Chapter 6: Project Schedule Management

Information Technology Project Management, Ninth Edition

Note: See the text itself for full citations

Learning Objectives (1 of 2)

- 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 (2 of 2)

- 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 (1 of 3)

- Managers often cite delivering projects on time as one of their biggest challenges
  - Time has the least amount of flexibility; it passes no matter what happens on a project
- Individual work styles and cultural differences may also cause schedule conflicts
  - Different cultures and even entire countries have different attitudes about schedules

Media Snapshot

- In contrast to the 2002 Salt Lake City Winter Olympic Games (see Chapter 4's Media Snapshot), planning and scheduling was very different for the 2004 Athens Summer Olympic Games and the 2014 Sochi Winter Olympic Games
  - Many articles were written before the opening ceremonies in Athens predicting that the facilities would not be ready in time
  - The Greeks even made fun of critics by having construction workers pretend to still be working as the ceremonies began, but the games cost more than twice the planned budget
- The 2014 Winter Olympic Games in Sochi, Russia, suffered even greater financial loss
  - Originally budgeted at $12 billion, final costs reached over $51 billion, making it the most expensive games in history

The Importance of Project Schedules (2 of 3)

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

The Importance of Project Schedules (3 of 3)

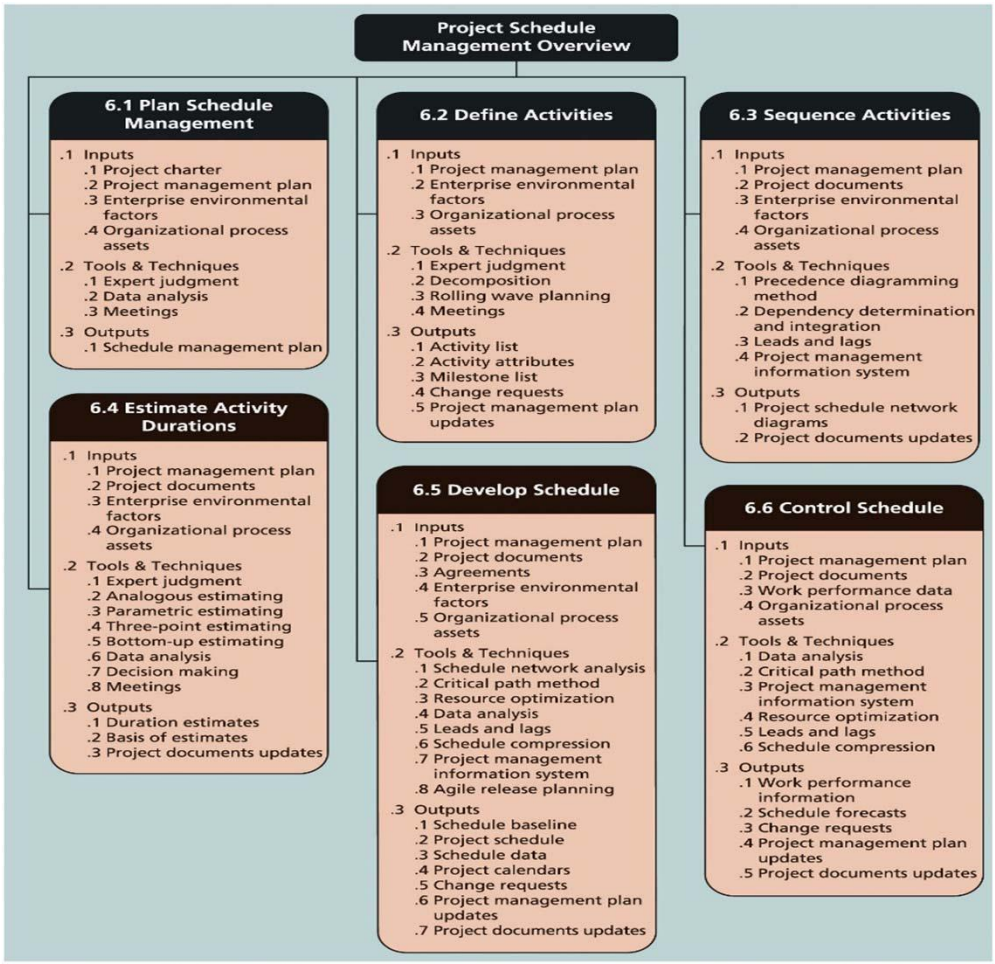

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FIGURE 6-1 Project schedule management overview

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 (1 of 2)

- 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

Defining Activities (2 of 2)

- A milestone is a significant event that normally has no duration
  - It often takes several activities and a lot of work to complete a milestone
  - They’re useful tools for setting schedule goals and monitoring progress
    - Examples: obtaining customer sign-off on key documents or completion of specific products

What Went Wrong?

