

Lecture 7: Reducing Project Duration

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PMG 605

**Project Resources and
Time Management**

Session Outline

Reducing Project Duration

- Rationale for Reducing Project Duration
- Options for Accelerating Project Completion
 - When Resources Are Not Constrained
 - When Resources Are Constrained
- Project Cost–Duration Graph
- Constructing a Project Cost–Duration Graph
- Practical Considerations

Rationale for Reducing Project Duration

Imagine the Following Scenarios

- After finalizing your project schedule, you realize the estimated completion date is two months beyond what your boss publicly promised an important customer.
- Five months into the project, you realize that you are already three weeks behind the drop-dead date for the project.
- Four months into a project top management changes its priorities and now tells you that money is not an issue. Complete the project ASAP!

Rationale for Reducing Project Duration

- **Time Is Money:** Cost-Time Tradeoffs
- Reducing the time of a critical activity usually incurs additional direct costs.
- Cost-time solutions focus on reducing (crashing) activities on the critical path to shorten overall duration of the project.

Reasons For Imposed Project Duration Dates

- *Time-to-market pressures*
- *Unforeseen delays*
- *Incentive contracts (bonuses for early completion)*
- *Imposed deadlines and contract commitments*
- *Overhead and public goodwill costs*
- *Pressure to move resources to other projects*

Reasons For Imposed Project Duration Dates

Time-to-market pressures

- Intense global competition and rapid technological advances have made speed a competitive advantage. To succeed, companies have to spot new opportunities, launch project teams, and bring new products or services to the marketplace in a flash. Perhaps in no industry does speed matter as much as in the electronics industry.

Reasons For Imposed Project Duration Dates

Unforeseen delays

- adverse weather, design flaws, and equipment breakdown—cause substantial delays midway in the project. Getting back on schedule usually requires compressing the time on some of the remaining critical activities. The additional costs of getting back on schedule need to be compared with the consequences of being late. This is especially true when time is a top priority.

Reasons For Imposed Project Duration Dates

Incentive contracts (bonuses for early completion)

- For example, a contractor finished a bridge across a lake 18 months early and received more than \$6 million for the early completion. The availability of the bridge to the surrounding community 18 months early to reduce traffic gridlock made the incentive cost to the community seem small to users.

Reasons For Imposed Project Duration Dates

Imposed deadlines and contract commitments

- For example, the president of a software company remarks in a speech that new advanced software will be available in one year. Such statements too often become imposed project duration dates—without any consideration of the problems or cost of meeting such a date.
- The project duration time is set while the project is in its “concept” phase before or without any detailed scheduling of all the activities in the project.

Reasons For Imposed Project Duration Dates

Overhead and public goodwill costs

- For example, it may cost \$80,000 per day to simply house and feed a construction crew.

Pressure to move resources to other projects

- Under these circumstances, the cost of compressing the project can be compared with the opportunity costs of not releasing key equipment or people.

Options for Accelerating Project Completion

Options for Accelerating Project Completion

- Resources *Not* Constrained

- Adding resources
- Outsourcing project work
- Scheduling overtime
- Establishing a core project team
- Do it twice—fast and then correctly

- Resources Constrained

- Improve the Efficiency of the Project Team
- Fast-tracking
- Critical-chain
- Reducing project scope
- Compromise quality

Options for Accelerating Project Completion

When Resources Not Constrained

Adding resources

- The common method for shortening project time
- There are limits as to how much speed can be gained by adding staff.
- Doubling the size of the workforce will not necessarily reduce most completion time by half
- Additional workers increase the communication requirements to coordinate their efforts

Options for Accelerating Project Completion

When Resources Not Constrained

Outsourcing project work

- The subcontractor may have access to superior technology or expertise that will accelerate the completion of the activity
- For example, contracting for a backhoe can accomplish in two hours what it can take a team of laborers two days to do
- Subcontracting also frees up resources that can be assigned to a critical activity and will ideally result in a shorter project duration

Options for Accelerating Project Completion

When Resources Not Constrained

Scheduling overtime

- The easiest way to add more labor to a project is not to add more people, but to schedule overtime
- If a team works 50 hours a week instead of 40, it might accomplish 20 percent more
- By scheduling overtime, you avoid the additional costs of coordination and communication encountered when new people are added
- Overtime and working longer hours is the preferred choice for accelerating project completion, especially when the project team is salaried. The key is to use overtime judiciously. Remember a project is a marathon not a sprint! You do not want to run out of energy before the finish line.

