



Project Schedule Management

Learning Objectives

- Illustrate the importance that project schedules and good project schedule management can have in helping to make projects successful
- Discuss the process of planning schedule management
- Define activities as the basis for developing project schedules
- Describe how project managers use network diagrams and dependencies to assist in activity sequencing
- Explain how various tools and techniques help project managers perform activity duration estimates
- Use a Gantt chart for planning and tracking schedule information, find the critical path for a project, and describe how critical chain scheduling and the Program Evaluation and Review Technique (PERT) affect schedule development

Learning Objectives

- Compare how schedule management is addressed using Agile vs. more predictive project approaches
- Discuss how reality checks and discipline are involved in controlling and managing changes to the project schedule
- Describe how project management software can assist in project schedule management and review words of caution before using this software
- Discuss considerations for agile/adaptive environments

The Importance of Project Schedules

- Project time management processes
 - ***Planning schedule management***
 - ***Defining activities***
 - ***Sequencing activities***
 - ***Estimating activity resources***
 - ***Estimating activity durations***
 - ***Developing the schedule***
 - ***Controlling the schedule***

Planning Schedule Management

- Elements of a schedule management plan
 - ***Project schedule model development***
 - ***Scheduling methodology***
 - ***Level of accuracy and units of measure***
 - ***Control thresholds***
 - ***Rules of performance measurement***
 - ***Reporting formats***
 - ***Process descriptions***

Defining Activities

- Defining activities involves identifying the specific actions that will produce the project deliverables in enough detail to determine resource and schedule estimates
 - **Activity list:** a tabulation of activities to be included on a project schedule
 - Activity name, activity identifier or number, and brief description of the activity
 - **Activity attributes:** provide more information
 - Predecessors, successors, logical relationships, leads and lags, resource requirements, constraints, imposed dates, and assumptions related to the activity

Sequencing Activities

- Sequencing process involves evaluating the reasons for dependencies and the different types of dependencies
 - A dependency or relationship is the sequencing of project activities or tasks
 - **Mandatory dependencies:** *inherent in the nature of the work being performed on a project, sometimes referred to as **hard logic***
 - **Discretionary dependencies:** *defined by the project team, sometimes referred to as **soft logic**. and should be used with care since they may limit later scheduling options*
 - **External dependencies:** *involve relationships between project and non-project activities*
 - **Internal dependencies:** *involve relationships between project activities*

Sequencing Activities

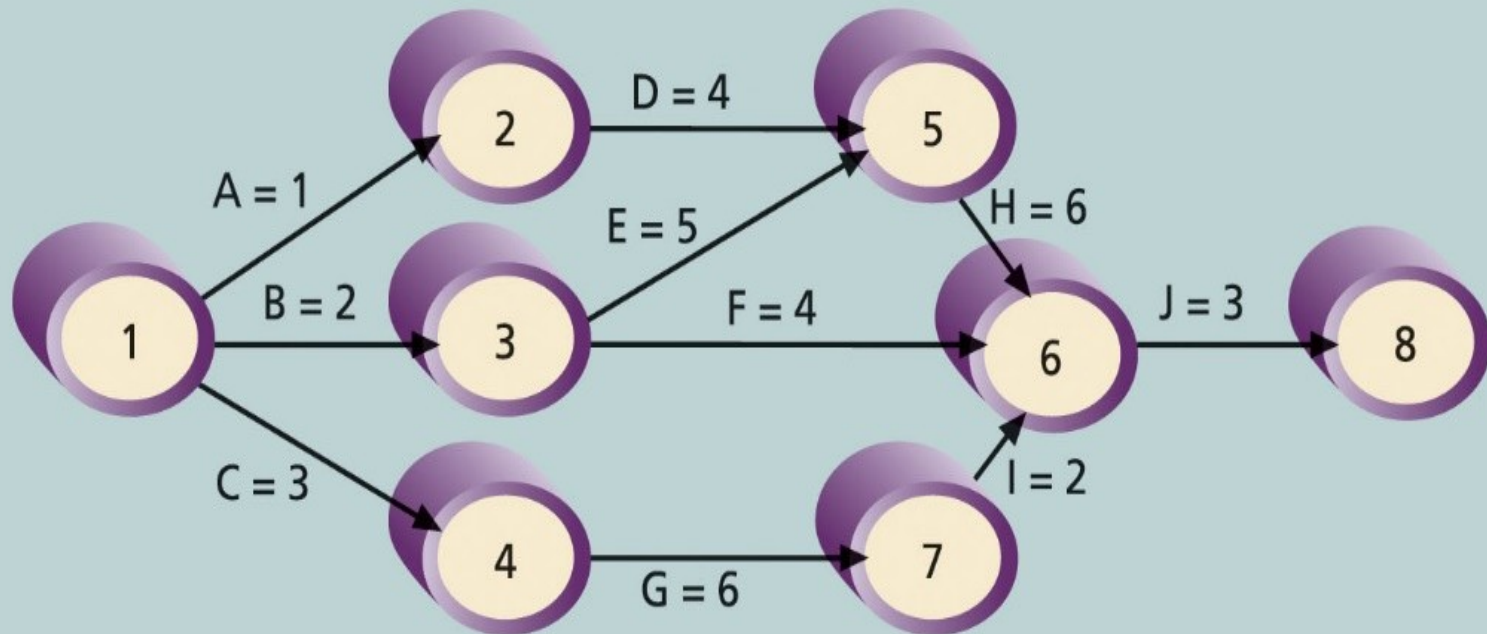
Network diagrams are the preferred technique for showing activity sequencing