- At the U.S. Federal Bureau of Investigation (FBI), poor time management was one of the reasons behind the failure of Trilogy
  - System was supposed to integrate intelligence within the Bureau
  - In May 2006, the Government Accounting Agency said that the Trilogy project failed at its core mission of improving the FBI's investigative abilities and was plagued with missed milestones and escalating costs
- Sentinel replaced Trilogy in 2007
  - During a test exercise in 2011, Sentinel experienced two outages, and the FBI determined that the current hardware structure was inadequate
  - In 2014, the system still wasn't working well

Sequencing Activities (1 of 6)

- 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

Sequencing Activities (2 of 6)

- 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 arrow and precedence diagramming methods

Sequencing Activities (3 of 6)

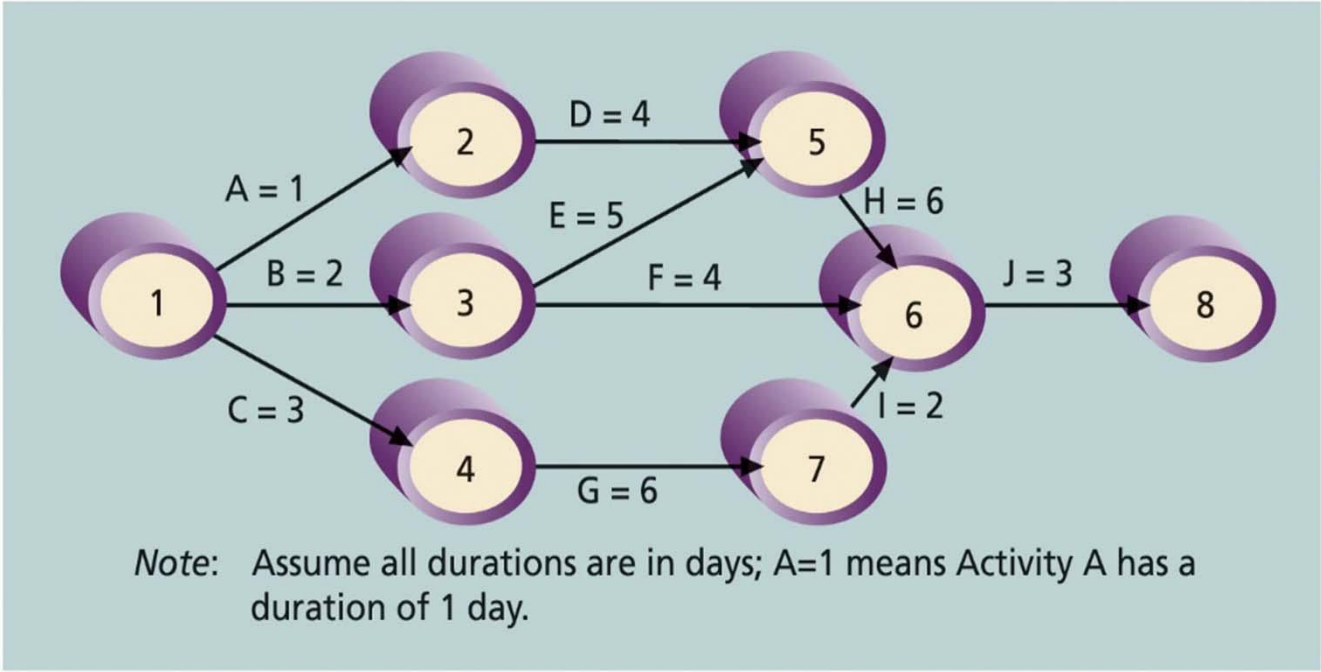


FIGURE 6-2 Network diagram for project X

Sequencing Activities (4 of 6)

- 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 (5 of 6)

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.

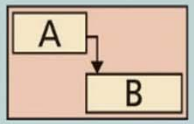
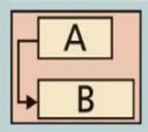
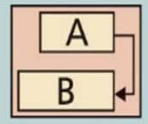
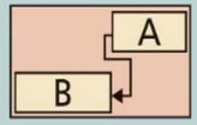
Task dependency	Example	Description
Finish-to-start (FS)		Task (B) cannot start until task (A) finishes.
Start-to-start (SS)		Task (B) cannot start until task (A) starts.
Finish-to-finish (FF)		Task (B) cannot finish until task (A) finishes.
Start-to-finish (SF)		Task (B) cannot finish until task (A)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

FIGURE 6-3 Task dependency types

Sequencing Activities (6 of 6)

