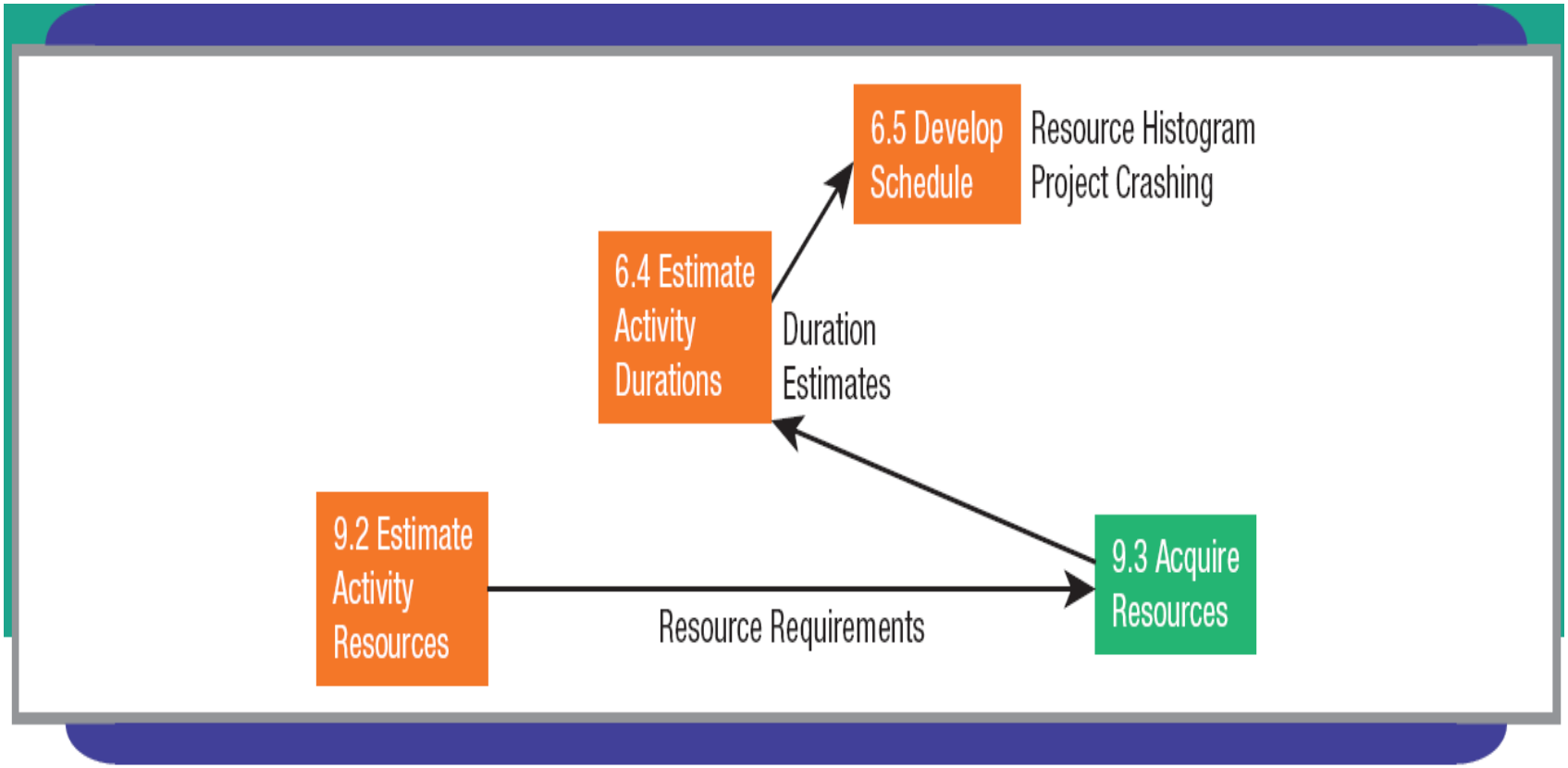
Resource Allocation

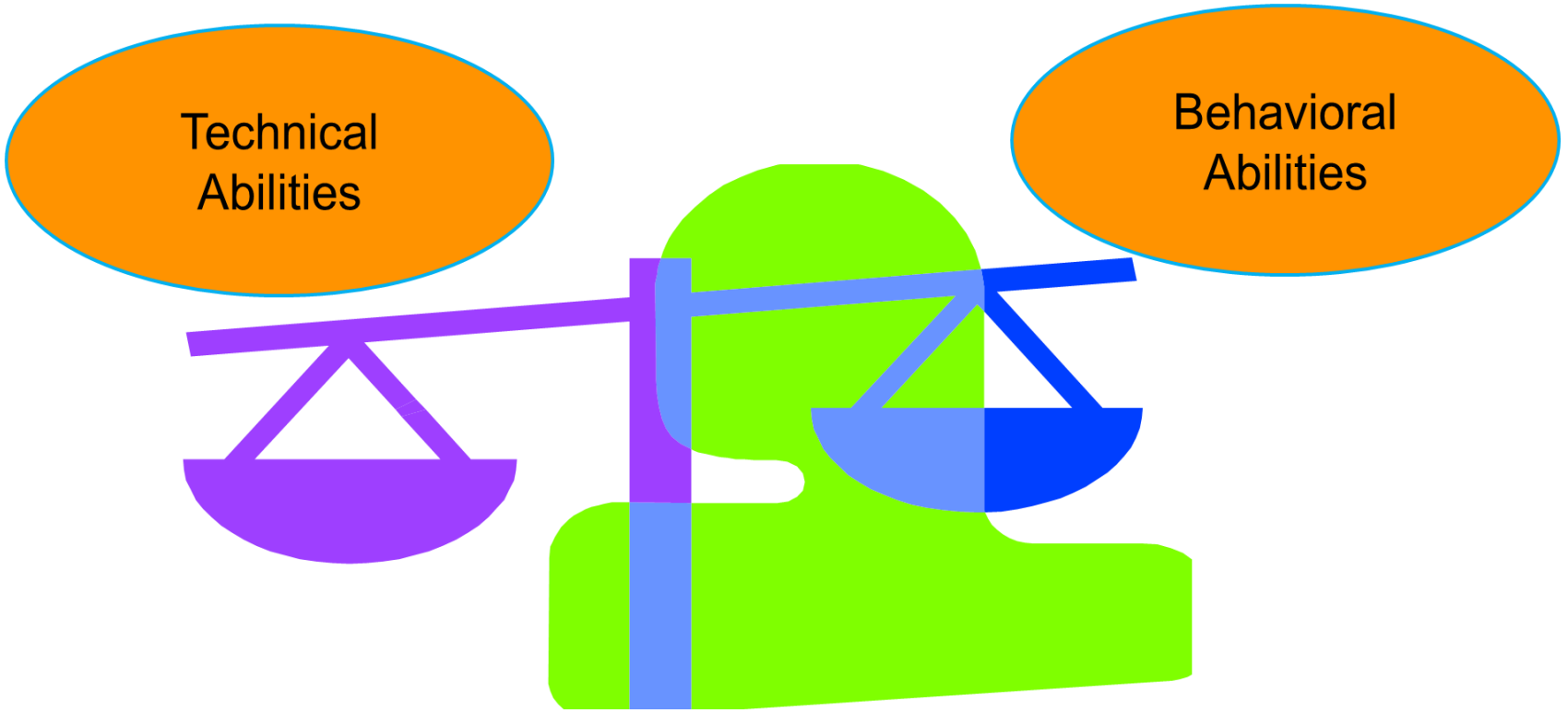
Resourcing Projects



What is Resource Allocation?

- Allocating resources (human, technical, etc) to projects
- Use in both individual and multiple, simultaneous projects
- Relates to scheduling and costs

Successful projects balance…



Must complement each other to develop a workable resource-based schedule that people will accept

Technical Abilities Needed when Resourcing Projects

Estimate resource demands

Create a staffing management plan

Identify person(s) with work overloads

Assign person(s) to each activity

Compress a project schedule

Schedule a project with limited resources

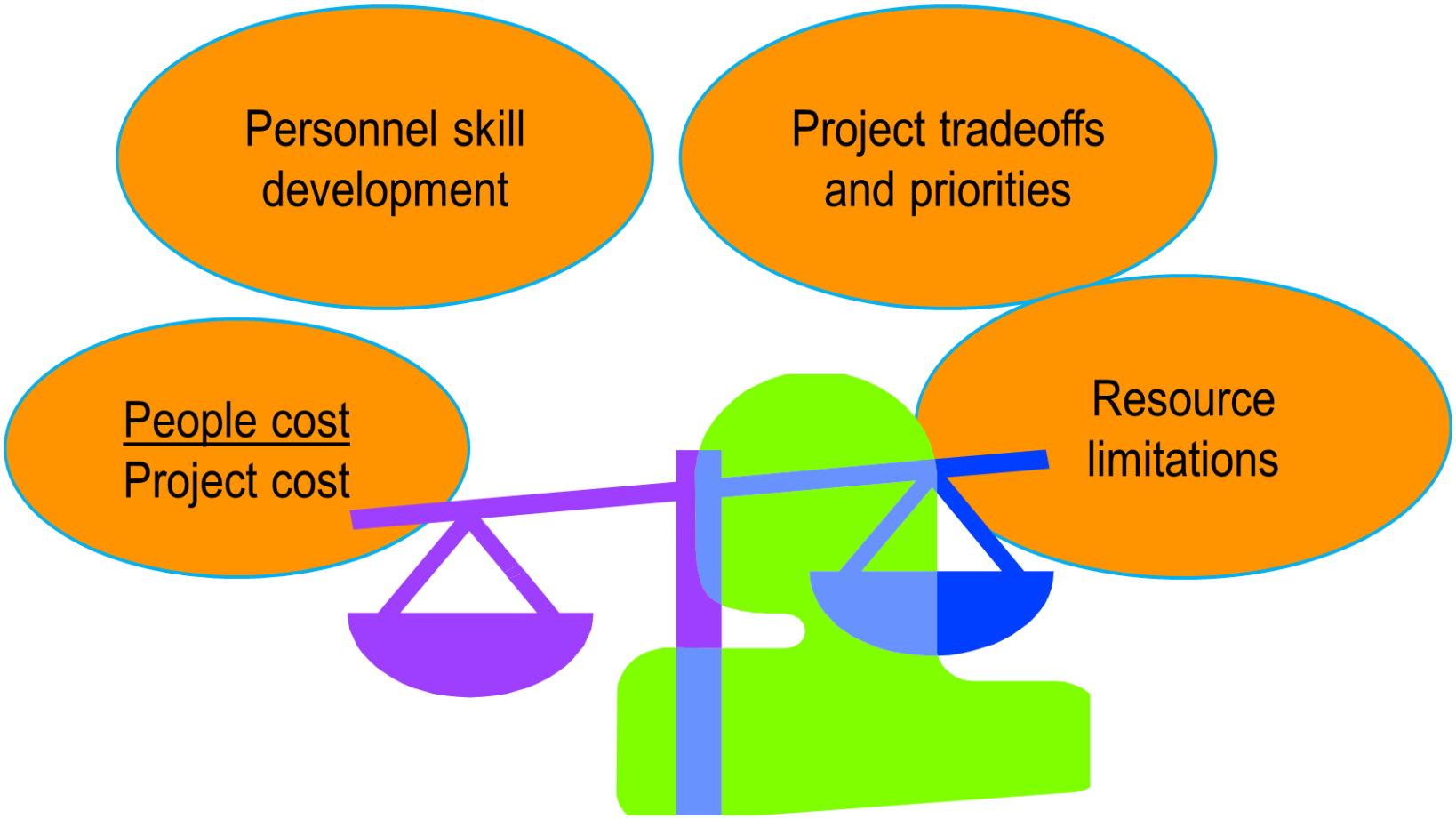
Behavioral Abilities Needed when Resourcing Projects (1 of 2)