Schematic display of the logical relationships among, or sequencing of, project activities

Two main formats are the:

1. Activity On Arrow
2. Activity On Node (Precedence Diagramming Methods)

Sequencing Activities



Note: Assume all durations are in days; A=1 means Activity A has a duration of 1 day.

FIGURE 6-2 Network diagram for project X

Sequencing Activities

- Arrow diagramming method (ADM) (i.e., activity-on-arrow network diagrams)
 - Activities are represented by arrows
 - Nodes or circles are the starting and ending points of activities
 - Only show finish-to-start dependencies
 - Refer to the text for the step-by-step process of creating AOA diagrams
- Precedence diagramming method (PDM)
 - Network diagramming technique in which boxes represent activities
- Types of dependencies or relationships between activities
 - **Finish-to-start**
 - **Start-to-start**
 - **Finish-to-finish**
 - **Start-to-finish**

Sequencing Activities

Task dependencies

The nature of the relationship between two linked tasks. You link tasks by defining a dependency between their finish and start dates. For example, the “Contact caterers” task must finish before the start of the “Determine menus” task. There are four kinds of task dependencies in Microsoft Project.

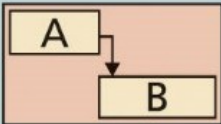
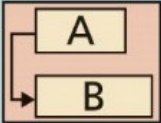
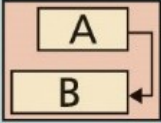
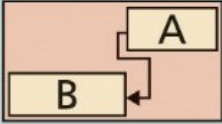
Task dependency	Example	Description
Finish-to-start (FS)		Task (B) cannot start until task (A) finishes.
Start-to-start (SS)		Task (B) cannot start until task (A) starts.
Finish-to-finish (FF)		Task (B) cannot finish until task (A) finishes.
Start-to-finish (SF)		Task (B) cannot finish until task (A) starts.