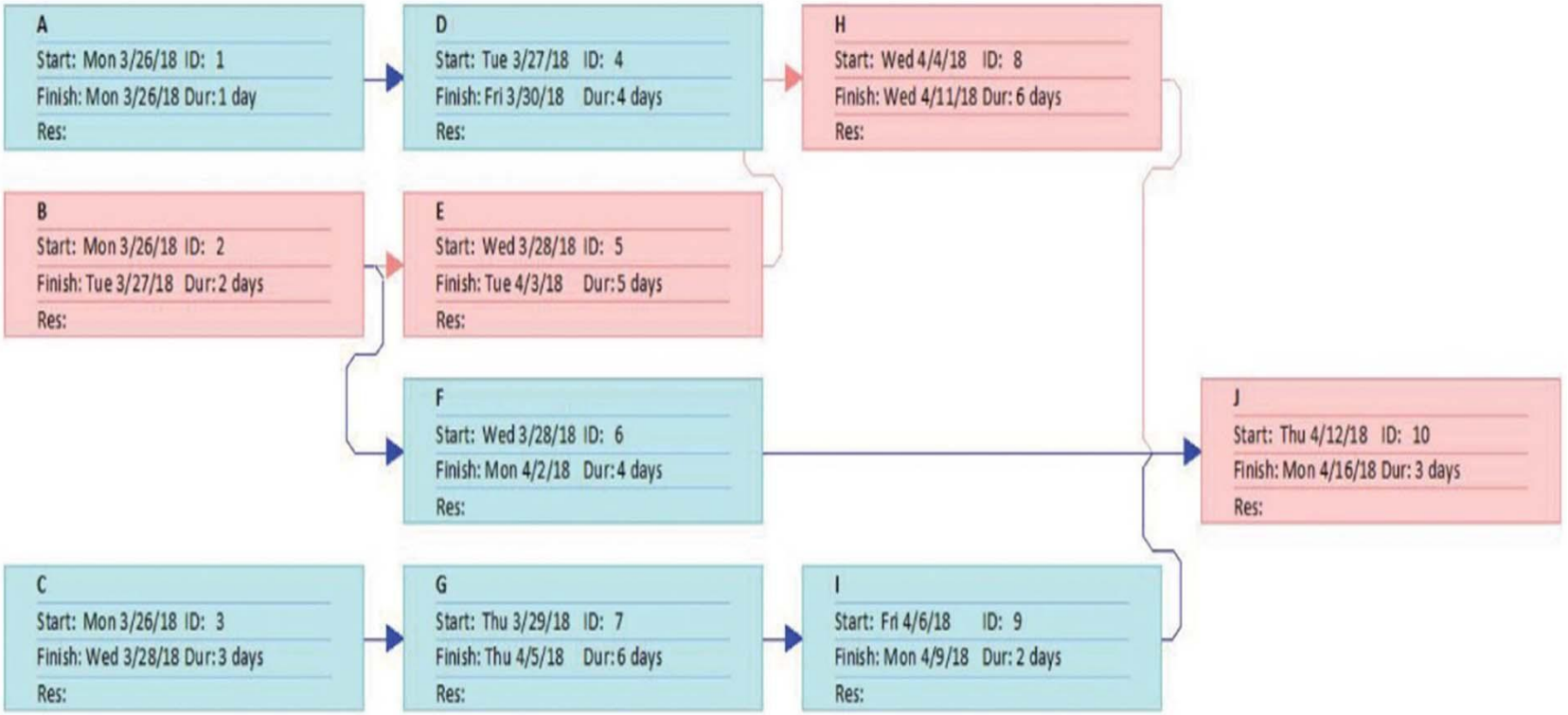


FIGURE 6-4 Precedence diagramming methods (PDM) network diagram for project X

Estimating Activity Durations

- 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

Advice for Young Professionals

- Some people find estimating to be challenging, especially for their own work
  - It is very important to develop this skill
    - Practice estimating how long it takes you to do different activities and then take actual measurements
    - Define the activity in detail to help make better estimates
    - If you realize that an activity estimate might not be a good one, let your team know as soon as possible so that adjustments can be made early in the project

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 (1 of 5)

- 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 (2 of 5)