- Select the right people
- Identify needs to be accomplished
- Ensure performance capability
- Deal with work schedules
- Schedule overtime

Behavioral Abilities Needed when Resourcing Projects (2 of 2)

- Estimate amount of work per activity
- Assemble effective team
- Deal with people from diverse backgrounds
- Decide where each person will work
- Establish effective virtual relationships

Key Resourcing Considerations



Activity versus Resource Dominated Schedule Basis Comparison

	MORE ON ACTIVITY	MORE ON RESOURCE
Time in project when scope is determined	Early	Late
Confidence in duration estimates	Great	Little
Rate of resource learning	Small	Extensive
Specialization of resources	Commodity	Unique
Availability of resources	Easily available	Tight availability
Firmness of activity predecessors (order)	Absolute	Optional
Concurrency of activities	Little	Significant

Activity versus Resource Dominated Schedule Basis Comparison

- Use when client does not understand their needs
- Rapid rate of change expected on projects
- Team members should remain on project for at least one iteration
- Budget is set based on *people*, and product is produced at pace team can maintain
- Agile team is cross-functional with general expertise
  - Develop skills as needed
  - Work flows to the team rather than vice versa

Estimate Resource Needs

- How many resources of each type & skill or knowledge level are needed?
- Consider support needs such as information systems & human resources
- Consider constraints placed upon how people are hired, scheduled, & released

Estimating activity resources– a process of assessing all types of resources—people, materials, tools, & equipment (along with quantities)—required for each activity to complete it as specified in project scope.

Plan Resource Management (1 of 2)

Plan Resource Management – the process of identifying resources and required skills for a project, defining and assigning roles and responsibilities to all resources, developing a reporting hierarchy, and communicating expectations.

- Identify potential resources
- Determine resource availability
- Decide timing issues

Staffing management plan – a proposal focused on acquiring, developing, and retaining human resources for as long as you need them on the project.

Plan Resource Management (2 of 2)

ROLE DESCRIPTION EXAMPLE

ROLE: Project Team Member

ASSIGNED DUTIES:

- Achieves the project objective, working closely with the PM and project team
- Applies Project Management concepts, methodology, and best practices
- Works well with co-located teams, virtual teams, cross-functional teams
- Delivers on commitments, completes tasks on time, communicates clearly

LIMITS OF AUTHORITY:

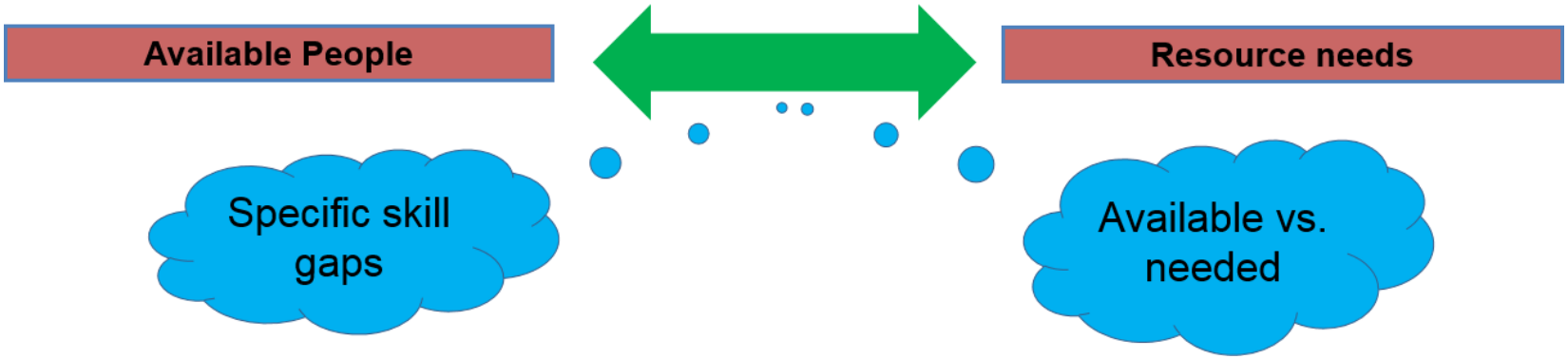
- Takes action and contributes to decisions within the parameters of the project (cost, schedule, scope, quality)
- Accountable to and reports to the Project Manager

Source: Connie Plowman, PMP, COO (retired), PMI Eric Jenett Project Management Excellence Award Recipient

Identify Potential Resources (1 of 3)

Work functions	job titles and range of responsibilities
Professional discipline	degrees and professional certifications
Skill level	experience and performance ratings
Physical location	willingness to relocate and travel
Organizational/administrative unit	costs & contractual issues

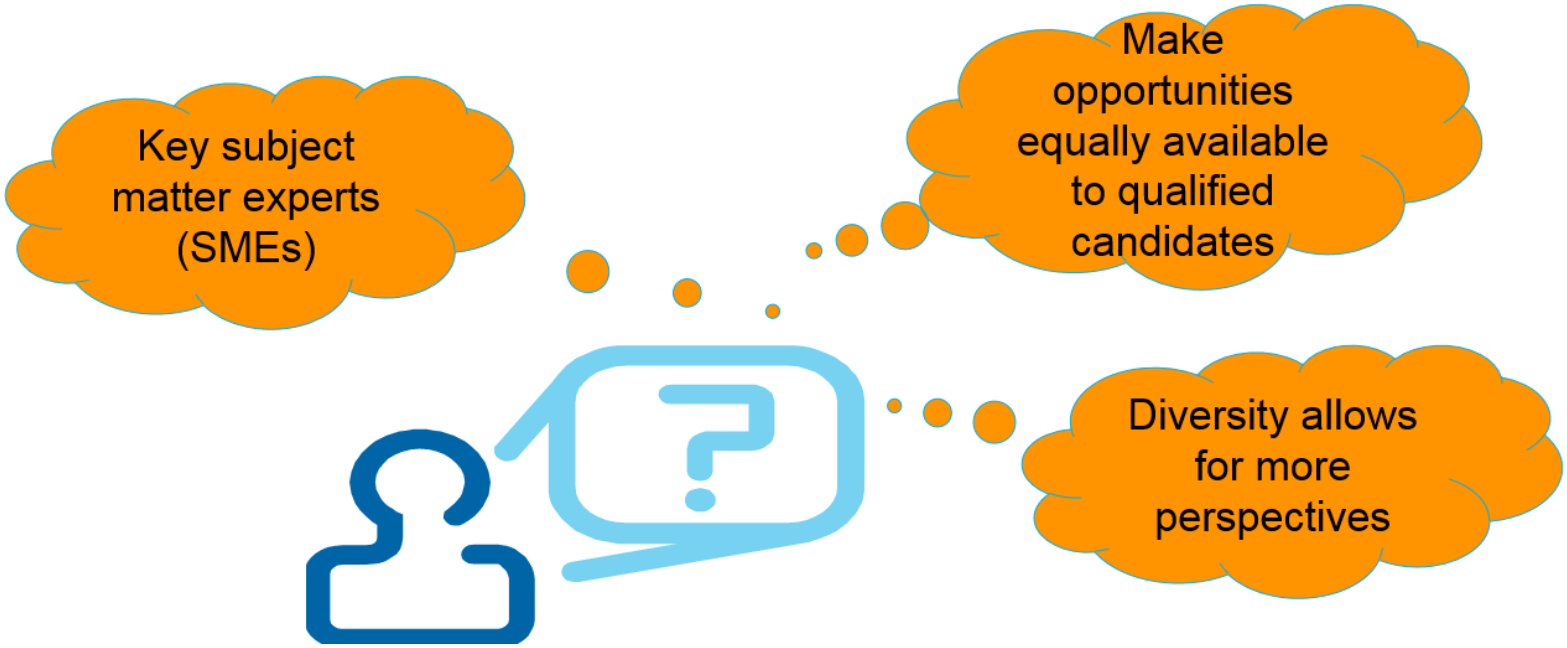
Identify Potential Resources (2 of 3)



- Identify an adequate number and mix of people
- Core team should participate in chartering the project

Resource Breakdown structure (RBS)– grouping all resources into main categories in level one and populating each main category with resources based on either function or skill level….see Exhibit 9.3 in textbook

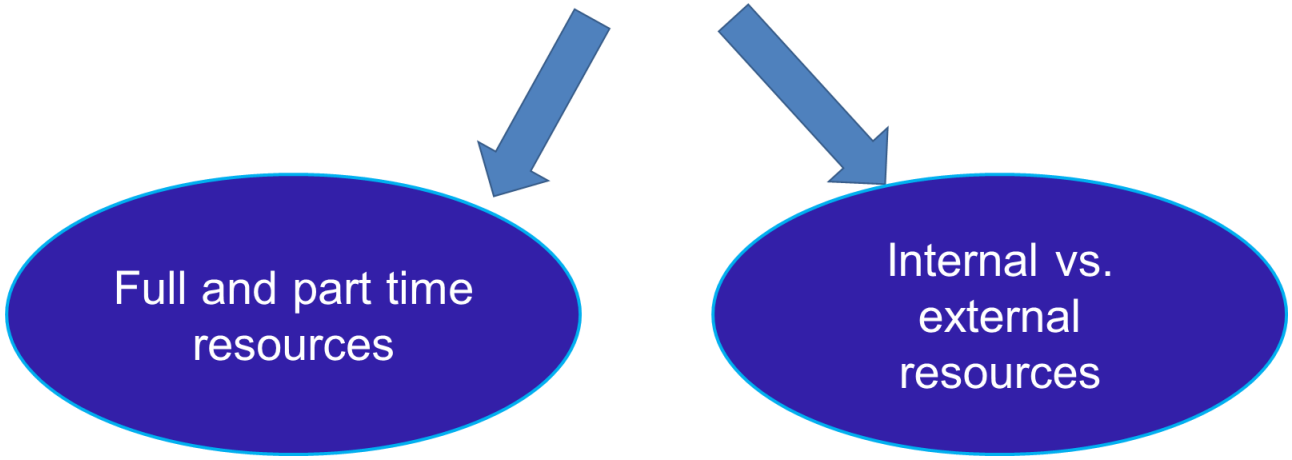
Identify Potential Resources (3 of 3)



You may not get the specific people you want for your project, so it makes sense to identify all possible resources!