Options for Accelerating Project Completion

When Resources Not Constrained

Establishing a core project team

- one of the advantages of creating a dedicated core team to complete a project is speed
- Assigning professionals full time to a project avoids the hidden cost of multitasking in which people are forced to juggle the demands of multiple projects
- Professionals are allowed to devote their undivided attention to a specific project.
- This singular focus creates a shared goal that can bind a diverse set of professionals into a highly cohesive team capable of accelerating project completion

Options for Accelerating Project Completion

When Resources Not Constrained

- *Do it twice—fast and then correctly*
- If you are in a hurry, try building a “quick and dirty” short-term solution, then go back and do it the right way
- For example, software companies are notorious for releasing version 1.0 of products that are not finished and tested. Subsequent versions 1.1 . . . x correct bugs and add intended functionality to the product.
- The additional costs of doing it twice are often more than compensated for by the benefits of satisfying the deadline

Options for Accelerating Project Completion

- Resources *Not* Constrained

- Adding resources
- Outsourcing project work
- Scheduling overtime
- Establishing a core project team
- Do it twice—fast and then correctly

- Resources Constrained

- Improve the Efficiency of the Project Team
- Fast-tracking
- Reducing project scope
- Compromise quality
- Critical-chain

Options for Accelerating Project Completion

When Resources Are Constrained

Improve the Efficiency of the Project Team

- The project team may be able to improve productivity by implementing more efficient ways to do their work. This can be achieved by improving the planning and organization of the project or eliminating barriers to productivity such as excessive bureaucratic interference and red tape

Options for Accelerating Project Completion

When Resources Are Constrained

Fast-Tracking

- Sometimes it is possible to rearrange the logic of the project network so that critical activities are done in parallel (concurrently) rather than sequentially
- one of the most common methods for restructuring activities is to change a finish-to-start relationship to a start-to-start relationship.
- For example, instead of waiting for the final design to be approved, manufacturing engineers can begin building the production line as soon as key specifications have been established
- Changing activities from sequential to parallel is not without risk. Late design changes can produce wasted effort and rework.
- Fast tracking requires close coordination

Options for Accelerating Project Completion

When Resources Are Constrained

Reducing Project Scope

- For example, the new car will average only 25 mpg instead of 30, or the software product will have fewer features than originally planned
- The key to reducing a project scope without reducing value is to reassess the true specifications of the project
- It is important to talk to the customer and/or project sponsors and explain the situation
- Calculating the savings of reduced project scope begins with the work breakdown structure

Options for Accelerating Project Completion

When Resources Are Constrained

Compromise Quality

- Reducing quality is always an option, but it is rarely acceptable or used
- If quality is sacrificed, it may be possible to reduce the time of an activity on the critical path

Options for Accelerating Project Completion

When Resources Are Constrained

Critical-Chain Project Management

- CCPM creates an environment where people can quickly identify and monitor dependencies between tasks and resources. It also lets project managers handle uncertainty and unforeseen situations by:
 - Bringing task duration estimates to an average
 - Planning a schedule backward starting from the due date to make sure tasks are done when needed
 - Protecting the project by putting buffers in the plan
 - Controlling the plan and getting feedback by monitoring the buffers
- Unlike the critical path method (CPM), this one doesn't aim to find the absolute best schedule. Instead, it tries to find a good enough solution.