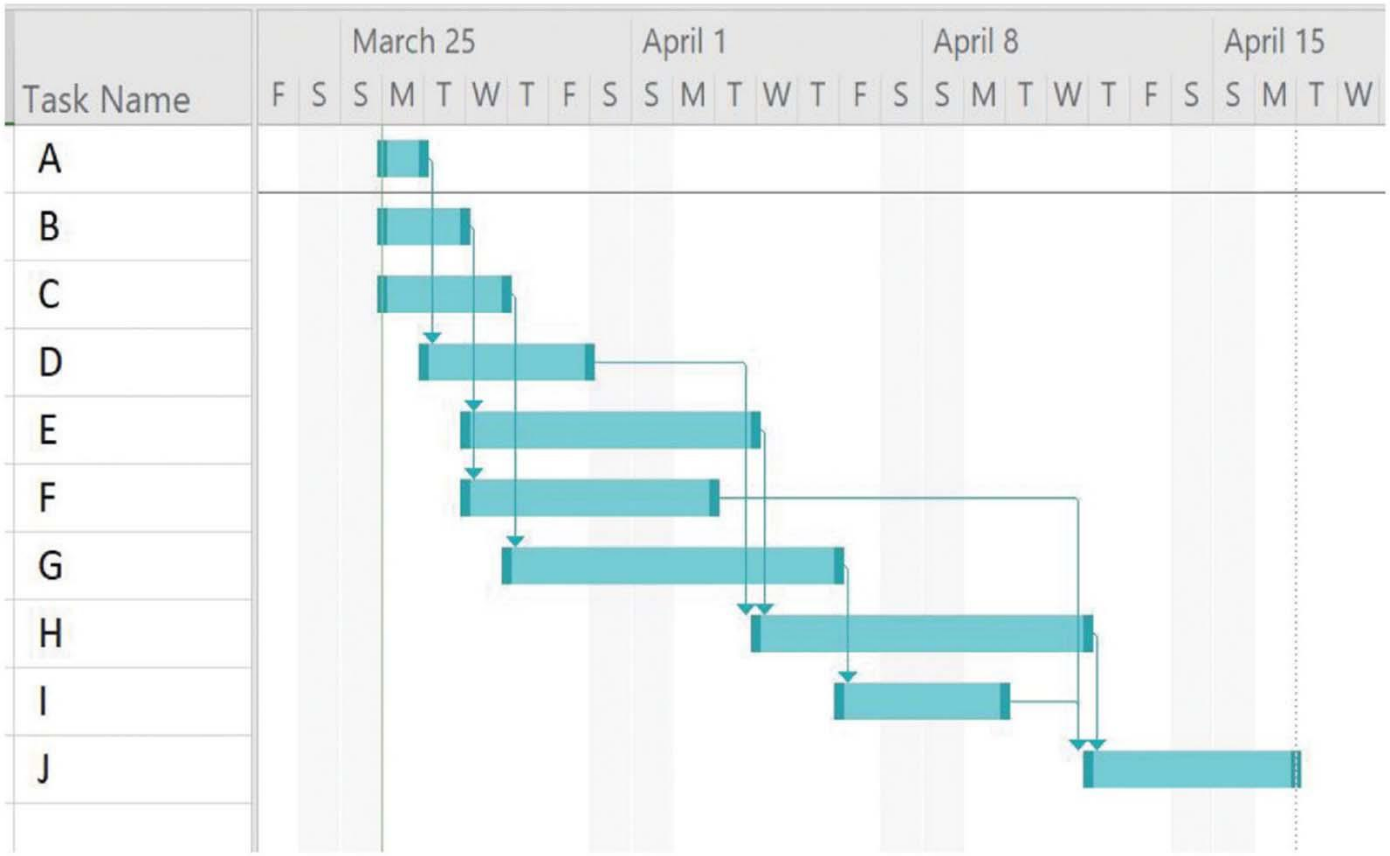


FIGURE 6-5 Gantt chart for project X

Gantt Charts (3 of 5)

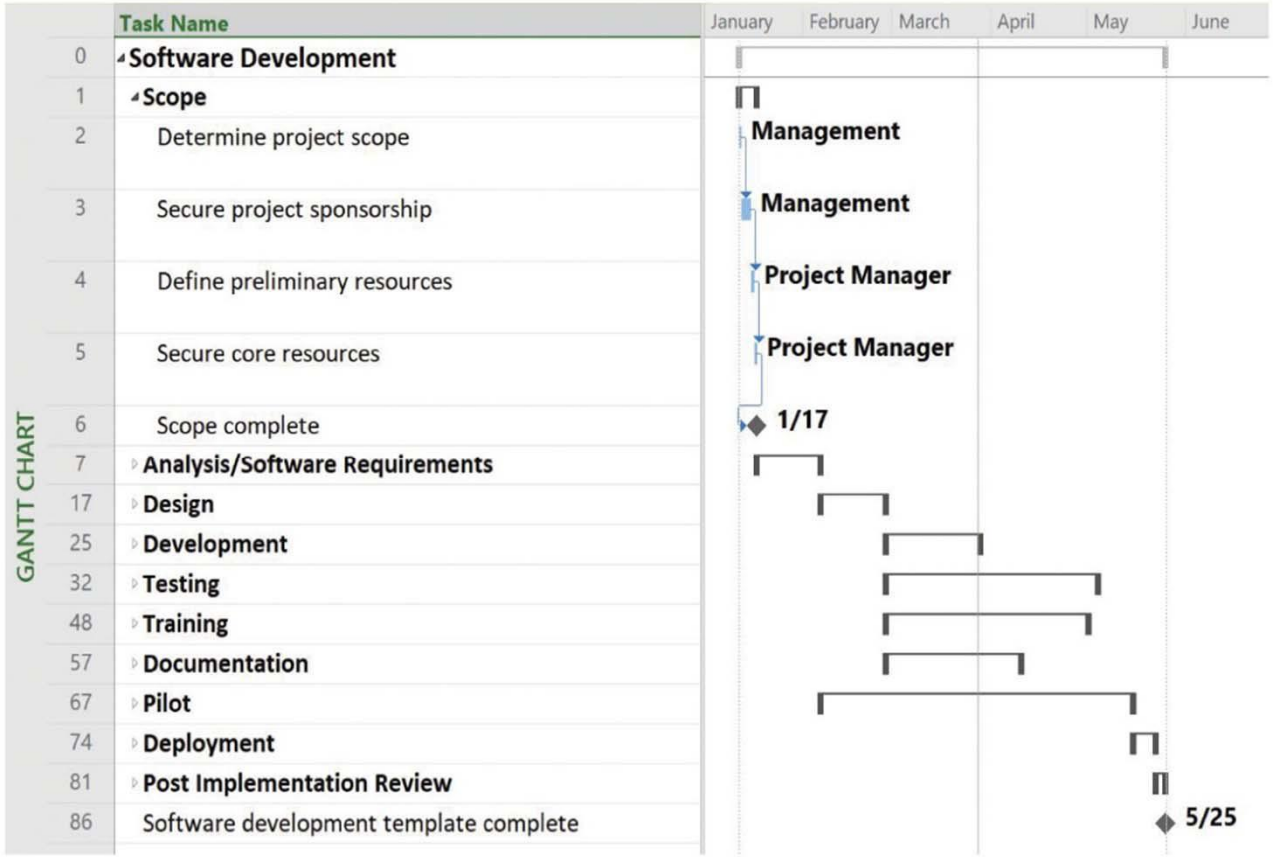


FIGURE 6-6 Gantt chart for software launch project

Gantt Charts (4 of 5)