Determine Resource Availability

- Identify availability of desired people
- Secure ***commitment***



Decide Timing Issues when Resourcing Projects

- When to bring people on board
- Get team functioning effectively
- Plan for keeping team motivated & on schedule
- When to reward & recognize the project team
- When & how to release project participants

Staffing Management Plan Issues

How will project planners identify potential people for the project?

How will they determine which people are available & secure their services?

How will they deal with timing issues of building up & then releasing the project workforce?

Project Team Composition Issues

Outsourced?

Co-located?

Virtual?

Cross-functional?

Assign a Resource to each Activity

- Show resource responsibilities on RACI chart
- Show resource assignments on Gantt Chart
- Summarize resource responsibilities with histogram

WBS	Activity	Who 1?	Who 2?
The work breakdown structure	Project activities that correspond to the WBS	Who will be involved	May be more than one person

Show Resource Responsibilities on RACI Chart

RACI is a form of RAM

Responsibility assignment matrix (RAM) – a matrix depicting work packages & assigned resources for completing activities required to produce work packages

RACI – a popular form of RAM that presents roles of key stakeholders and their roles defined as responsible (R), accountable (A), consult (C), and inform (I) for project activities in a matrix form

Agile team members decide among themselves who will do each work activity; when finished, they begin next-highest-priority work

Partial RACI Chart Example

PARTIAL RACI CHART

PARTIAL RACI CHART								
WBS	WORK PACKAGES AND ACTIVITIES	SPON-SOR (LYNDA)	PROJECT MANAGER (JOE)	TEAM MEMBER (ALI)	TEAM MEMBER (BEN)	TEAM MEMBER (DAN)	STUDENTS	PARENTS
0.0	High School Recruitment Plan							
1.0	Project Management							
1.1	Manage Key Stake-holder Expectations	A	R	C	C	C	I	I
1.2	Develop Operating Methods		A	C	R	C		
1.3	Create Communi-cations Plan	I	A	R	R	R		
1.4	Control Progress	I	A	C	C	R		
2.0	Information Assessment							
2.1	Conduct Campus Visit	C	A	R	R	R	I	I
2.2	Conduct Students Surveys	I	A	I	C	R	C	I
2.3	Lead Group Discussion	I	A	C	C	C	C	
3.0	Workshop/ Activities							
3.1	Develop Ideas	C	A	C	C	R	C	
3.2	Analyze Possible Techniques	C	A	C	C	R	C	C
3.3	Compile Activities/ programs	C	A	C	C	R	C	I
3.4	Respond to Sponsor Feedback	R	A	I	I	I		
3.5	Reassess Activity Plan	C	A	C	C	C	I	I
3.6	Secure Sponsor Approval	R	A	I	I	I	I	I

Only *one* person accountable for each task

Dealing with Resource Overloads

- Identify which activities are involved
- Compare resource histogram to Gantt Chart Schedule
- Project scheduling software pinpoints when overloads occur for each worker
- Management decisions required to solve the problem

Methods of Resolving Resource Overloads

- Reorder activities
- Acquire or borrow additional resources
- Reduce project scope or extend project schedule
- Inform sponsor of severe overloads
- Resource- level the overloaded person's schedule
- Assign certain activities to other workers
- Split an activity into two activities
  - Perform 1st part as scheduled
  - Delay 2nd part of activity

Resource Leveling

- Delay activities so person doesn't perform as many activities at the same time (most common)
- Delay noncritical activities by an amount no more than their slack
- Allow project to slip
- If non-critical activities *must* be completed at rate of effort in original schedule, reassign activities to another worker
- Resource leveling is a combination of art & science

Resource Leveling – a project execution technique of adjusting the use of resources based on availability and the amount of float on activities to accomplish work as soon as possible, given the limited resource availability.

Compress the Project Schedule (1 of 2)

- Actions to reduce the critical path
- Crashing
- Fast tracking

Actions to Reduce the Critical Path

- Reduce project scope and/or quality.
- Overlap sequential activities
- Partially overlap sequential activities
- Increase number of work hours/days
- Schedule activities at same time.
- Shorten activities by assigning more resources.
- Shorten activities that cost least to speed up.

Compress the Project Schedule (2 of 2)

- Crashing may cost more money to speed up the schedule
- Fast tracking may increase the risk to speed up the schedule

Crashing – speeding up the critical path often by adding additional resources or employing existing resources for longer hours and/or more days per week

Fast Tracking – a method to expedite a project by executing activities at the same time that would ordinarily be done one after the other

- In agile, crashing is called “swarming,” since team members swarm on a problem to help get back on track

Crashing (1 of 4)

Certain activities are performed at a faster than normal pace

Which activities are on the critical path?

Which critical path activity costs the least on a per day basis to speed up?

Critical Path Method—Crashing a Project

Time and costs are interrelated

Faster an activity is completed, more is the cost

Change the schedule and you change the budget

Thus many activities can be speeded up by spending more money

What is Crashing / Crunching?

To speed up, or expedite, a project

Of course, the resources to do this must be available

Crunching a project changes the schedule for all activities

This will have an impact on schedules for all the subcontractors

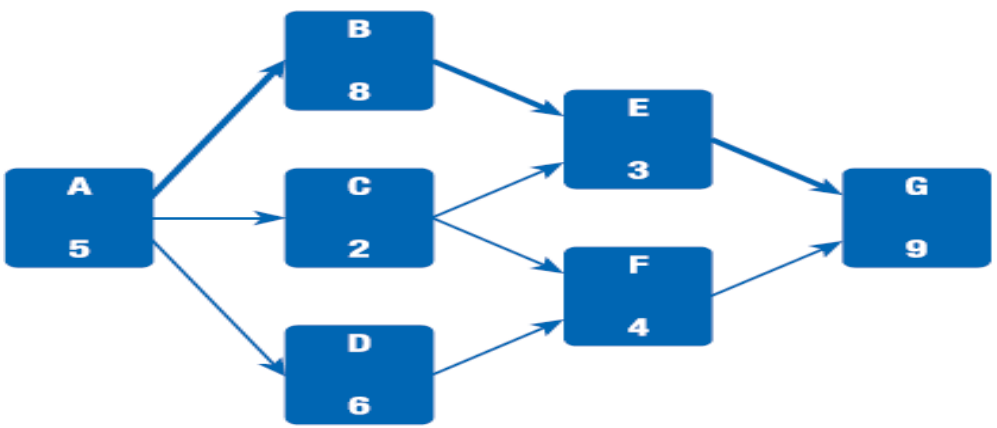
Crunching a project often introduces unanticipated problems

Activity Slope

$$Slope = \frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Crash Time} - \text{Normal Time}}$$

Crashing (2 of 4)

CRASHING EXAMPLE SET UP



PATH	DURATION
ABEG	25
ACEG	19
ACFG	20
ADFG	24

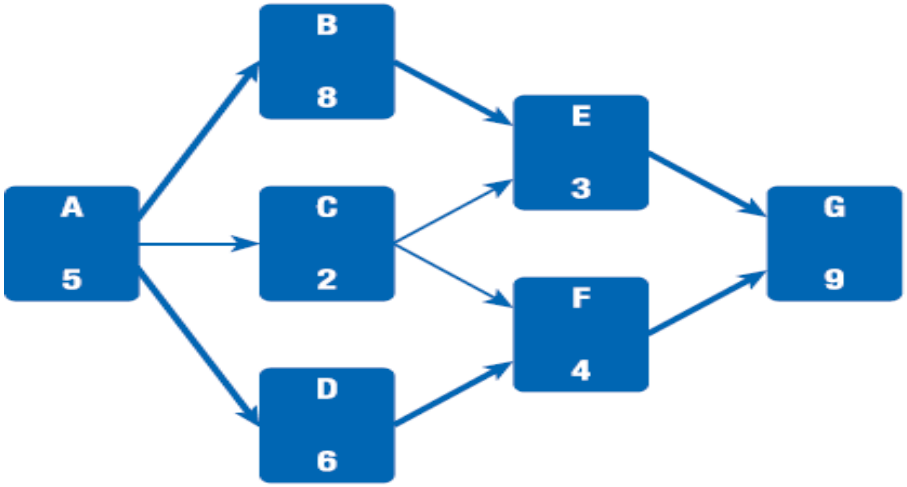
Activity	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
► A	5	$300	5	$300	N/A
► B	8	250	5	400	50
► C	2	100	2	100	N/A
D	6	300	3	600	100
► E	3	150	2	300	150
F	4	275	3	300	25
► G	9	700	8	900	200

PROJECT DURATION	ACTIVITY(IES) CRASHED	INCREMENTAL CRASH COST	CUMULATIVE CRASH COST
25	-	0	0

The enumeration method was used to identify each path and its duration.