Options for Accelerating Project Completion

When Resources Are Constrained

Critical-Chain Project Management

- CCPM uses the concept of buffers to make sure that resources are available when they're required for the completion of a task. Four types of buffers are the following:
 1. Project Buffers are inserted between the last task and the completion date and make sure the date doesn't change
 2. Feeding Buffer is set at the end of non-critical chains to prevent any delay from the critical chain
 3. Resource Buffer is inserted at the beginning of the critical chain and ensures it has the essential resources

Critical-Chain Project Management

FIGURE A8.1B
Air Control Project:
Time Plan without
Resources

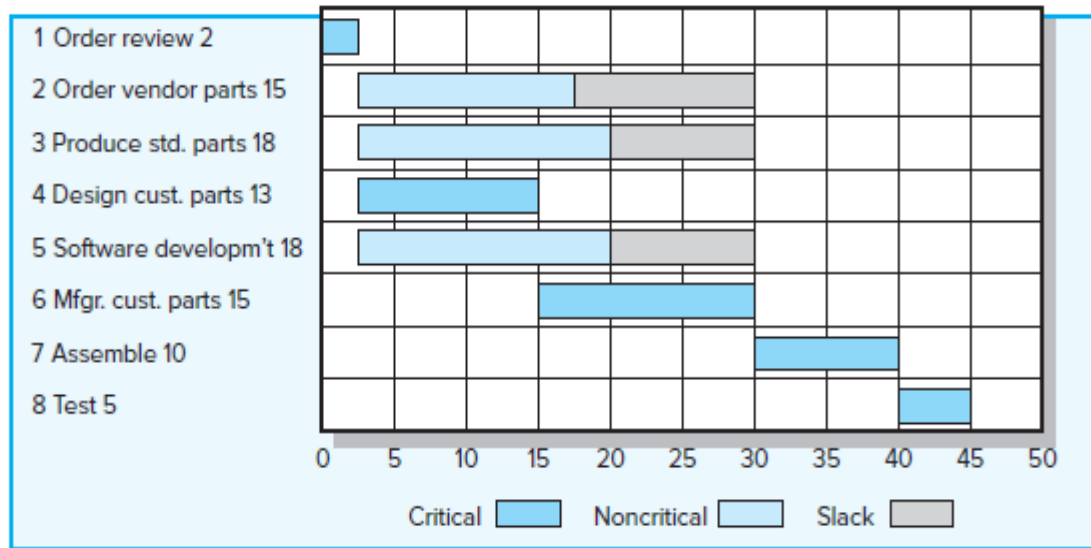
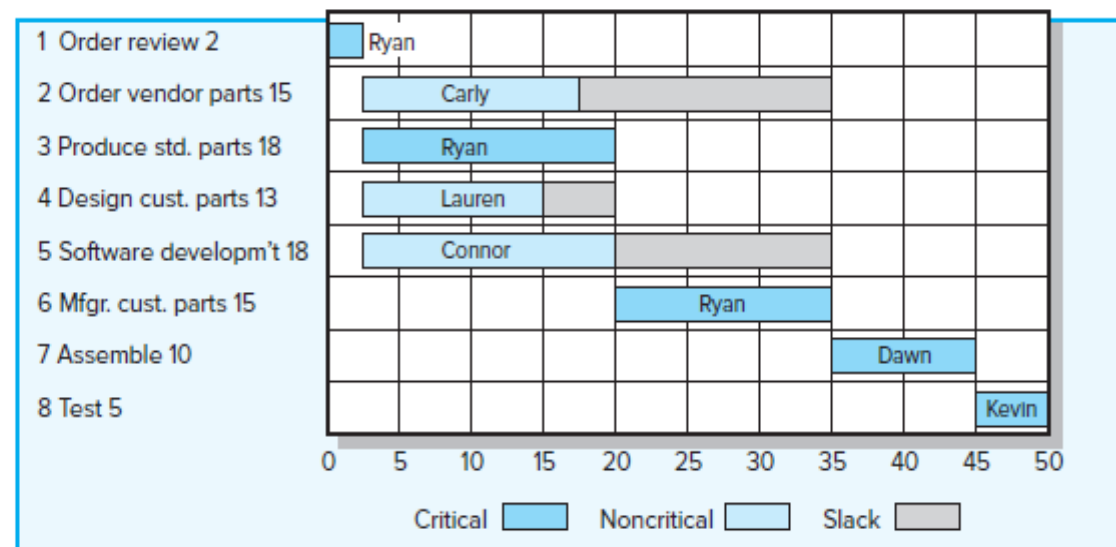