- 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

Best Practice

- Shawn Anchor suggests the 20-second rule in his book, *The Happiness Advantage*
  - People prefer the path of least resistance
    - For example, if you have to wait in line 20 seconds to get a second scoop of ice cream, you might resist it
  - Anchor recommends making it more difficult for yourself to be distracted at work by keeping email or websites closed while you are working
    - Save time by adding time to the distracting behaviors at work

Gantt Charts (5 of 5)

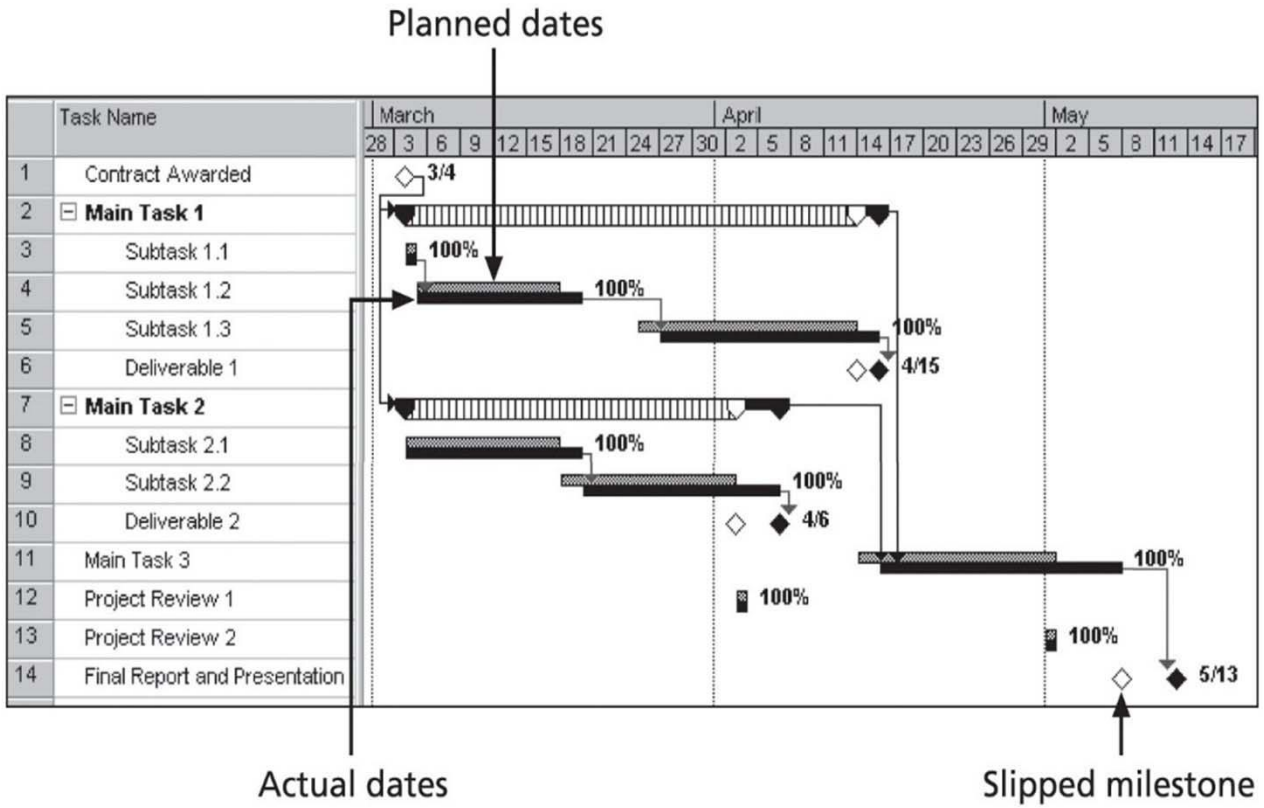
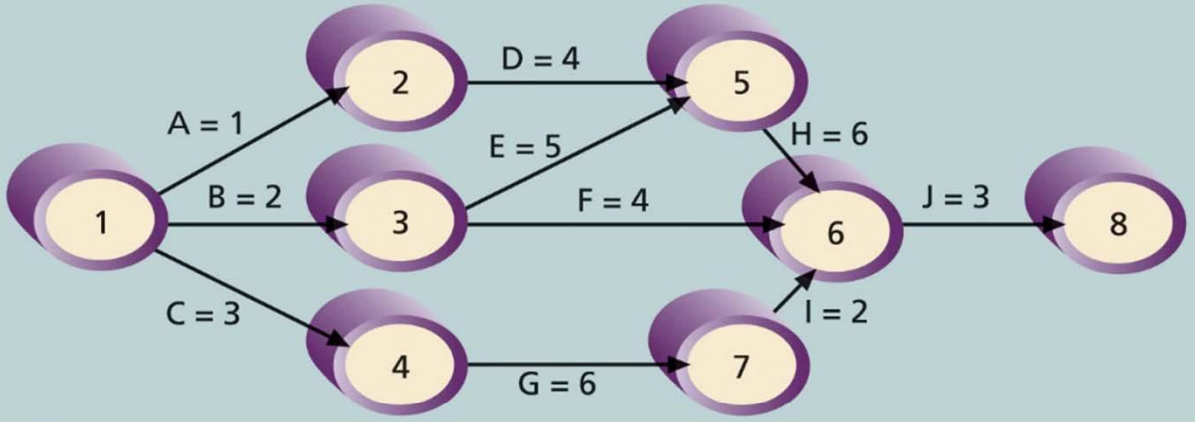