Crashing (3 of 4)

CRASHING EXAMPLE AFTER ONE ROUND



PATH	DURATION
ABEG	~~25~~ 24
ACEG	19
ACFG	20
ADFG	24

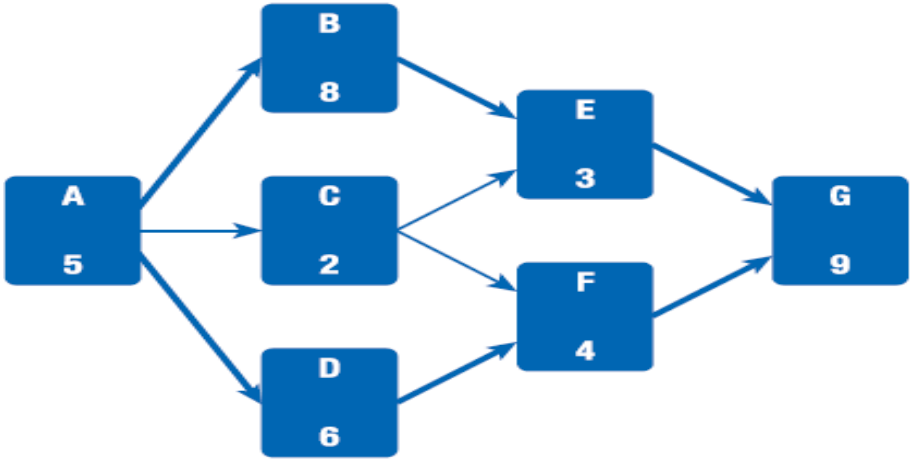
Activity	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
► • A	~~5~~	~~$300~~	~~5~~	~~$300~~	~~N/A~~
► B	~~8~~ 7	250	5	400	50
~~C~~	~~2~~	~~100~~	~~2~~	~~100~~	~~N/A~~
• D	6	300	3	600	100
► E	3	150	2	300	150
• F	4	275	3	300	25
► • G	9	700	8	900	200

PROJECT DURATION	ACTIVITY(IES) CRASHED	INCREMENTAL CRASH COST	CUMULATIVE CRASH COST
25	-	0	0
24	B	$50	$50

Activity B on the critical path is the least expensive choice

Crashing (4 of 4)

CRASHING EXAMPLE AFTER TWO ROUNDS



PATH	DURATION
ABEG	~~25~~ ~~24~~ 23
ACEG	19
ACFG	~~20~~ 19
ADFG	~~24~~ 23

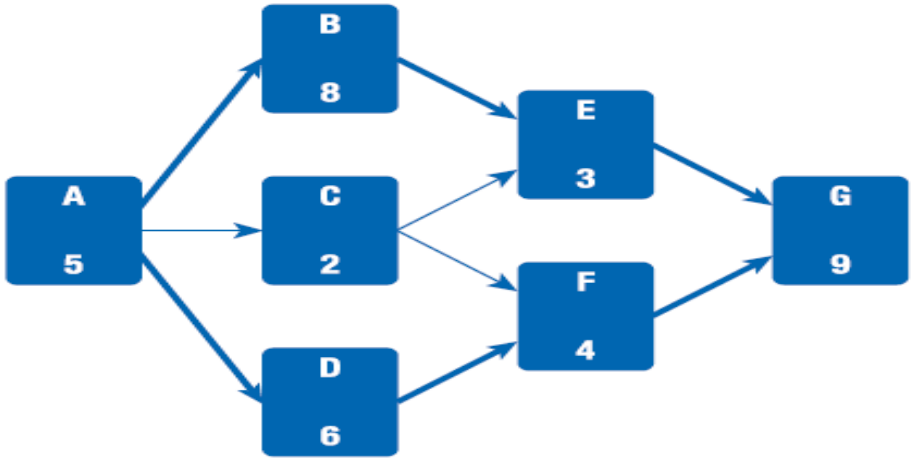
Activity	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
► • A	5	$300	5	$300	N/A
► B	~~8~~ ~~7~~ 6	250	5	400	50
C	2	100	2	100	N/A
• D	6	300	3	600	100
► E	3	150	2	300	150
• F	~~4~~ 3	275	3	300	25
► • G	9	700	8	900	200

PROJECT DURATION	ACTIVITY(IES) CRASHED	INCREMENTAL CRASH COST	CUMULATIVE CRASH COST
25	-	0	0
24	B	$50	$50
23	B & F	75 (50+25)	125

After 2 rounds, both critical paths are 23 days.

Crashing – "All-Crash" Mode

CRASHING EXAMPLE IN ALL-CRASH MODE



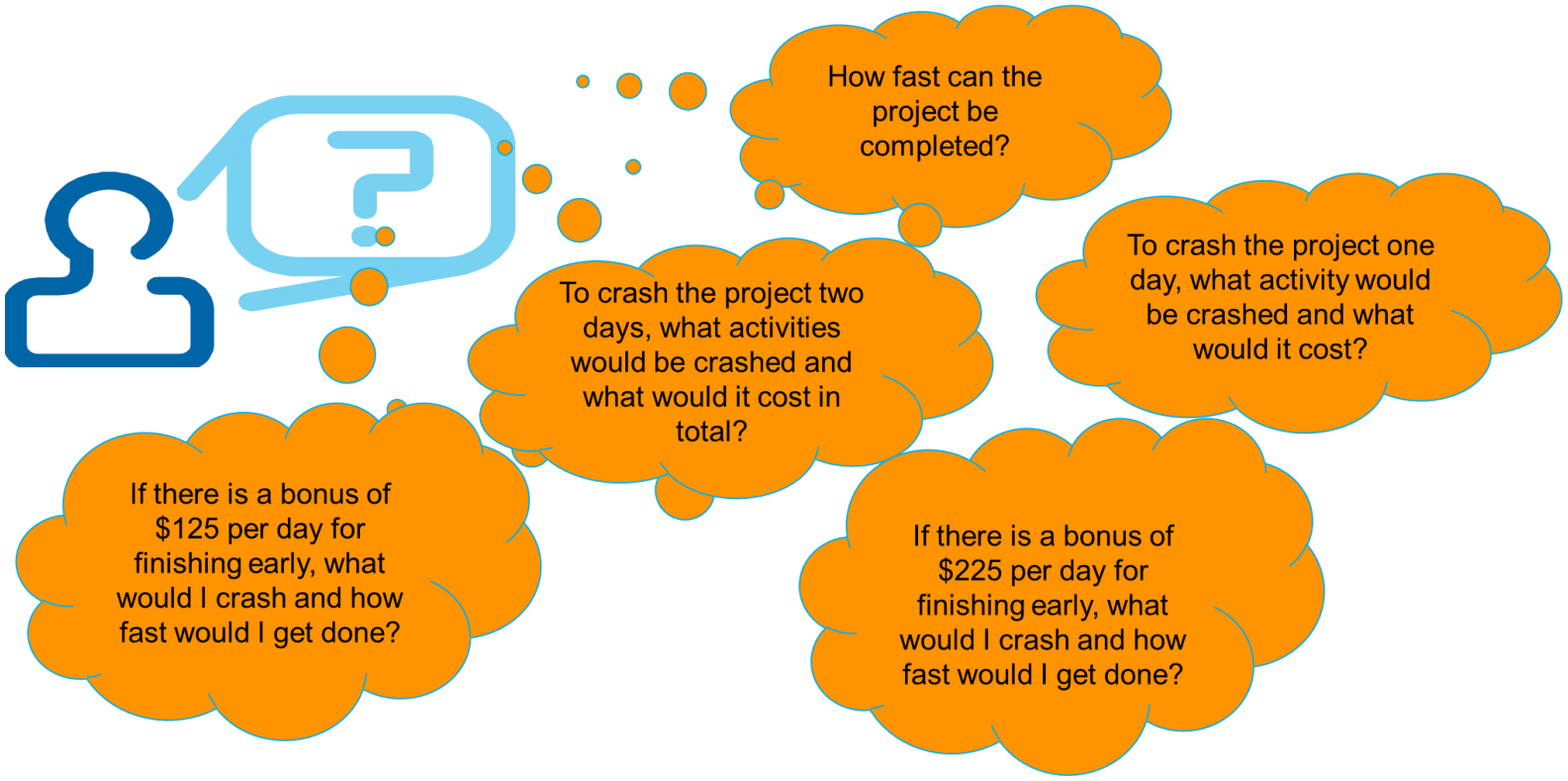
PATH	DURATION
ABEG	~~25~~ ~~24~~ ~~23~~ ~~22~~ ~~21~~ 20
ACEG	~~19~~ ~~18~~ 17
ACFG	~~20~~ ~~19~~ 18
ADFG	~~24~~ ~~23~~ ~~22~~ ~~21~~ 20

Activity	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
► • A	5	$300	5	$300	N/A
► B	~~8~~ ~~7~~ ~~6~~ 5	250	5	400	50
C	2	100	2	100	N/A
• D	~~6~~ ~~5~~ 4	300	3	600	100
► E	~~3~~ 2	150	2	300	150
• F	~~4~~ 3	275	3	300	25
► • G	~~9~~ 8	700	8	900	200

PROJECT DURATION	ACTIVITY(IES) CRASHED	INCREMENTAL CRASH COST	CUMULATIVE CRASH COST
25	-	0	0
24	B	$50	$50
23	B & F	75 (50+25)	125
22	B & D	150 (50+100)	275
21	G	200	475
20	D & E	250 (100+150)	725

Continuing to crash activities until it is not worthwhile

Crashing Consideration Questions



Example

Using the data below, create the project schedule using normal times. Determine the order in which you would crash the project one day, two days, and so on until it is in an all-crash mode. Identify how much it would cost for each day you crash the schedule.

Activity	Predecessor	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
A	–	12	200	9	350	
B	A	8	300	8	300	
C	A	9	250	7	450	
D	B	6	400	5	600	
E	B, C	5	150	4	225	
F	C	10	500	9	650	
G	D, E, F	8	400	6	900	

Example

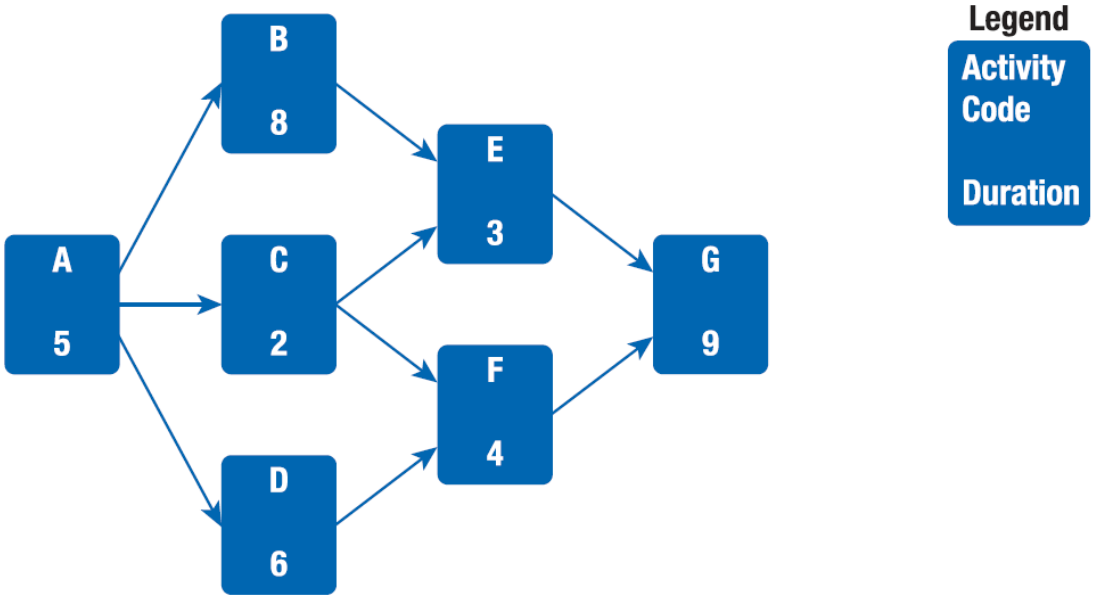
Using the data below, create the project schedule using normal times. Determine the order in which you would crash the project one day, two days, and so on until it is in an all-crash mode. Identify how much it would cost for each day you crash the schedule.

