GSOE9820 – Engineering Project Management

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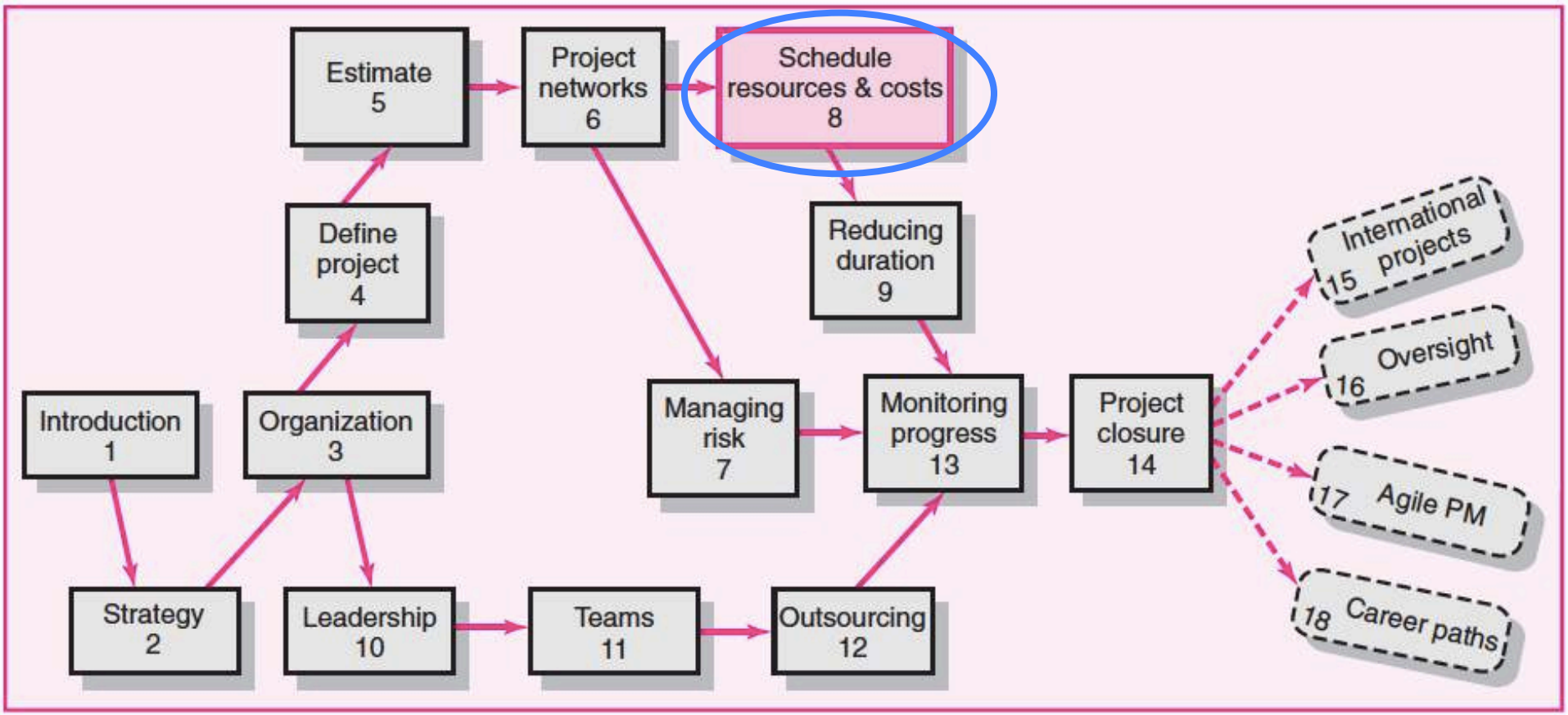
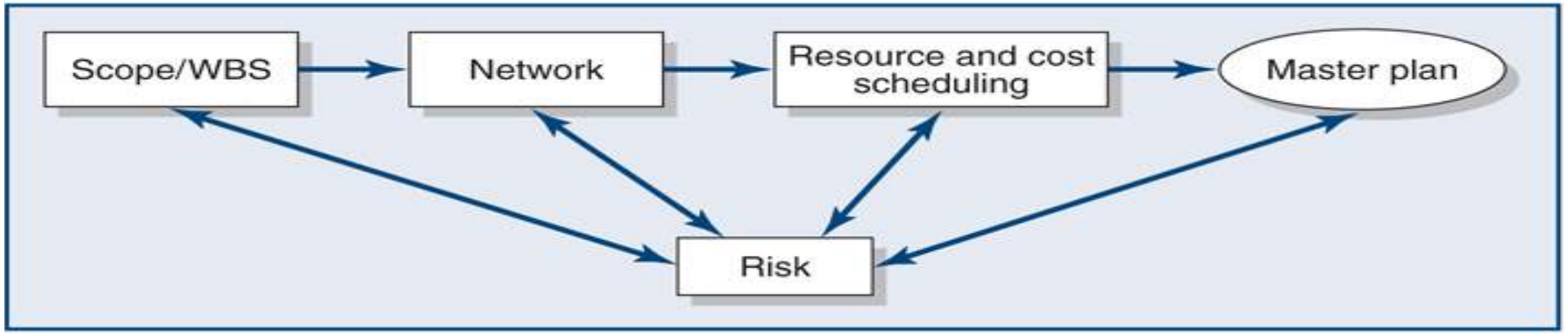
Week 7
Scheduling Resources and Costs