FIGURE 6-3 Task dependency types

Sequencing Activities

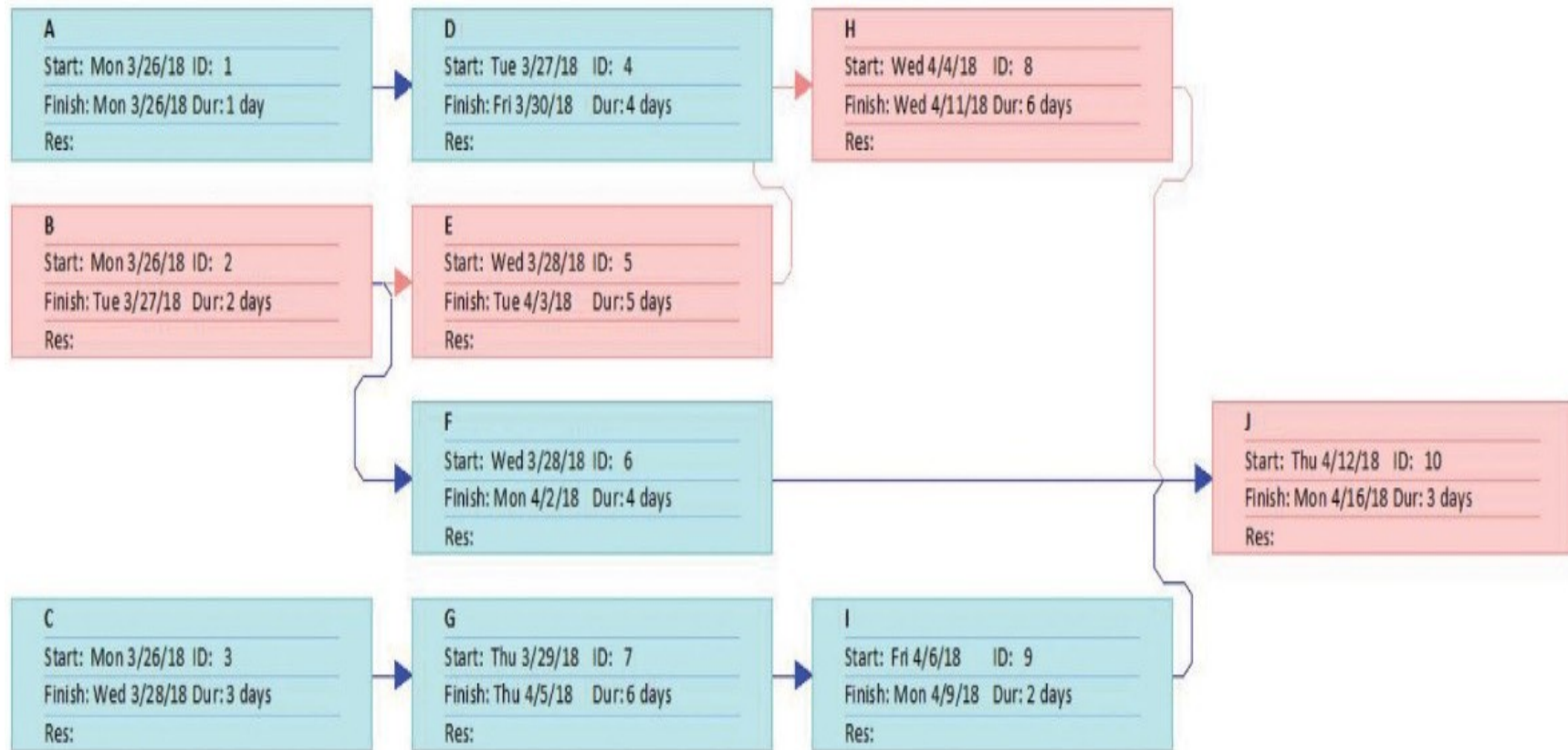


FIGURE 6-4 Precedence diagramming methods (PDM) network diagram for project X

Estimating Activity Durations

Duration = Effort?

- Duration includes the actual amount of time worked on an activity plus elapsed time
 - Effort is the number of workdays or work hours required to complete a task and does not normally equal duration
- People doing the work should help create estimates
 - An expert should review them
- A three-point estimate is an estimate that includes an optimistic, most likely, and pessimistic estimate
 - Three-point estimates are needed for PERT and Monte Carlo simulations

Developing the Schedule

- Uses results of the other time management processes to determine the start and end date of the project
 - Ultimate goal is to create a realistic project schedule that provides a basis for monitoring project progress for the time dimension of the project
- Important tools and techniques
 - ***Gantt charts***
 - ***Critical path analysis***
 - ***Critical chain scheduling***
 - ***PERT analysis***

Gantt Charts

- Provide a standard format for displaying project schedule information by listing project activities and corresponding start and finish dates in a calendar form
 - Symbols
 - ***Black diamond: milestones***
 - ***Thick black bars: summary tasks***
 - ***Light gray horizontal bars: durations of tasks***
 - ***Arrows: dependencies between tasks***