Activity	Predecessor	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
A	B	5	200	4	350	
B		8	220	8	220	
C	B	6	250	4	650	
D	A	9	500	5	600	
E	A, C	10	150	9	500	
F	E	10	500	9	650	
G	D, F	8	400	6	900	

Fast tracking

Activities normally performed in series are performed at the same time

FAST TRACKING EXAMPLE



Alternative Scheduling Methods

- Critical Chain Project Management (CCPM)
- Reverse Phase Schedules
- Rolling Wave Planning
- Agile Project Planning
- Auto/Manual Scheduling

Methods are not mutually exclusive!

Critical Chain Project Management (CCPM)

- Incorporates calculations on resource availability
- The resource most in demand is identified
- Keep that resource appropriately busy on critical chain activities

Critical chain method – an alternative scheduling technique that modifies project schedule by taking resource constraints into account…allows the project team to place buffers on any project schedule path to account for uncertainty and limited resources

CCPM Components

Avoid multitasking

Estimate aggressively activity completion time

Feed time buffer in front of critical chain activities

Put time reserved for uncertainty at project end

Finish activities early if possible

Reverse Phase Schedules

- a.k.a. Last Planner System
- Developed by people closest to the work
- Start with final project deliverables
- Ask what needs to be completed prior to starting work on this deliverable
- Think from end of the project to the beginning
- Often used in construction projects

Rolling Wave Planning

- Plan first part of project in detail
- Plan later parts at a high level/ use placeholders
- Focus on the near term
- Extreme of rolling wave planning is Agile

Agile Project Planning

- Collaborative approach with workers and stakeholders
- Stakeholders want cost, schedule, & functionality data before approving a project
- Avoid stringent change control
- Projects planned in short increments called sprints

Auto/Manual Scheduling

- MS Project now allows manual scheduling
- Enables users to emulate MS Excel
- When showing few milestones without dates (i.e. during Chartering), manual scheduling may be good option

An Example of Two-Time CPM

Table 9-1 An Example of Two-Time CPM

Activity	*Precedence*	*Duration, Days (normal, crash)*	*Cost (normal, crash)*
a	—	3, 2	$40, 80
b	a	2, 1	20, 80
c	a	2, 2	20, 20
d*	a	4, 1	30, 120
e**	b	3, 1	10, 80

* Partial crashing allowed
** Partial crashing *not* allowed

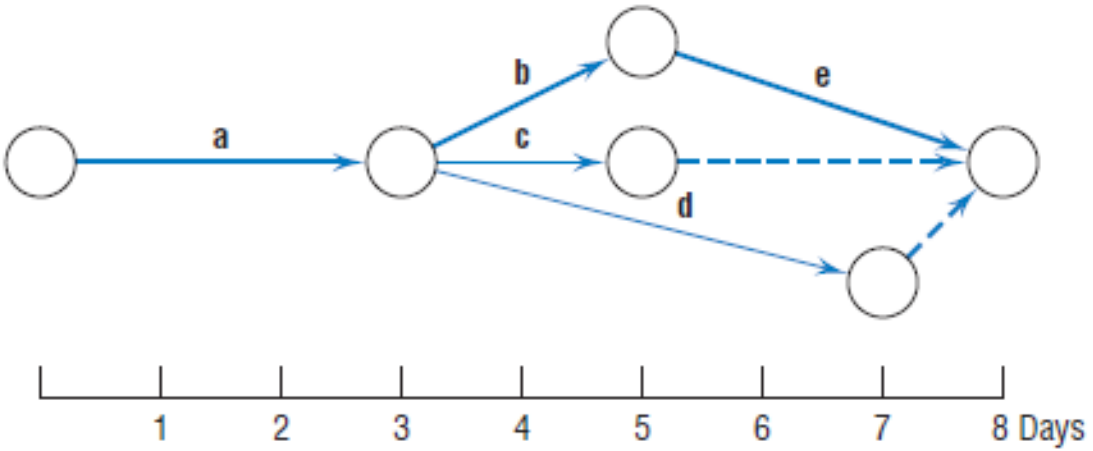
Activity Slopes—Cost per Period for Crashing

Table 9-2 Activity Slopes–Cost per Period for Crashing

Activity	*Slope ($/day)*
a	40/–1 = –40
b	60/–1 = –60
c	—
d	90/–3 = –30
e	–70 (2 days)

