of Estimates	The basis of estimates for duration includes documentation that delineates the manner in which the estimates were determined, lists all assumptions and constraints, identifies the range of estimates used and the degree of certainty associated with those estimates, and details individual project risks that impacted those estimates.
	Activity Attributes	Activity attributes clarify an activity by identifying multiple components related to the activity. The components evolve during the project: during the initial stage, they include a singular activity identifier, a WBS identifier, and an activity label; when completed they typically include a description of the activity, predecessor and successor activities, logical relationships, leads and lags, resource needs, constraints, assumptions, and exact dates. They are used to evolve the schedule and clarify reporting.

Situational Question and Real World Application
Failure to effectively perform the Estimate Activity Durations process can result in the failure to properly estimate activities, which often results in schedule and cost overruns. If inaccurate estimates cause time slippage, the cost component of the triple constraint is often impacted.

11.4.1. Estimating Methods

It is very important to understand and recognize the estimating methods used in situational examples:

Know the characteristics of the estimating methods analogous, bottom-up, parametric, and computerized.

- Analogous
- Bottom-up
- Parametric
- Computerized (Monte Carlo)

Method	Description	Example
Analogous (Sometimes called Top-Down)	This estimate is usually a total time or cost estimate that has no significant detail. The main advantage of this estimate is that it can be created **quickly**; the disadvantage is that it **lacks detail** or individual piece estimates. Typically, it is called an **analogous method** when the estimate is based on the time or cost of a **similar project**.	An executive or a subject matter expert (SME) creates a high-level estimate **based on experience or past project history.**

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Method	Description	Example
Bottom-up	Compared to the analogous estimate, the main advantage of the bottom-up method is **detail and accuracy**. The disadvantage is that it **can take significant time to create** and the team may pad the estimate to compensate for unknowns.	The project manager and the team work together to create a complete estimate from the bottom (activity level) up and roll it up to the total estimate.
Parametric	Based on an **existing parameter**, this method is usually created by industry standards or experience. The advantage is that it **can be done quickly** and is usually **accurate**.	A house builder quotes the cost of a house at $150.00 per square foot. A carpet installer quotes $5.00 per square yard for installation.
Computerized/ Monte Carlo	Monte Carlo is a **computerized tool that simulates project outcome** to determine factors such as **time** or **cost** or number of needed **resources**. The main advantages are the accuracy of estimates and the "what-if" analysis that can be performed. The main disadvantages are the ramp-up time and cost associated with setting up of the tool.	Variables could include the overall time and cost estimates, as well as the confidence levels of the estimates. Variables could also include the number of people needed to achieve project goals.

PERT (*Program Evaluation Review Technique*)

The Program Evaluation Review Technique (PERT), also known as beta distribution, is a weighted averaging approach that uses three estimates per activity: pessimistic, optimistic, and most likely (realistic).

The theory is that using a pessimistic, optimistic, and most likely (realistic) approach yields a more accurate result.

Note that the PERT formula can be used to calculate time or cost.

Know the concepts of the PERT estimating method. Know that PERT stands for Program Evaluation Review Technique.

The formula for PERT is:

$$\frac{(O + P + (4 \times M))}{6} \quad \text{or} \quad t_E = \frac{t_O + 4t_M + t_P}{6}$$

In the first formula, O is Optimistic, P is Pessimistic, and M is Most Likely (R,Realistic, could be substituted for M). In the second formula, T is Time, E is Estimated, O is Optimistic, M is Most Likely, and P is Pessimistic.

11.4.2. Parkinson's Law

According to Parkinson's Law, work expands to consume the time scheduled for its completion. This observation of economics was made by C. Northcote Parkinson based on his experience in the British Civil Service. He noted that as the British Empire shrank in size and significance, the colonial office staff actually increased.

Parkinson's Law can be applied to:

- Generalized situations
  The demand upon a resource expands to match the supply of the resource.
- Computer storage
  Data expands to fill the space available.
- Financial situations
  Expenses rise to meet income.

11.4.3. Schedule Processes

Figure 11-13: Overview of Schedule Processes illustrates the processes and primary artifacts of the Project Schedule Management knowledge area.
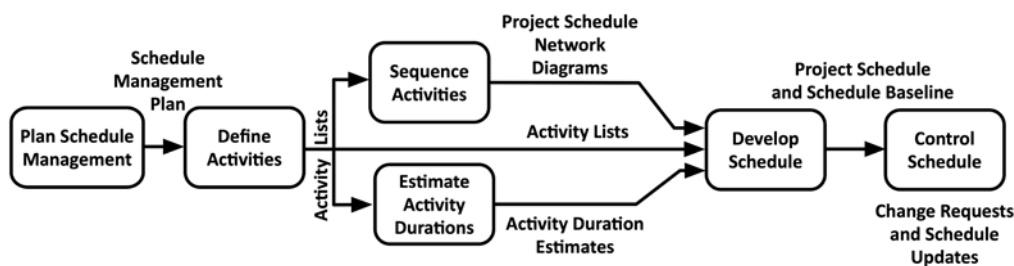

Figure 11-13: Overview of Schedule Processes
The source for the above figure is the Project Management Institute, *A Guide to the Project Management Body of Knowledge*, (*PMBOK® Guide*) – Sixth Edition, Project Management Institute Inc., 2017, Figure 6-1, Page 174

The processes in sections 11.1, 11.2, 11.3, and 11.4 lead to the development of the project schedule and establishment of the schedule baseline.

The source for the above text is the Project Management Institute, *A Guide to the Project Management Body of Knowledge*, (*PMBOK® Guide*) – Sixth Edition, Project Management Institute Inc., 2017, Pages 195-204

11.5. Develop Schedule (Planning Process Group)

During the Develop Schedule process, the creation of activity lists, the sequencing of activities, and the estimation of activity durations all come together to create the project schedule.

Note that on smaller projects, Define Activities, Sequence Activities, Estimate Activity Resources (EAD), and Develop Schedule may occur as a single overall process.

Know the Develop Schedule concepts. Know the Key Inputs, Tools & Techniques, and Outputs for Develop Schedule.