Gantt Charts

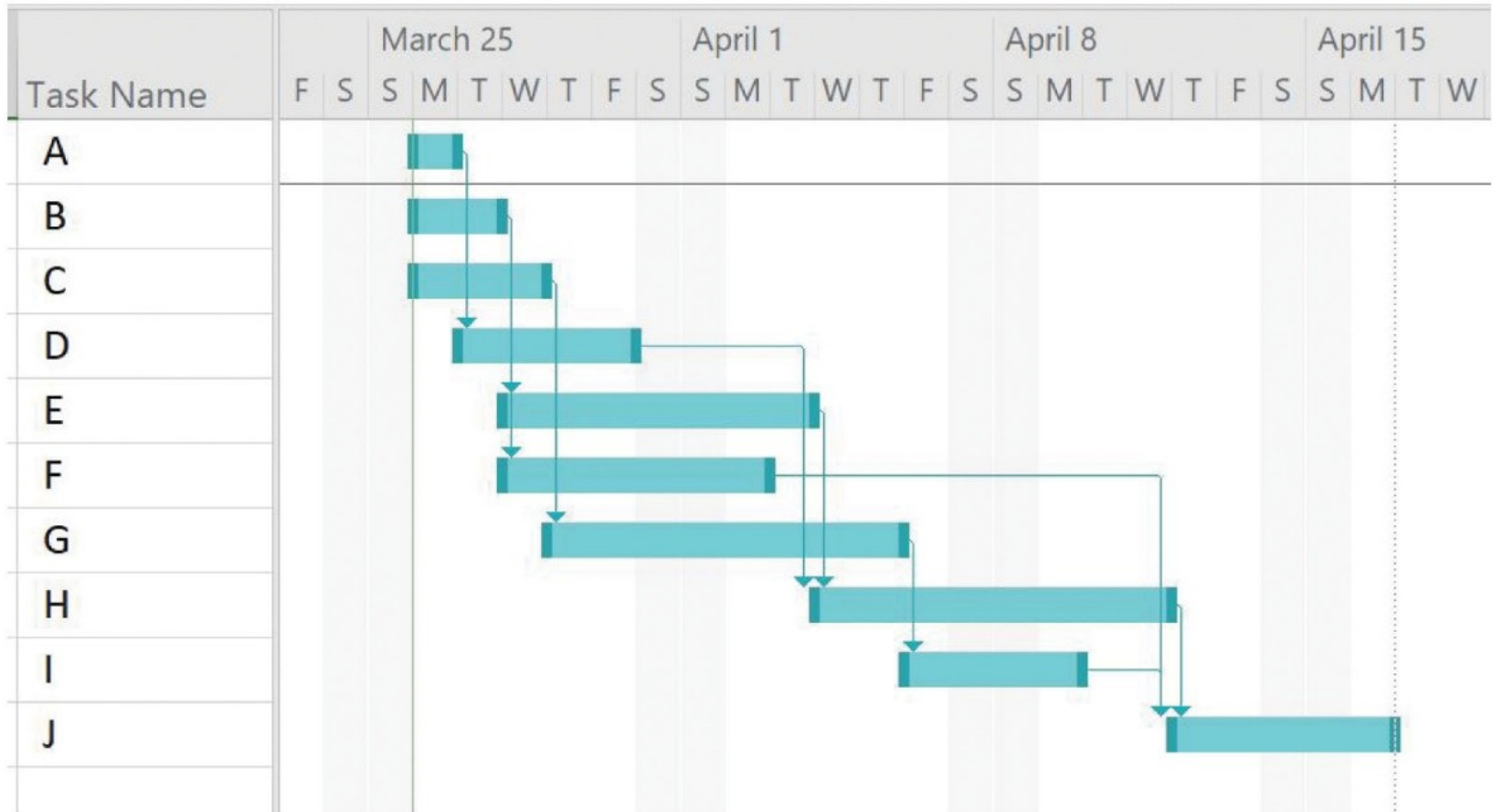


FIGURE 6-5 Gantt chart for project X

Gantt Charts

- Adding milestones to Gantt charts
 - Many people like to focus on meeting milestones, especially for large projects
 - Milestones emphasize important events or accomplishments on projects
- SMART Criteria for milestones
 - Specific
 - Measurable
 - Assignable
 - Realistic
 - Time-framed