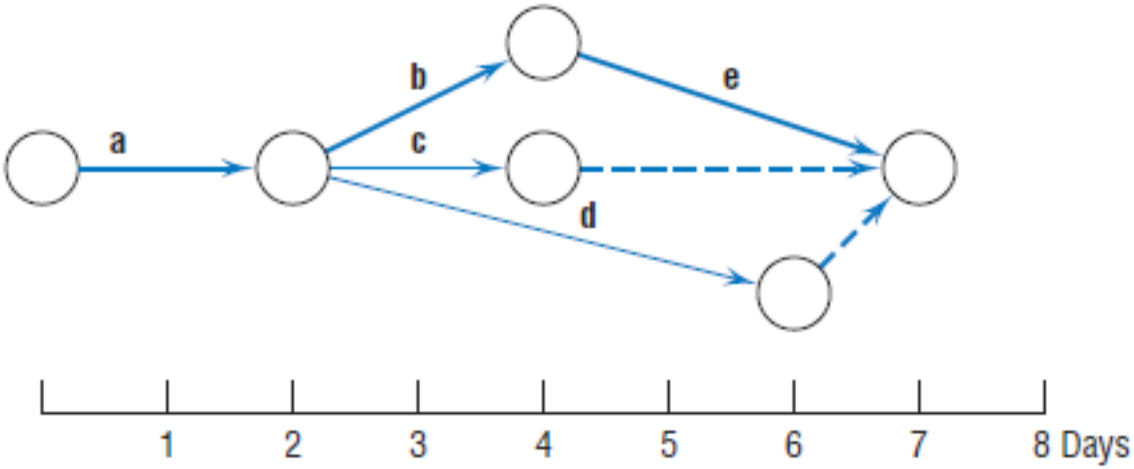
Crashing the Project

a. Normal Schedule,
8 Days, $120



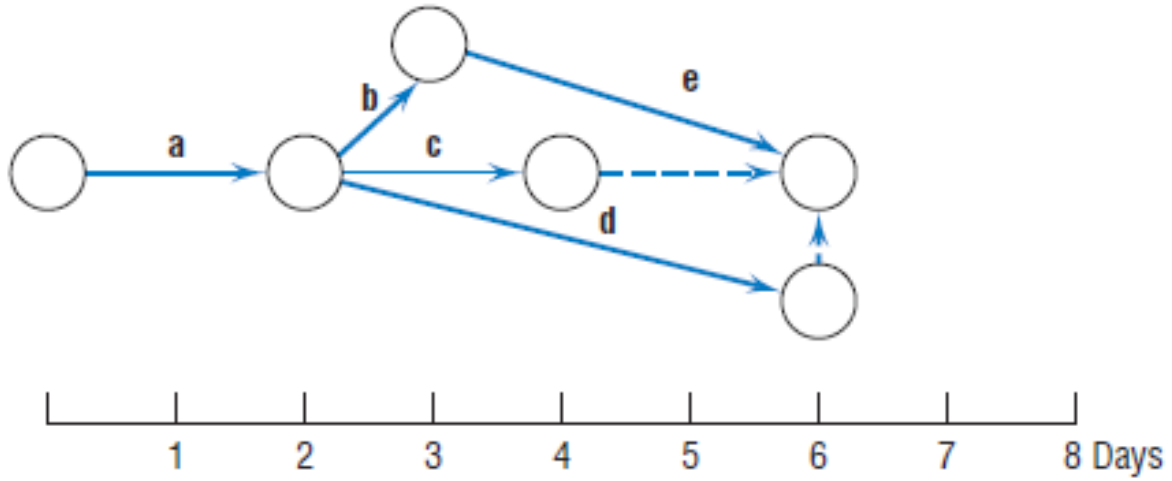
Seven Day Schedule

b. 7-Day Schedule, $160



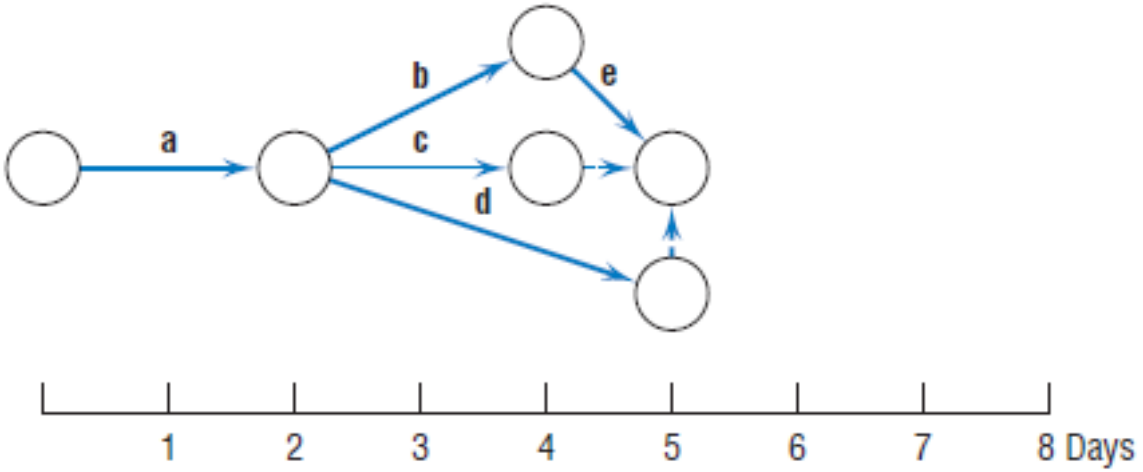
Six Day Schedule

c. 6-Day Schedule,
$220



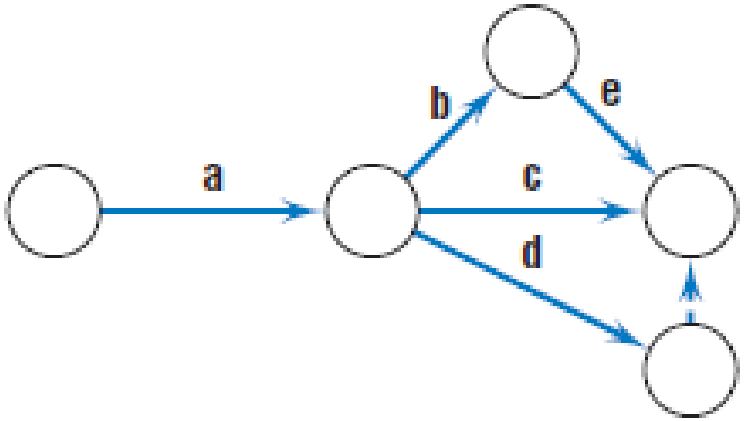
Five Day Schedule

d. 5-Day Schedule, $260



Four Day Schedule

e. 4-Day Schedule, $350



Cost-Crash Curve

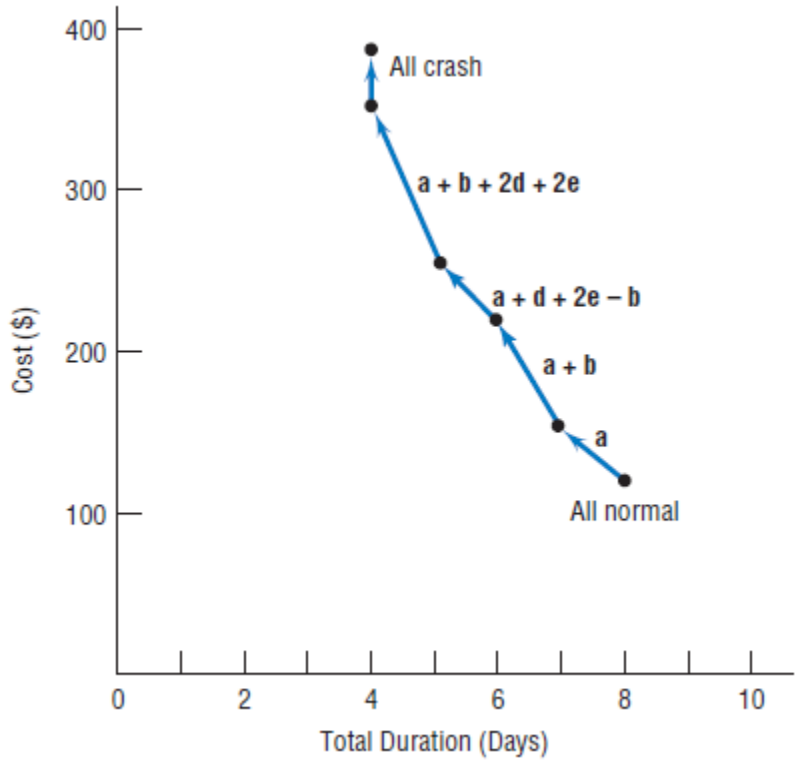


Figure 9-2 CPM cost-duration history.

Fast-Tracking

- Fast-tracking is another way to expedite a project
  - Mostly used for construction projects
  - Can be used in other projects
- Refers to overlapping design and build phases
- Increases number of change orders
- Increase is not that large

Official Pace of a Project

Table 9-3 Official Pace of a Project

Title	*Normal*	*Rush*	*Blitz*
Approved Project Definition	Full	Some abbreviations from normal pace.	Only as necessary for major management decisions, purchasing and design engineering.
Study of Alternates	Reasonable	Quick study of major profitable items.	Only those not affecting schedule.
Engineering Design	Begins near end of Approved Project Definition	Begins when Approved Project Definition 50–75% complete	Concurrently with such Approved Project Definition as is done.
Issue Engineering to Field	Allows adequate time for field to plan and purchase field items. Usually $\frac{1}{2}$–2 months lead time between issue and field erection.	Little or no lead time between issue and field erection.	No lead time between issue and field erection.
Purchasing	Begins in latter stages of Approved Project Definition.	Approved Project Definition. Rush purchase of all long delivery items. Many purchases on "advise price" basis.	Done concurrently with such Approved Project Definition as is done. Rush buy anything that will do job. Overorder and duplicate order to guarantee schedule.
Premium Payments	Negligible	Some to break specific bottlenecks.	As necessary to forestall any possible delays.
Field Crew Strength	Minimum practical or optimum cost.	Large crew with some spot overtime.	Large crew; overtime and/or extra shifts.
Probable Cost			
Difference Compared with Normal Pace, as a Result of:			
— Design and Development	Base	5–10% more	15% and up, more
— Engineering and Construction Costs	Base	3–5% more	10% and up, more
Probable Time	Base	Upto 10% less	Up to 50% less

The Resource Allocation Problem

- CPM/PERT ignore resource utilization and availability
- With external resources, this may not be a problem
- It is, however, a concern with internal resources
- Schedules need to be evaluated in terms of both time and resources

Time Use and Resource Use

- Time limited: A project must be finished by a certain time
- Resource limited: A project must be finished without exceeding some specific level of resource usage
- Overdetermined: when time, cost, and scope are fixed
- System-constrained: A project requires a fixed amount of time and resources

Resource Loading

- Resource loading describes the amount of resources an existing schedule requires
- Gives an understanding of the demands a project will make of a firm’s resources

Resource Usage Calendar

Career Day Project
Resource Usage Calendar

ID	Resource Name	Work	May				June				July				
			25	2	9	16	23	30	6	13	20	27	4	11	18	25
1	**Secretary**	**1,020 hrs**	24h	40h	40h	40h	88h	120h	102h	40h	40h	40h	40h	40h	40h	40h
	Print forms	240 hrs														
	Gather college particulars	160 hrs	24h	40h	40h	40h	16h									
	Print programs	240 hrs					24h	40h	40h	40h	40h	40h	16h			
	Advertise in college paper	200 hrs					24h	40h	36h	0h	0h	0h	24h	40h	36h	
	Organize posters	180 hrs					24h	40h	26h	0h	0h	0h	0h	0h	4h	40h
2	**Program Manager**	**1,440 hrs**	40h	40h	40h	16h	24h	40h	40h	40h	16h					
	Contact organizations	600 hrs	16h													
	Select guest speaker	560 hrs														
	Organize food	120 hrs	24h	40h	40h	16h										
	Contact faculty	60 hrs					24h	36h								
	Arrange facility for event	100 hrs						4h	40h	40h	16h					
3	**Office Manager**	**180 hrs**	24h	40h	40h	40h	16h				20h					
	Collect display information	160 hrs	24h	40h	40h	40h	16h									
	Transport materials	20 hrs									20h					
4	**Graduate Assistant**	**1,140 hrs**	24h	40h	40h	40h	64h	80h	80h	56h	40h	40h	16h			
	Print participants' certificates	320 hrs														
	Organize refreshments	280 hrs	24h	40h	40h	40h	40h	40h	40h	16h						
	Send invitations	80 hrs														
	Organize gift certificates	220 hrs														
	Arrange banner	200 hrs					24h	40h	40h	40h	40h	16h				
	Class announcements	40 hrs										24h	16h			
5	**Director**	**400 hrs**	24h	40h	40h	40h	40h	40h	40h	40h	40h	40h	16h			
	Organize liquor	400 hrs	24h	40h	40h	40h	40h	40h	40h	40h	40h	40h	16h			

Figure 9-3 Resource usage calendar for Career Day Project.

AOA Network

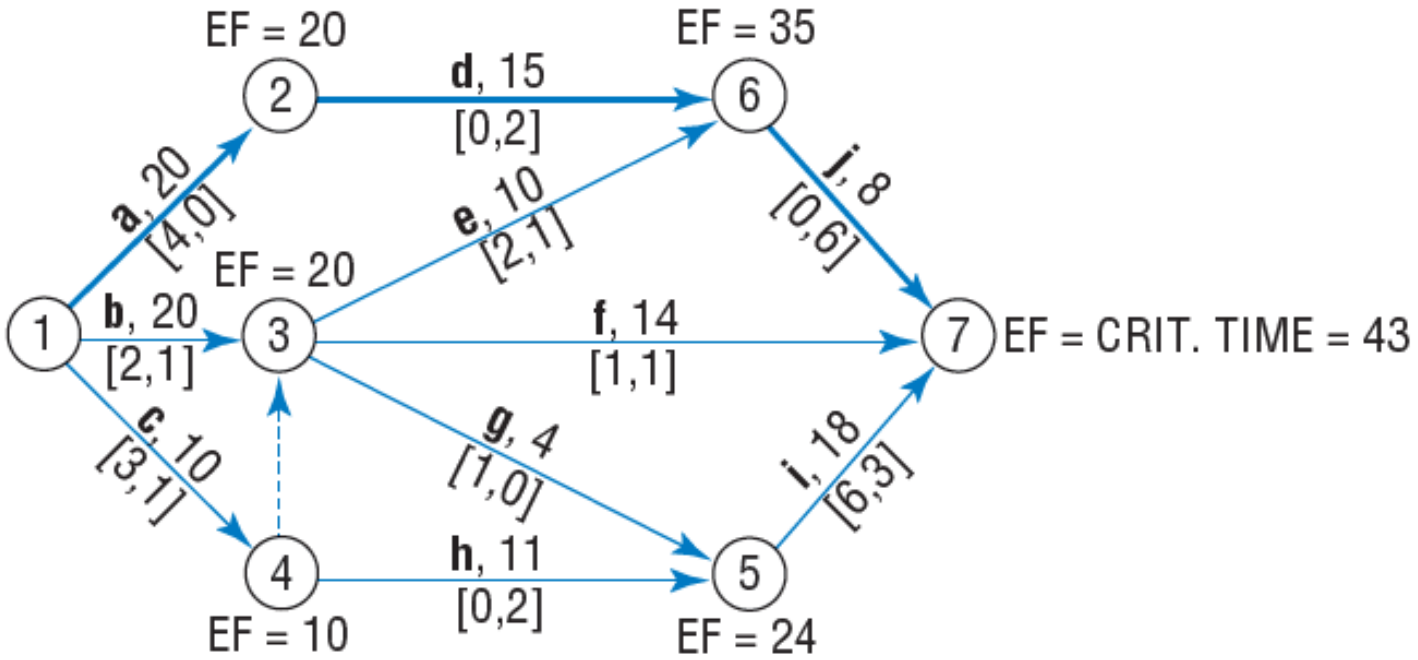


FIGURE 9.4 The AOA network of Table 8.2.