Course Roadmap



The project planning process



Scheduling of project activities

Up to now the start and sequencing of activities has been based solely on technical or logical considerations.

E.g. design → code → test

A study by Woodworth and Willie found that the duration of a project increased on average by 38% when resources were added to the schedule.

Project baseline / master plan

A baseline is the value or condition against which all future measurements will be compared.

- The baseline is a point of reference.
- Time-phasing baselines are important for a reliable measure of information and control for project status and tracking.

In project management there are three baselines

1. Scope baseline
2. Schedule baseline
3. Cost/budget baseline

The resource problem

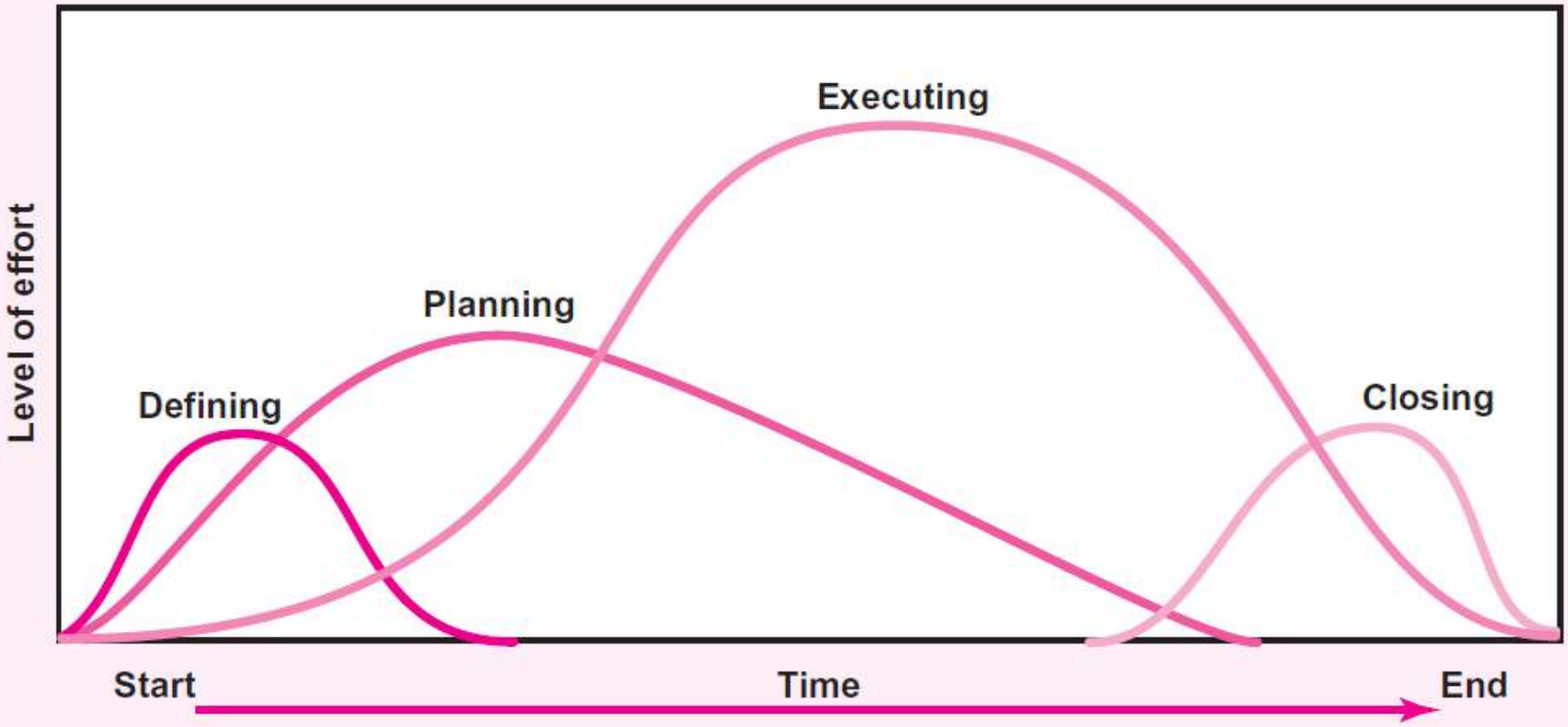
Project network times are not a schedule until resources have been assigned.