Gantt Charts

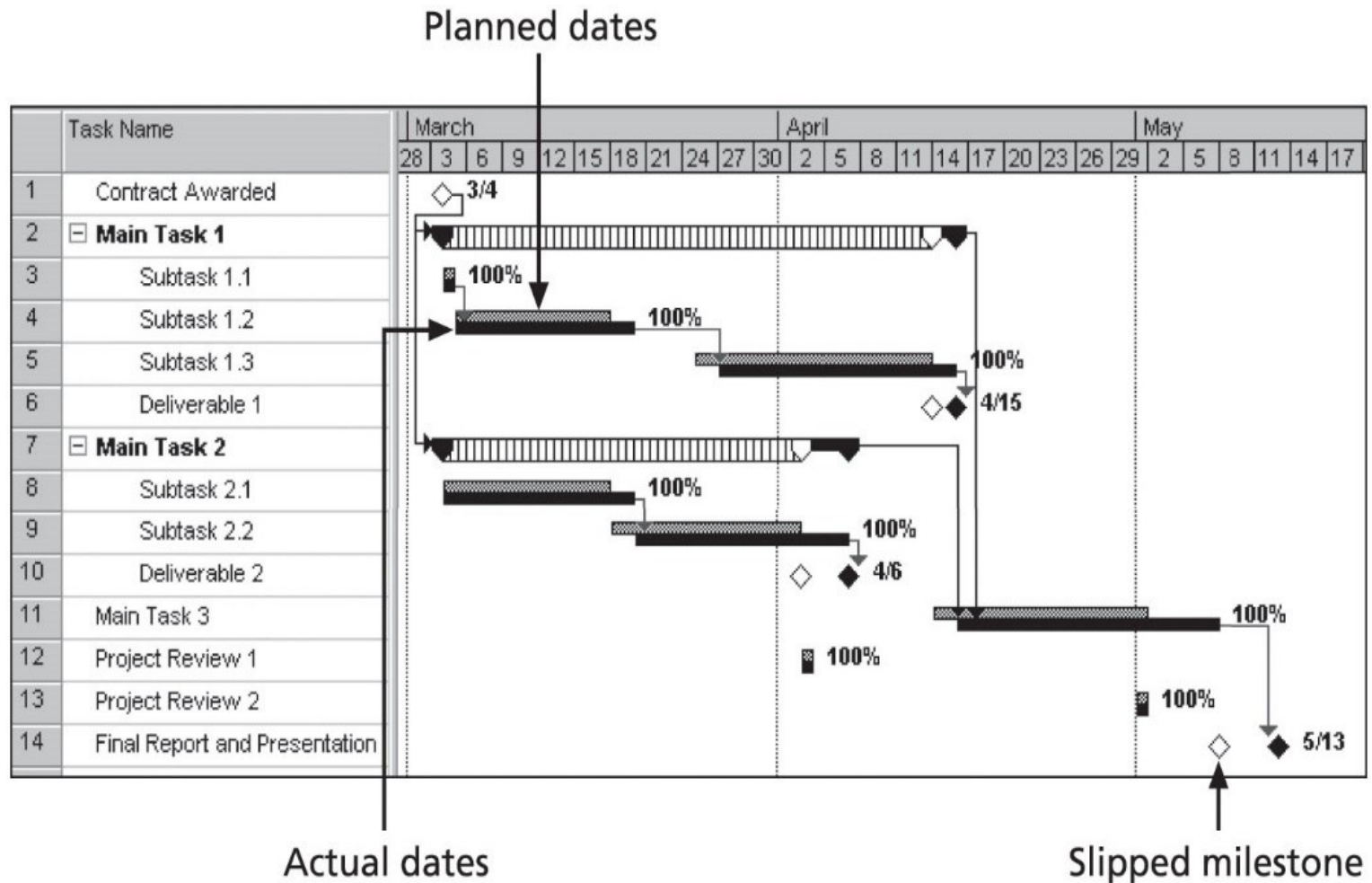
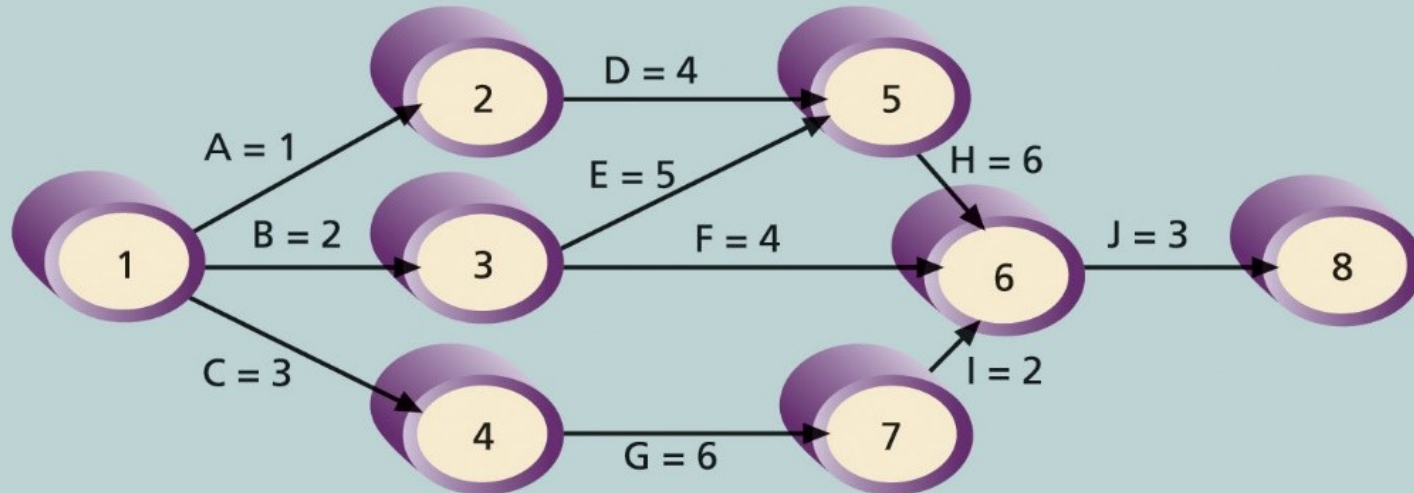