Modified AOA

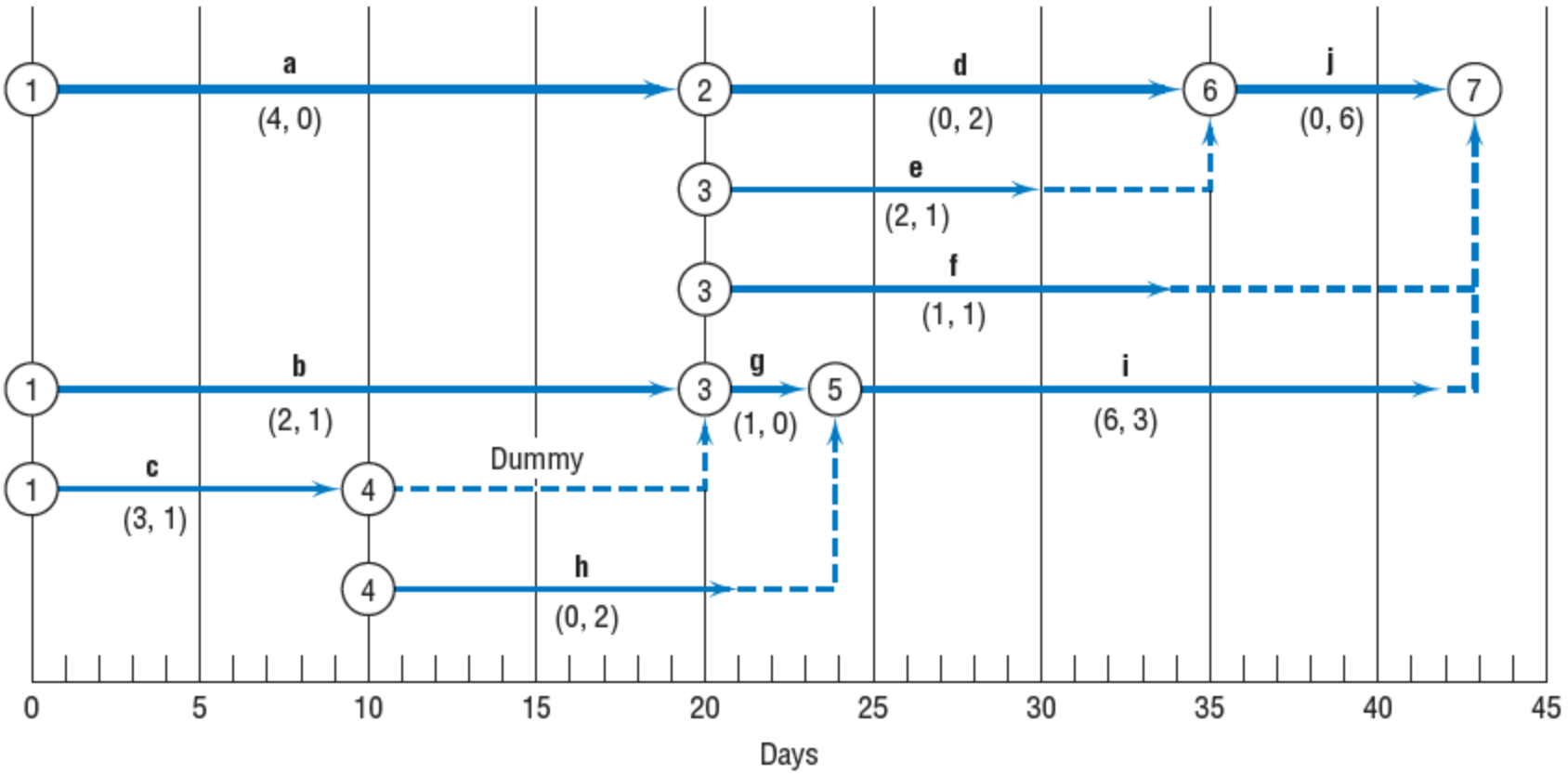
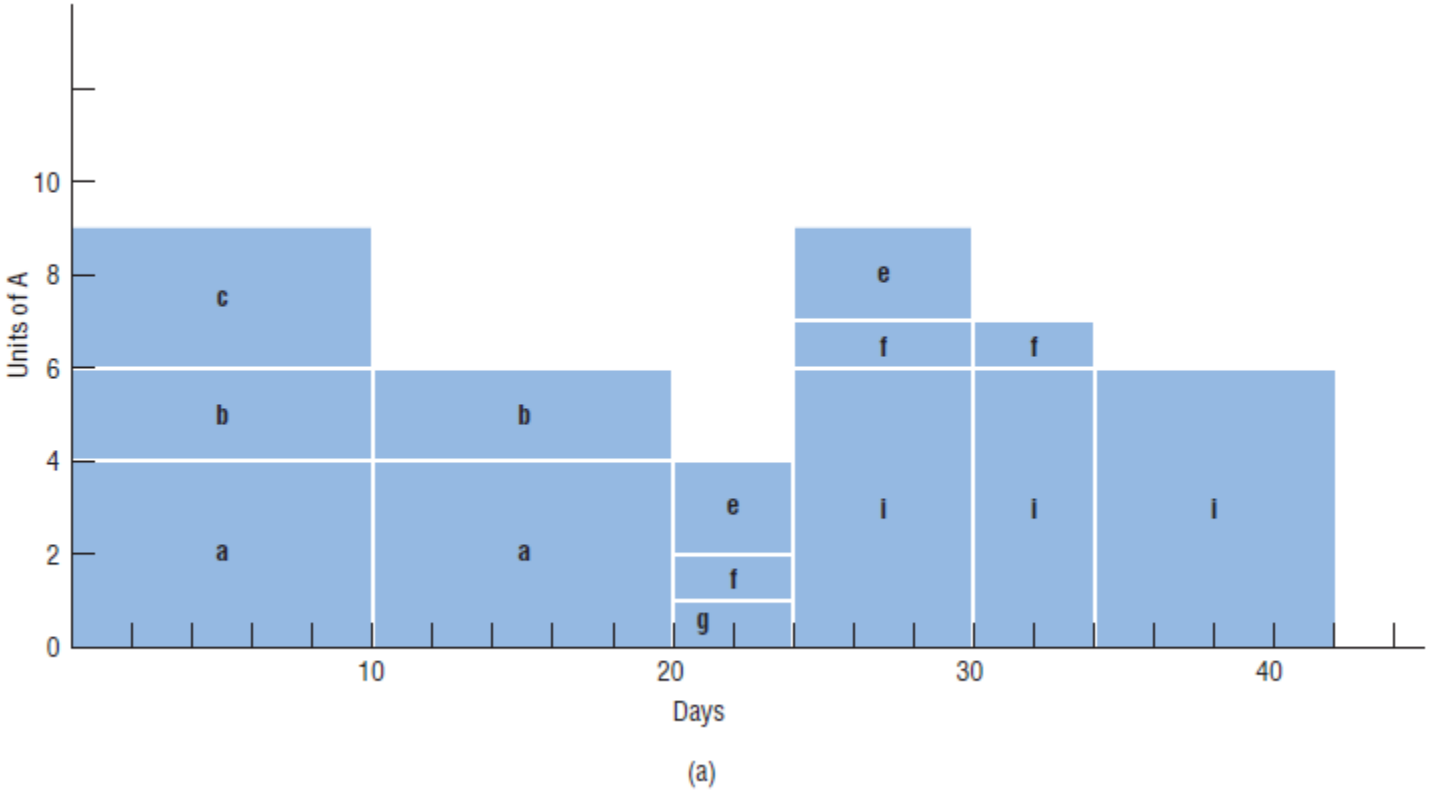


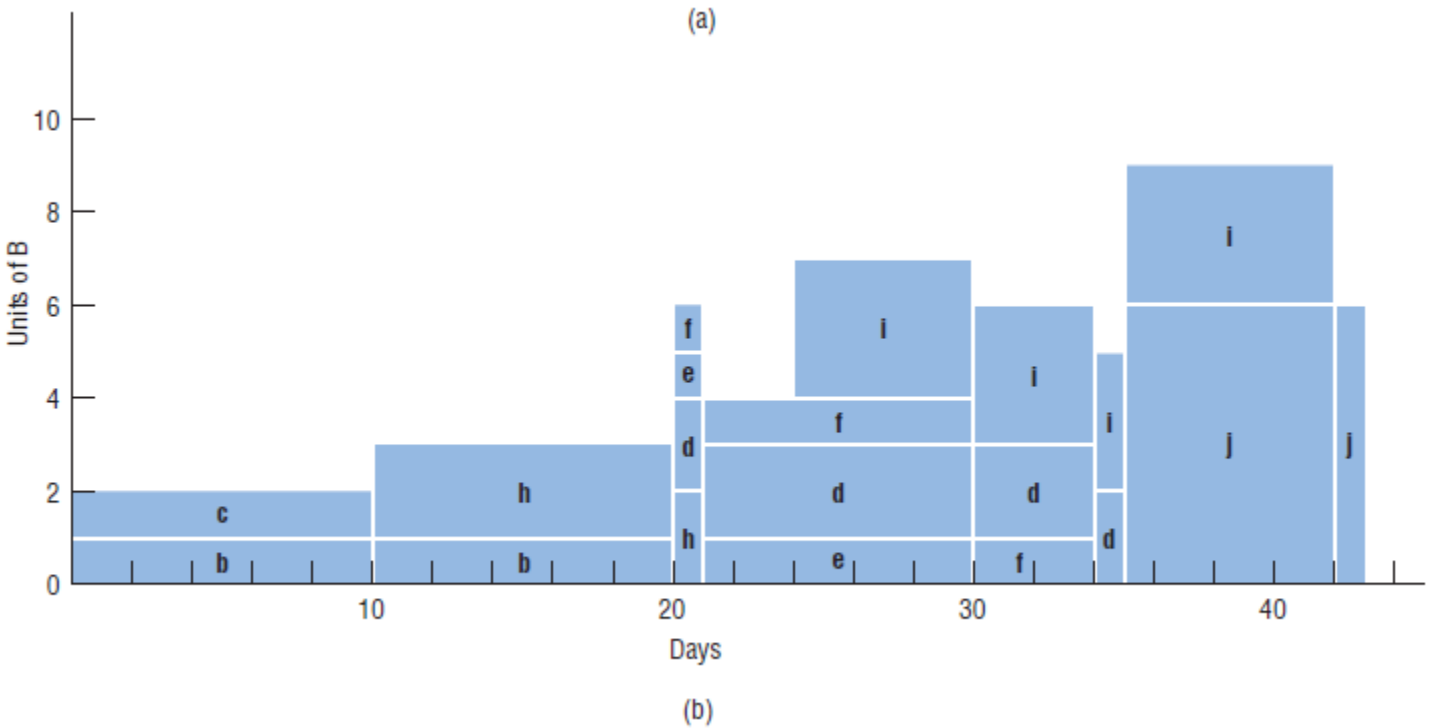
FIGURE 9.5 Modified AOA diagram showing activity slack and resource usage (from Figure 9.4).