FIGURE 6-7 Sample tracking Gantt chart

Critical Path Method (CPM) (1 of 2)

- 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) (2 of 2)



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

Growing Grass Can Be on the Critical Path

- The fact that its name includes the word critical does not mean that it includes all critical activities
  - Only accounts for time
    - Example: growing grass for Disney's Animal Kingdom
- 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

Using Critical Path Analysis to Make Schedule Trade-Offs (1 of 3)

- Free slack or free float
  - Amount of time an activity can be delayed without delaying the early start of any immediately following activities
- Total slack or total float
  - Amount of time an activity may be delayed from its early start without delaying the planned project finish date
- Forward pass
  - Determines the early start and finish dates
- Backward pass
  - Determines the late start and finish dates

Using Critical Path Analysis to Make Schedule Trade-Offs (2 of 3)

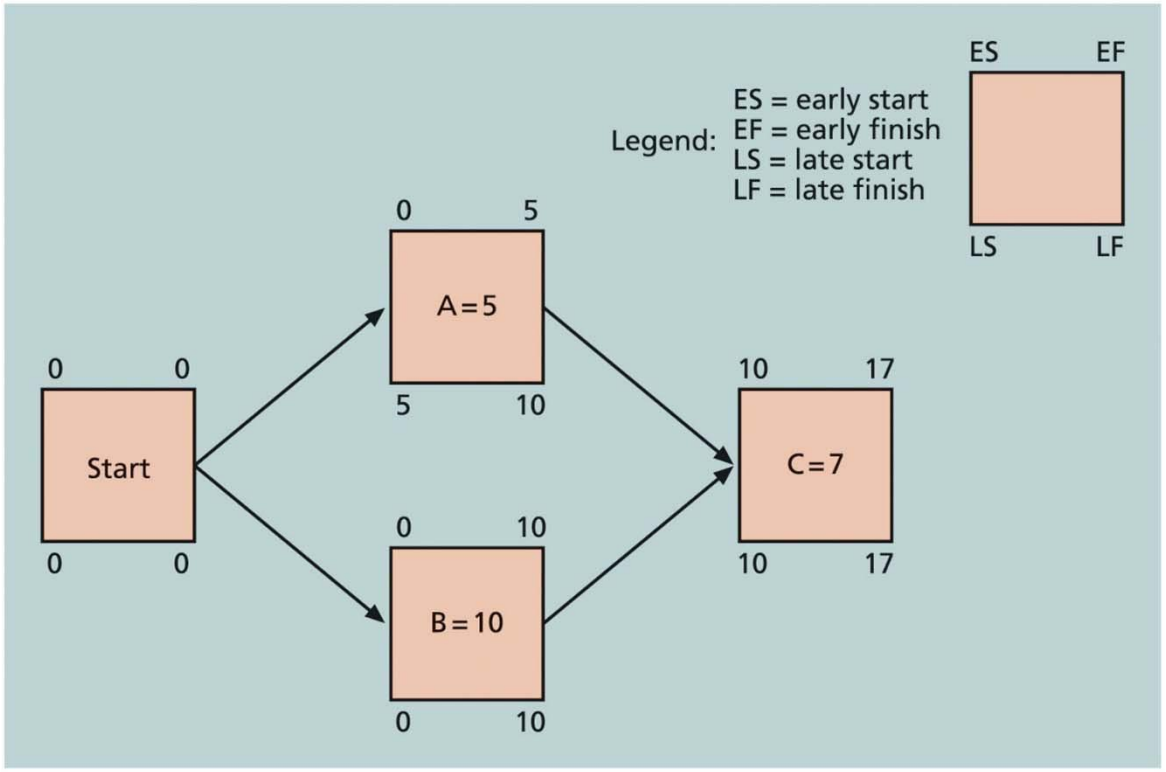


FIGURE 6-9 Calculating early and late start and finish dates

Using Critical Path Analysis to Make Schedule Trade-Offs (3 of 3)

Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
A	8/3/15	8/3/15	8/5/15	8/5/15	0d	2d
B	8/3/15	8/4/15	8/3/15	8/4/15	0d	0d
C	8/3/15	8/5/15	8/5/15	8/7/15	0d	2d
D	8/4/15	8/7/15	8/6/15	8/11/15	2d	2d
E	8/5/15	8/11/15	8/5/15	8/11/15	0d	0d
F	8/5/15	8/10/15	8/14/15	8/17/15	7d	7d
G	8/6/15	8/13/15	8/10/15	8/17/15	0d	2d
H	8/12/15	8/19/15	8/12/15	8/19/15	0d	0d
I	8/14/15	8/17/15	8/18/15	8/19/15	2d	2d
J	8/20/15	8/24/15	8/20/15	8/24/15	0d	0d

Table 6-1 Free and Total Float or Slack for Project X

Using the Critical Path to Shorten a Project Schedule

- Main techniques for shortening schedules
  - Shortening durations of critical activities/tasks by adding more resources or changing their scope
  - Crashing activities by obtaining the greatest amount of schedule compression for the least incremental cost
  - Fast tracking activities by doing them in parallel or overlapping them

Importance of Updating Critical Path Data

- It is important to update the schedule with actual data
  - Note actual activity durations as they are completed
  - Revise estimates for activities in progress
  - Monitor changes to make informed decisions

Critical Chain Scheduling (1 of 4)

- 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 (2 of 4)

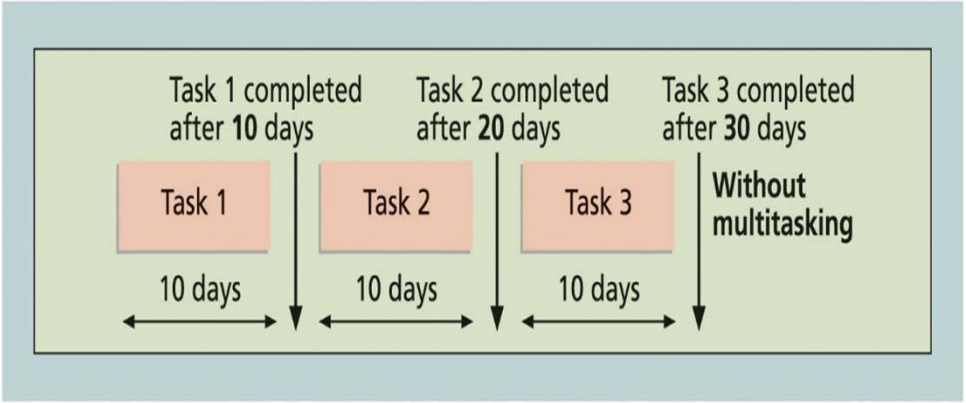


FIGURE 6-10a Three tasks without multitasking

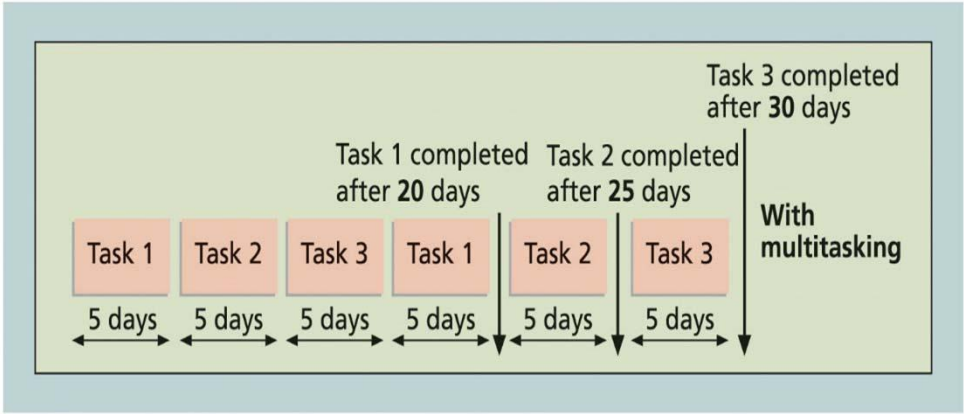
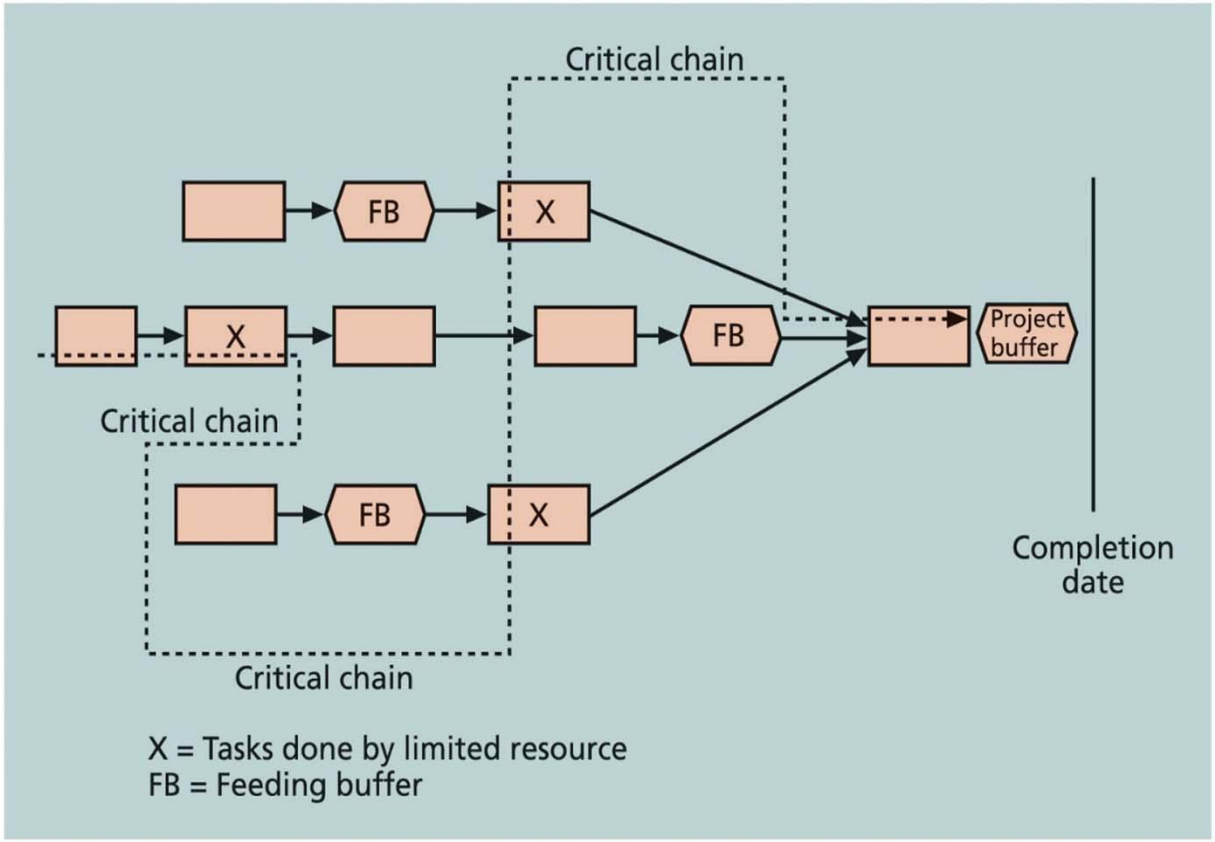