FIGURE 6-7 Sample tracking Gantt chart

Critical Path Method (CPM)

- Network diagramming technique used to predict total project duration
 - Critical path: series of activities that determine the earliest time by which the project can be completed
 - The longest path through the network diagram and has the least amount of slack or float; amount of time an activity may be delayed without delaying a succeeding activity or the project finish date
- Calculating the critical path
 - Develop a good network diagram and add the duration estimates for all activities on each path through the network diagram
 - Longest path is the critical path
 - If one or more of the activities on the critical path takes longer than planned, the whole project schedule will slip unless the project manager takes corrective action

Critical Path Method (CPM)



Note: Assume all durations are in days.

Path 1: A-D-H-J Length = $1+4+6+3 = 14$ days

Path 2: B-E-H-J Length = $2+5+6+3 = 16$ days

Path 3: B-F-J Length = $2+4+3 = 9$ days

Path 4: C-G-I-J Length = $3+6+2+3 = 14$ days

Since the critical path is the longest path through the network diagram, Path 2, B-E-H-J, is the critical path for Project X.

FIGURE 6-8 Determining the critical path for project X

Facts about the Critical Path

- The fact that its name includes the word critical does not mean that it includes all critical activities
- There can be more than one critical path if the lengths of two or more paths are the same
- Project managers should closely monitor performance of activities on the critical path to avoid late project completion
- Critical path can change as the project progresses

Critical Chain Scheduling

- Considers limited resources when creating a project schedule and includes buffers to protect the project completion date
- Uses the Theory of Constraints (TOC): management philosophy developed by Eliyahu M. Goldratt; attempts to minimize multitasking when a resource works on more than one task at a time