Resource A



(a)

Resource B


(a)
Units of B
10
8
6
4
2
0
10
20
30
40
Days
(b)
c
b
h
b
f
e
d
h
i
f
d
e
i
d
f
i
d
d
i
j
j

Resource Leveling

- Less hands-on management is required
- May be able to use just-in-time inventory
- Improves morale
- Fewer personnel problems
- When an activity has slack, we can move that activity to shift its resource usage

Resource Leveling

- May also be possible to alter the sequence of activities to levelize resources
- Small projects can be levelized by hand
- Software can levelize resources for larger projects
- Large projects with multiple resources are complex to levelize

Resource Leveling

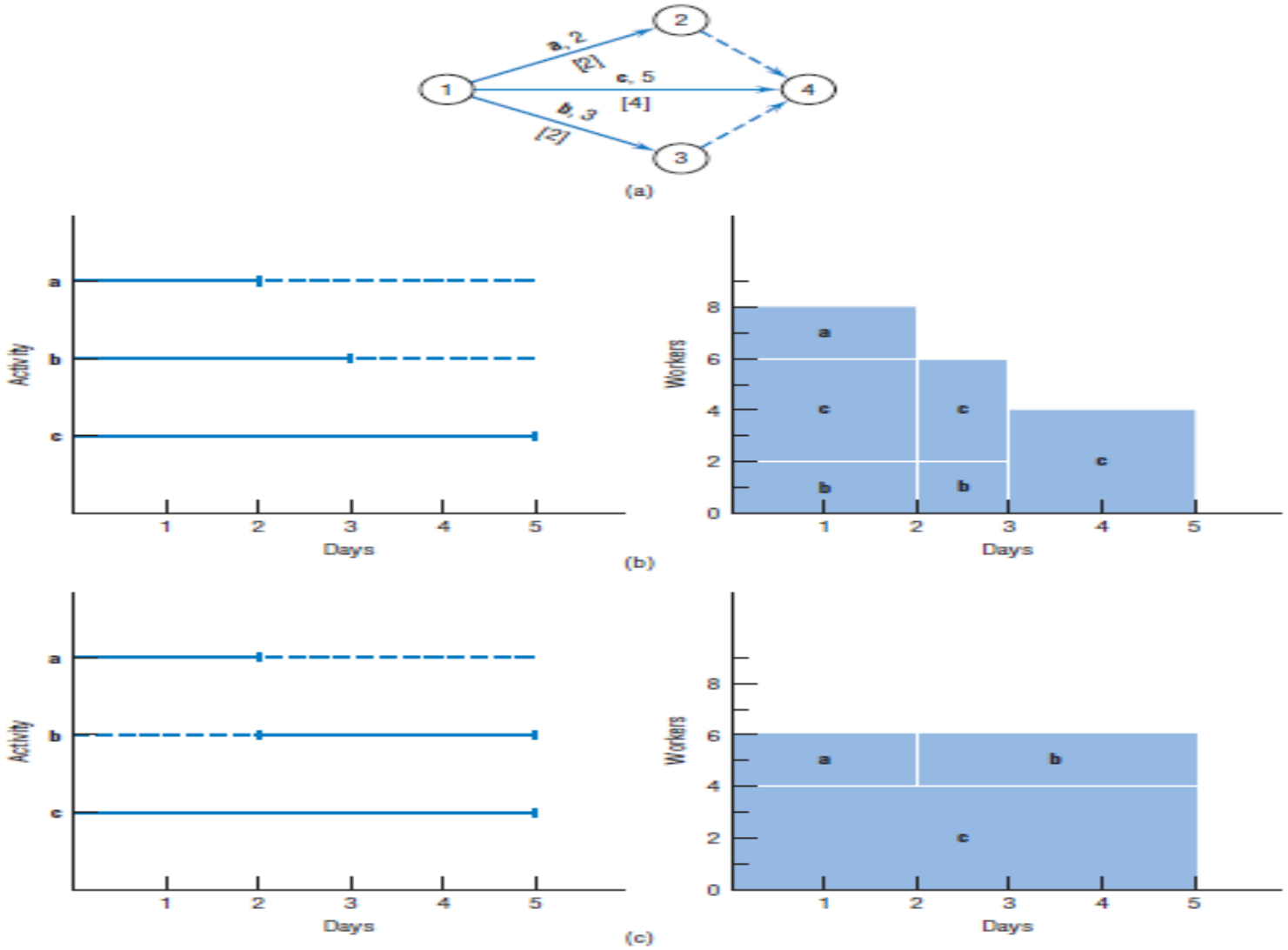


Figure 9-7 (a) The network. (b) Before resource leveling. (c) After resource leveling.

Resource Loading/Leveling and Uncertainty

- Resource availability, needs, etc may fluctuate over time such that resources required and capacity available may not be constant
- Methods to address this issue:
  - Attempt to level demand
  - Alter supply of human resource availability
- Disruptions, emergencies, maintenance, personnel issues, inefficiencies
- Schedule scarce resources between 85-90% capacity

Constrained Resource Scheduling

Heuristic Approach	An approach, such as a rule of thumb, that yields a good solution that may or may not be optimal
Optimization Approach	An approach, such as linear programming, that yields the *one best* solution.

Heuristic Methods (Slide 1 of 2)

- They are the only feasible methods used to attack large projects
- While not optimal, the schedules are very good
- Take the CPM/PERT schedule as a baseline

Heuristic Methods (Slide 2 of 2)

- They sequentially step through the schedule trying to move resource requirements around to levelize them
- Resources are moved around based on one or more priority rules

Common Priority Rules

- As soon as possible
- As late as possible
- Shortest task first
- Most resources first
- Minimum slack first
- Most critical followers
- Most successors
- Arbitrary

Heuristic Methods

- These are just the common ones
- There are many more
- The heuristic can either start at the beginning and work forwards
- Or it can start at the end and work backwards

Optimizing Methods

- Finds the one best solution
- Uses either linear programming or enumeration
- Not all projects can be optimized

Goldratt's Critical Chain

- This is the best attack on the resource-constrained scheduling problem
- Applies his Theory of Constraints to constrained resource scheduling problem

Goldratt's Critical Chain (Slide 2 of 2)

- Some of the things that help create strong optimism bias

1. Thoughtless optimism
2. Capacity should be equal to demand
3. The "Student Syndrome"
4. Multitasking to reduce idle time
5. Assuming network complexity makes no difference
6. Management cutting time to "motivate" workers
7. Game playing

Do Early Finishes and Late Finishes Cancel Out? So What?

- The answer is generally “no”
- Why?
  - Workers won’t admit to finishing early
  - Resources may not be available

A Common Chain of Events (Slide 1 of 2)

1. Assuming that activity times are known and that the paths are independent leads to underestimating the actual amount of time needed to complete the project.
2. Because the time needed to complete the project is underestimated, project team members tend to inflate their time estimates.
3. Inflated time estimates lead to work filling available time, workers not reporting that a task has been completed early, and the ever-present student syndrome.
4. An important caveat then becomes that safety time is usually visible to project workers and is often misused.
5. Misused safety time results in missed deadlines and milestones.

A Common Chain of Events (Slide 2 of 2)

6. Hidden safety time further complicates the task of prioritizing project activities.
7. The lack of clear priorities likely results in poor multitasking.
8. Task durations increase as a result of poor multitasking.
9. Uneven demand on resources—some overloaded and others underloaded—may also occur as a result of poor multitasking.
10. In an effort to utilize all resources fully, more projects will be undertaken to make sure that no resources are underutilized.
11. Adding more projects further increases poor multitasking.

The Critical Chain (Slide 1 of 3)

- Another limitation of traditional approaches is the PM often ignores dependencies between resources and tasks
- Goldratt argues that activities should be ordered onto paths based on
  - Resource dependencies
  - Technological precedence requirements
- The longest is “critical chain”

The Critical Chain (Slide 2 of 3)

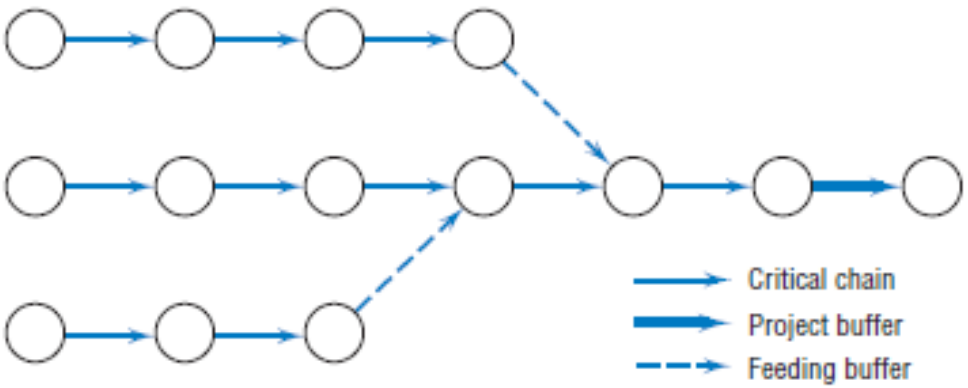


Figure 9-18 Project and feeder buffers.

The Critical Chain (Slide 3 of 3)

- Delays on projects due to
  - delay of one or more activities in the critical chain
  - delay in one or more of the activities on a noncritical or "feeder" chain