- 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.

What is time-phased

Is the distribution of activities, resources and costs over an appropriate time scale for the scheduled completion of a project.



Defining	Planning	Executing	Closing
1. Goals	1. Schedules	1. Status reports	1. Train customer
2. Specifications	2. Budgets	2. Changes	2. Transfer documents
3. Tasks	3. Resources	3. Quality	3. Release resources
4. Responsibilities	4. Risks	4. Forecasts	4. Evaluation
	5. Staffing		5. Lessons learned

Benefits of scheduling resources

Leaves time for consideration of reasonable alternatives:

- cost–time tradeoffs
- changes in priorities

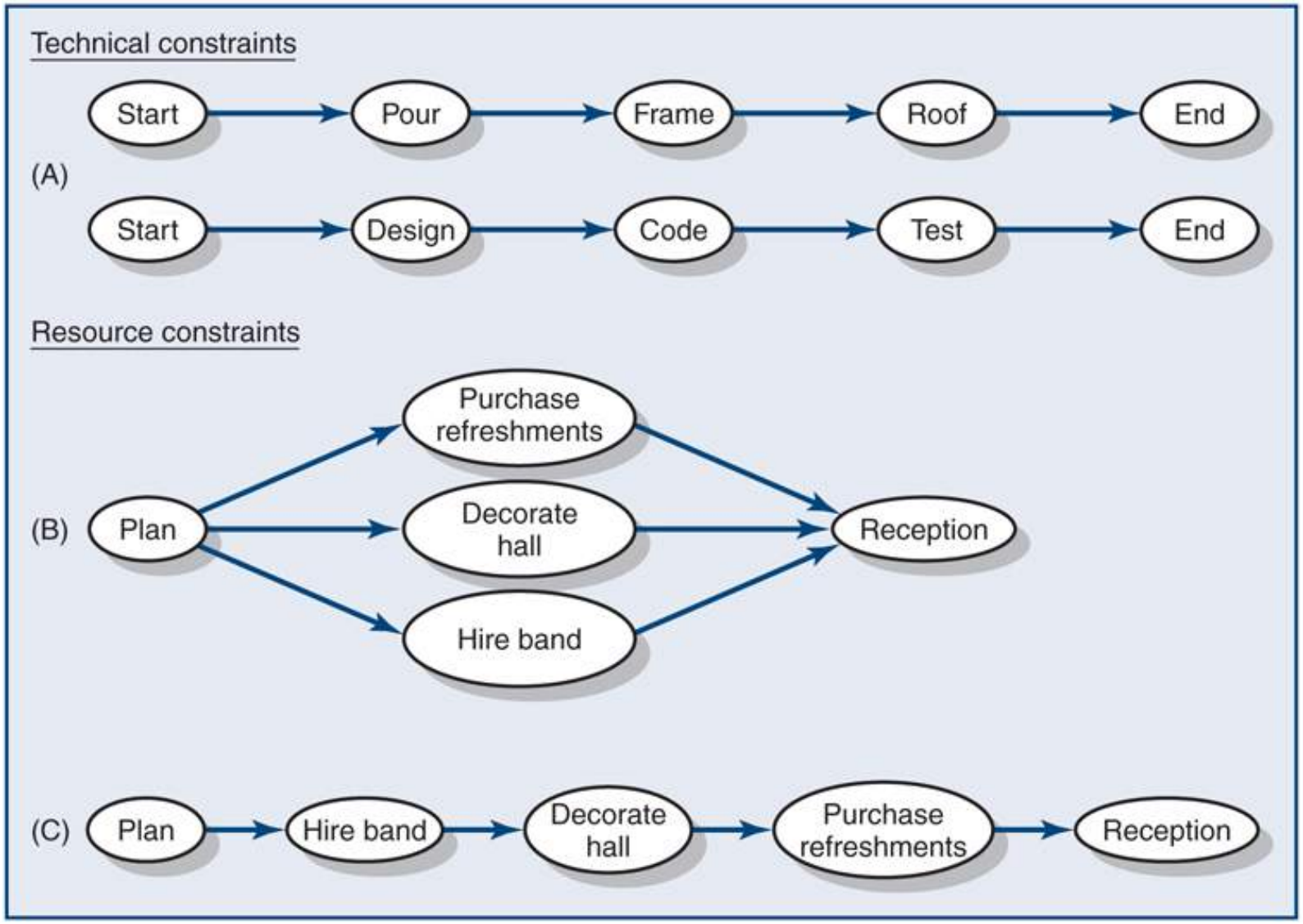
Provides information for time-phased work package budgets to assess:

- impact of unforeseen events
- amount of flexibility in available resources
- Helpful to assess availability of resources when you receive requests from other PM's to borrow resources.

Classification 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

Figure 8.2 CONSTRAINT EXAMPLES



Types of resource constraints

People

Materials

Equipment

Time or Resource constrained?

Time-constrained project

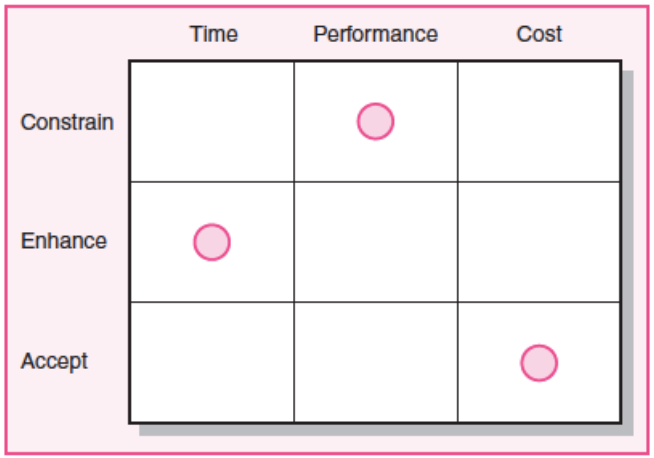
- Must be completed by an imposed date.
  - Time is fixed, resources are flexible: additional resources are required to ensure project meets schedule.

Resource-constrained project

- One in which the level of resources available cannot be exceeded.
  - Resources are fixed, time is flexible: inadequate resources will delay the project.

Classification of a scheduling problem

Using a priority matrix will help determine if the project is time or resource constrained.



Ask the question, “If the critical path is delayed, will resources be added to get back on schedule?”

- If YES, the project is time-constrained
- Otherwise, the project is resource-constrained

Resource allocation methods

Limiting assumptions

- Splitting activities is not allowed—once an activity is started, 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

Resource smoothing (or levelling)

- Involves attempting to even out varying demands on resources by using slack (delaying non-critical activities) to manage resource utilisation 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.

Pros and cons: Resource demand leveling techniques

Advantages

- Peak resource demands are reduced
- Resources over the life of the project are reduced
- Fluctuation in resource demand is minimised

Disadvantages

- Loss of flexibility that occurs from reducing slack
- Increases the criticality of all activities and hence sensitivity of the project.

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 utilisation 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 minimised.

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.

A note about project management software

The software is not “managing” the project.

It is simply a tool for the project manager to use to view the project from different perspectives and conditions.