Critical Chain Scheduling

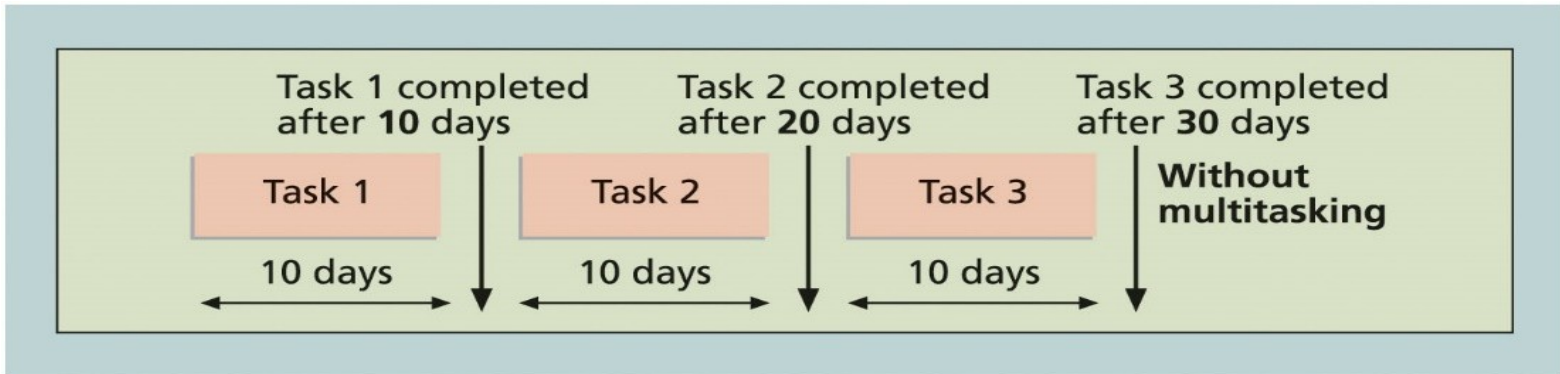


FIGURE 6-10a Three tasks without multitasking

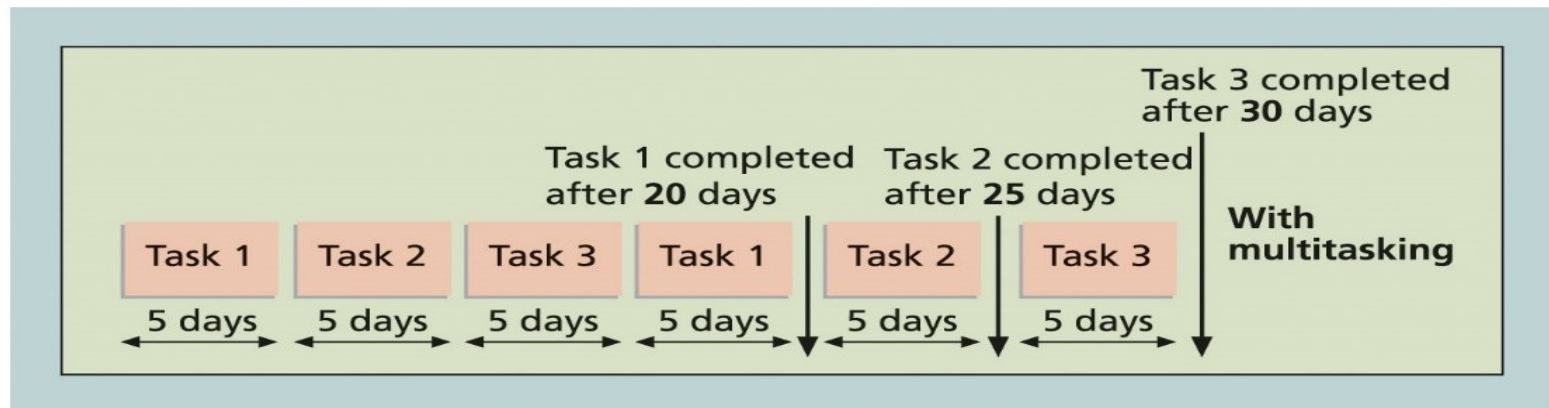


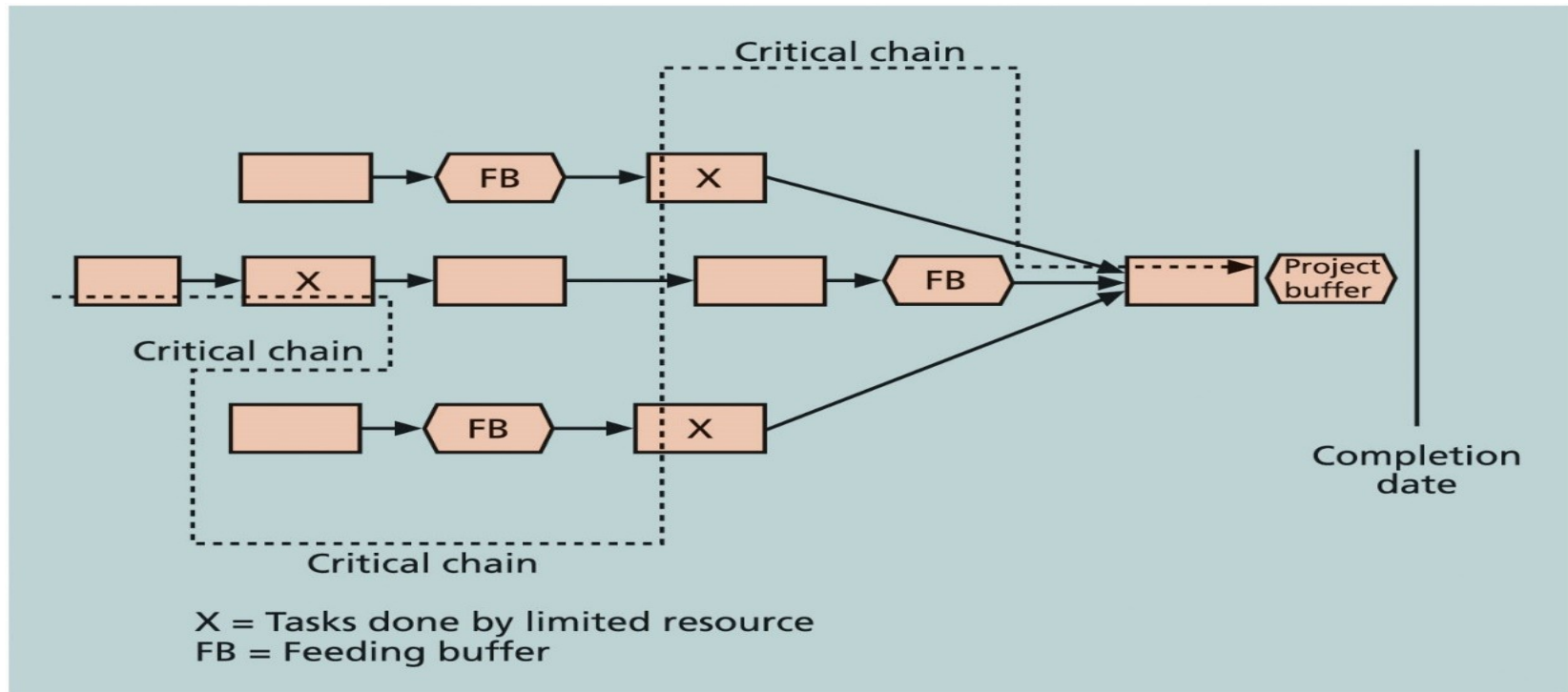
FIGURE 6-10b Three tasks with multitasking

Critical Chain Scheduling

- Additional concepts
 - **Murphy's Law**: if something can go wrong, it will
 - **Parkinson's Law**: work expands to fill the time allowed
 - **Buffer**: additional time to complete a task
 - **Project buffer**: additional time added before the project's due date
 - **Feeding buffers**: additional time added before tasks on the critical path

Critical Chain Scheduling

The task estimates in critical chain scheduling should be shorter than traditional estimates because they do not include their own buffers. Not having task buffers should mean fewer occurrences of Parkinson's Law,



Source: Eliyahu Goldratt, *Critical Chain*

FIGURE 6-11 Example of critical chain scheduling⁸

Agile and Schedule Management

- Core values of the Manifesto for Agile Software Development
 - Customer collaboration over contract negotiation
 - Responding to change over following a plan
- Example: product owner defines and prioritizes the work to be done within a sprint
 - Collaboration and time management are designed into the process
 - The short period of each sprint (normally two to four weeks) and daily
 - Scrum meetings provide an environment where team members collaborate to focus on completing specific tasks.

Chapter Summary

- Project time management is often cited as the main source of conflict on projects
 - Most IT projects exceed time estimates
- Main processes
 - Plan schedule management
 - Define activities
 - Sequence activities
 - Estimate activity resources
 - Estimate activity durations
 - Develop schedule
 - Control schedule