FIGURE 6-10b Three tasks with multitasking

Critical Chain Scheduling (3 of 4)

- Additional concepts
  - Buffer: additional time to complete a task
  - Murphy's Law: if something can go wrong, it will
  - Parkinson's Law: work expands to fill the time allowed
  - 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 (4 of 4)



Source: Eliyahu Goldratt, *Critical Chain*

FIGURE 6-11 Example of critical chain scheduling[8]

What Went Right?

- Scheduling at healthcare clinic's can be more efficient by using critical chain scheduling
  - National University Hospital in Singapore decreased patient admission times by more than 50 percent
    - Improved scheduling lowered average wait times, which went from six to eight hours to less than three hours
    - 63 percent of patients were admitted in less than 1.5 hours

Program Evaluation and Review Technique (PERT)

- Network analysis technique used to estimate project duration when there is a high degree of uncertainty about the individual activity duration estimates
  - Uses probabilistic time estimates: duration estimates based on using optimistic, most likely, and pessimistic estimates of activity durations
  - By using the PERT weighted average for each activity duration estimate, total project duration estimate takes into account the risk or uncertainty in the individual activity estimates

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

Controlling the Schedule

- Goals of schedule control
  - Know the status of the schedule
  - Influence the factors that cause schedule changes
  - Determine that the schedule has changed
  - Manage changes when they occur
- Main inputs to schedule control
  - Project management plan
  - Project documents
  - Work performance data
  - Organizational process assets

Reality Checks on Scheduling and the Need for Discipline

- Important activities
  - Review the draft schedule or estimated completion date in the project charter
  - Prepare a more detailed schedule with the project team
  - Make sure the schedule is realistic and followed
  - Alert top management well in advance if there are schedule problems

Using Software to Assist in Project Schedule Management

- Software for facilitating communications helps people exchange schedule-related information
  - Decision support models help analyze trade-offs that can be made to address schedule issues
  - Project management software can help in various time management areas

Global Issues

- Microsoft tells the customer story of Mexico's Secretary of Economy, who wanted to ensure that IT initiatives aligned with business goals and improved project management efficiency
  - After implementing new software, their IT team could handle four times the number of concurrent projects without adding more staff

Words of Caution on Using Project Management Software

- Many people misuse project management software because they don’t understand important concepts and have not had training
  - Example: dependencies must be entered to have dates adjust automatically and to determine the critical path
- Many project management software programs come with templates or sample files
  - It is very easy to use these files without considering unique project needs
  - Project managers and their teams should be careful not to rely too much on templates or sample files and ignore the unique concerns of their particular projects

Considerations for Agile/Adaptive Environments

- Schedule management is radically different using Agile and Scrum
  - Projects that rely heavily on the critical path method consider meeting the project's estimated completion date as a crucial component of success
  - Agile projects may not even need to estimate activity durations or project schedules at all; overall project completion time is not important

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