Chapter Eight

Scheduling Resources and Costs

Overview of the Resource Scheduling Problem

- Resources and Priorities
  - Project network times are not a schedule until resources have been assigned.
    - The implicit assumption is that resources will be available in the required amounts when needed.
    - Adding new projects requires making realistic judgments of resource availability and project durations.
  - Cost estimates are not a budget until they have been time-phased.

The Resource Scheduling Problem (cont'd)

- Resource Smoothing (or Leveling)
  - Involves attempting to even out varying demands on resources by using slack (delaying noncritical activities) to manage resource utilization when resources are adequate over the life of the project.
- Resource-Constrained Scheduling
  - The duration of a project may be increased by delaying the late start of some of its activities if resources are not adequate to meet peak demands.

Types of Project Constraints

- Technical or Logic Constraints
  - Constraints related to the networked sequence in which project activities must occur
- Physical Constraints
  - Activities that cannot occur in parallel or are affected by contractual or environmental conditions
- Resource Constraints
  - The absence, shortage, or unique interrelationship and interaction characteristics of resources that require a particular sequencing of project activities
    - People, materials, equipment

Classification of a Scheduling Problem

- Classification of Problem
  - Using a priority matrix will help determine if the project is time or resource constrained.
- Time-Constrained Project
  - Must be completed by an imposed date.
    - Time is fixed, resources are flexible: additional resources are required to ensure project meets schedule.
- Resource-Constrained Project
  - Is one in which the level of resources available cannot be exceeded.
    - Resources are fixed, time is flexible: inadequate resources will delay the project.

Resource Allocation Methods

- Limiting Assumptions
  - Splitting activities is not allowed—once an activity is start, it is carried to completion.
  - Level of resources used for an activity cannot be changed.
- Risk Assumptions
  - Activities with the most slack pose the least risk.
  - Reduction of flexibility does not increase risk.
  - The nature of an activity (easy, complex) doesn't increase risk.

Resource Allocation Methods (cont'd)

- Time-Constrained Projects
  - Must be completed by an imposed date.
  - Require use of leveling techniques that focus on balancing or smoothing resource demands.
  - Use positive slack (delaying noncritical activities) to manage resource utilization over the duration of the project.
    - Peak resource demands are reduced.
    - Resources over the life of the project are reduced.
    - Fluctuation in resource demand is minimized.

Resource Allocation Methods (cont'd)

- Resource-Constrained Projects
  - Resources are limited in quantity or availability.
  - Activities are scheduled using *heuristics* (rules-of-thumb) that focus on:
    1. Minimum slack
    2. Smallest (least) duration
    3. Lowest activity identification number
  - The parallel method is used to apply heuristics
    - An iterative process starting at the first time period of the project and scheduling period-by-period the start of any activities using the three priority rules.

The Impacts of Resource-Constrained Scheduling

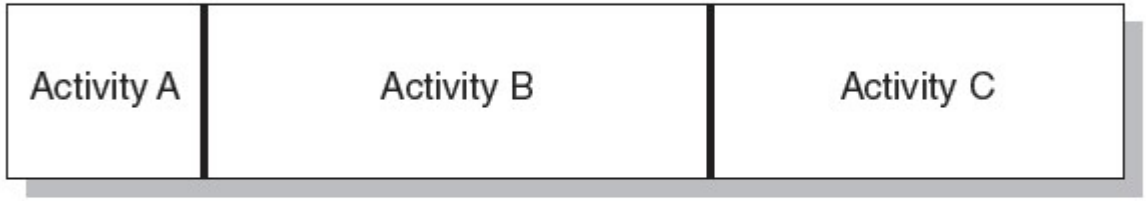
- Reduces slack; reduces flexibility
- Increases criticality of events
- Increases scheduling complexity
- May make the traditional critical path no longer meaningful
- Can break sequence of events
- May cause parallel activities to become sequential
- Activities with slack may become critical

Splitting

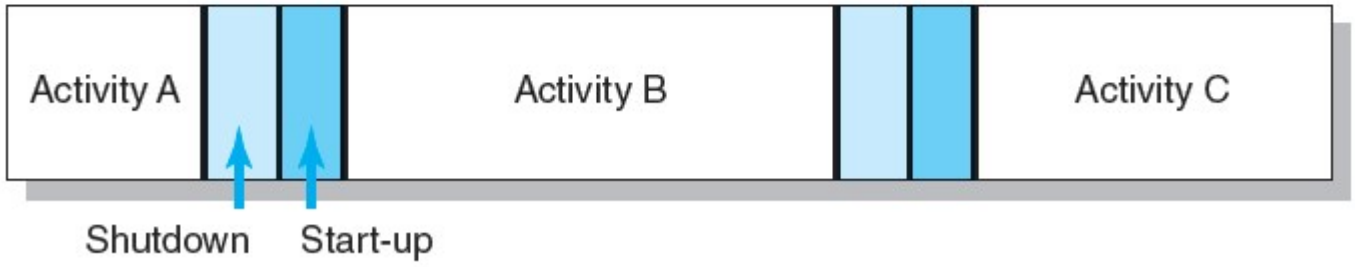
- Splitting
  - A scheduling technique for creating a better project schedule and/or increase resource utilization
    - Involves interrupting work on an activity to employ the resource on another activity, then returning the resource to finish the interrupted work.
    - Is feasible when startup and shutdown costs are low.
    - Is considered the major reason why projects fail to meet schedule.

Splitting Activities

Activity duration without splitting



Activity duration split into three segments—A, B, C



Activity duration split with shutdown and start-up

FIGURE 8.11

Benefits of Scheduling Resources

- Leaves time for consideration of reasonable alternatives:
  - Cost-time tradeoffs
  - Changes in priorities
- Provides information for time-phased work package budgets to assess:
  - Impact of unforeseen events
  - Amount of flexibility in available resources

Assigning Project Work

- Reasons why we should not always assign the best people the most difficult tasks
  - Best people: resent to the fact that they are always given the toughest assignments
  - Less experienced participants: resent to the fact that they are never given the opportunity to expand their skill/knowledge base
- Factors to be considered in deciding who should work together
  - Minimize unnecessary tension; complement each other
  - Experience: veterans team up with new hires

Multiproject Resource Schedules

- Multiproject Scheduling Problems
  1. Overall project slippage
     - Delay on one project create delays for other projects.
  2. Inefficient resource application
     - The peaks and valleys of resource demands create scheduling problems and delays for projects.
  3. Resource bottlenecks
     - Shortages of critical resources required for multiple projects cause delays and schedule extensions.

Multiproject Resource Schedules (cont'd)

- Managing Multiproject Scheduling:
  - Create project offices or departments to oversee the scheduling of resources across projects
  - Use a project priority queuing system: first come, first served for resources
  - Centralize project management: treat all projects as a part of a "megaproject"
  - Outsource projects to reduce the number of projects handled internally

Using the Resource Schedule to Develop a Project Cost Baseline

- Why a Time-Phased Budget Baseline Is Needed
  - To determine if the project is on, ahead, or behind schedule and over or under its budgeted costs?
  - To know how much work has been accomplished for the allocated money spent—the project cost baseline (planned value, PV)
- Creating a Time-Phased Budget
  - Assign each work package to one responsible person or department and deliverable
  - Compare planned schedule and costs using an integrative system called earned value