Impacts of resource-constrained scheduling

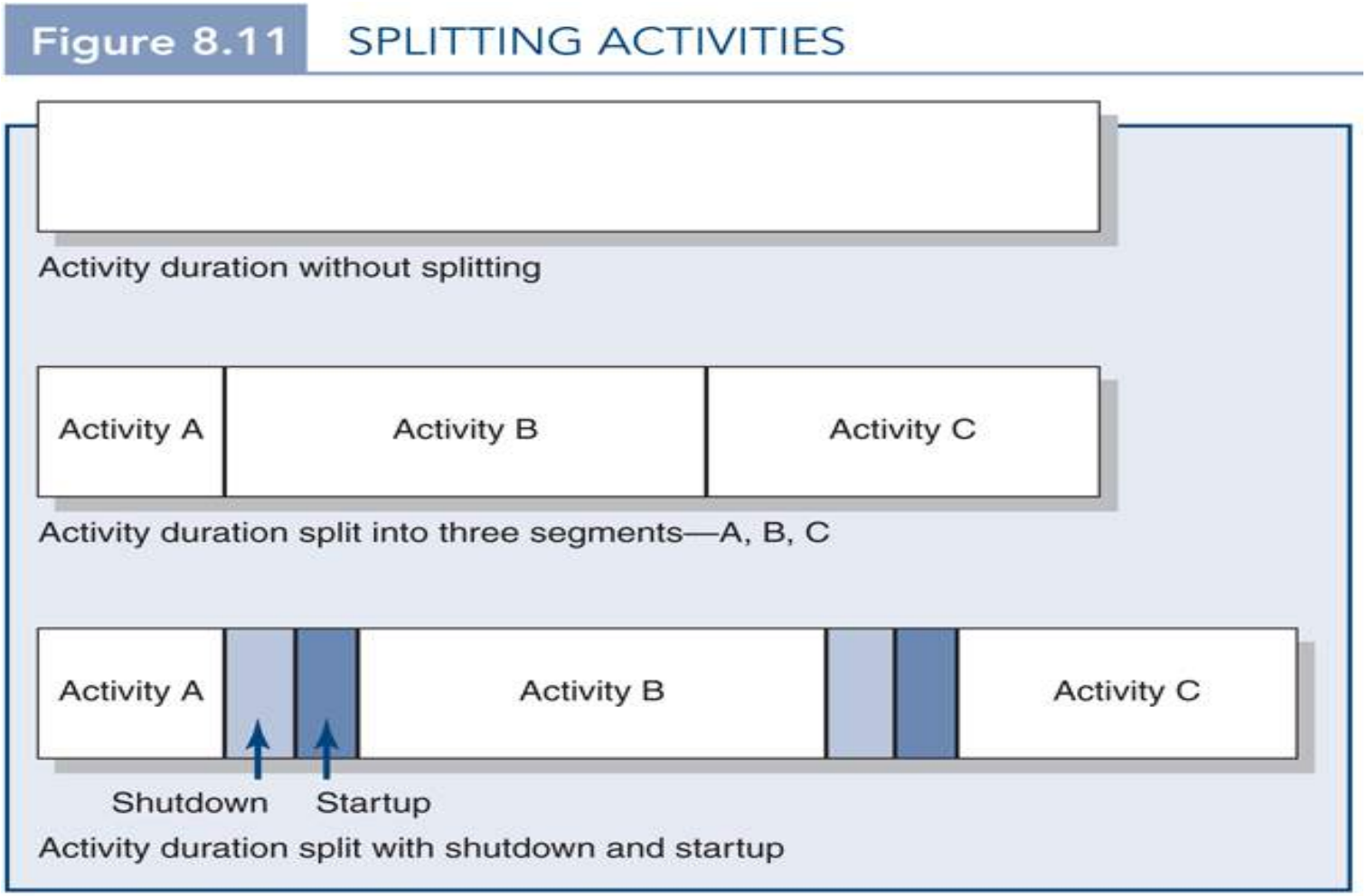
- Reduces delay but reduces flexibility.
- Increases criticality of events.
- Increases scheduling complexity.
- May make the traditional critical path no longer meaningful.
- Can break sequence of events.
- May cause parallel activities to become sequential and critical activities with slack to become non-critical.

Splitting activities

A scheduling technique used to get a better project schedule and/or increase resource utilisation.

- 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 argued to be one of the major reason why projects fail to meet schedule due to high costs (often hidden) of people switching between jobs.

Splitting activities



Common multi-project scheduling problems

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

Managing multi-project 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.
- Centralise project management: treat all projects as a part of a ‘megaproject’ (i.e. could be a program)
- Outsource projects to reduce the number of projects handled internally.

Next week

Reducing project duration