FIGURE A8.2B
Air Control Project:
Schedule with
Resources Limited



Critical-Chain Project Management



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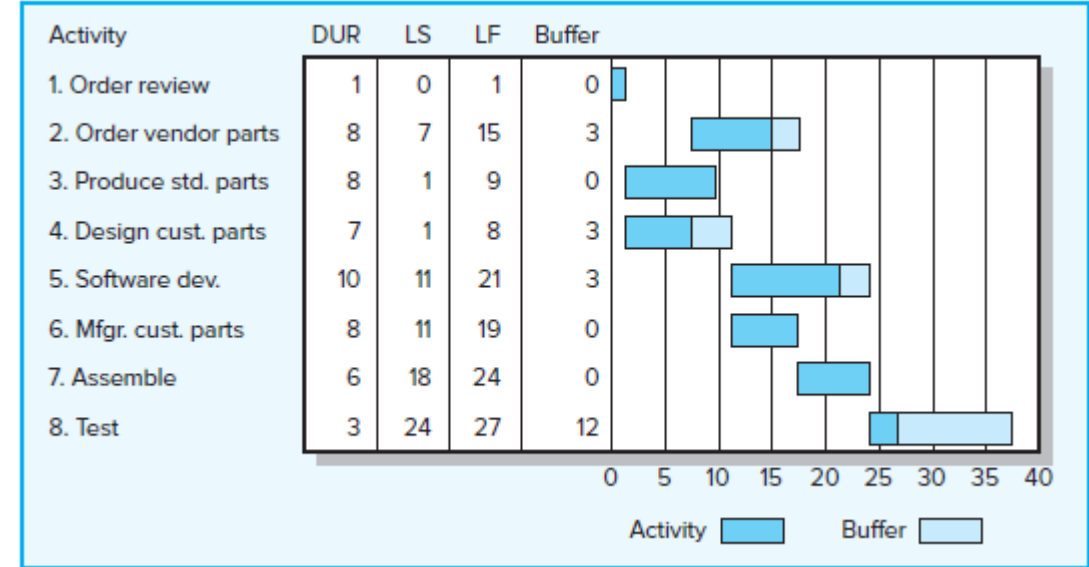
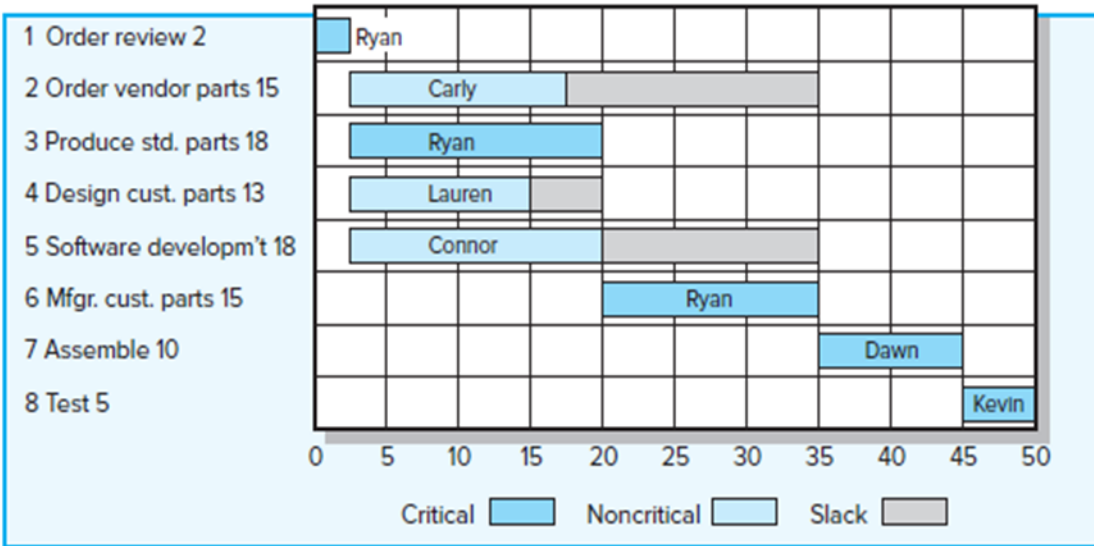
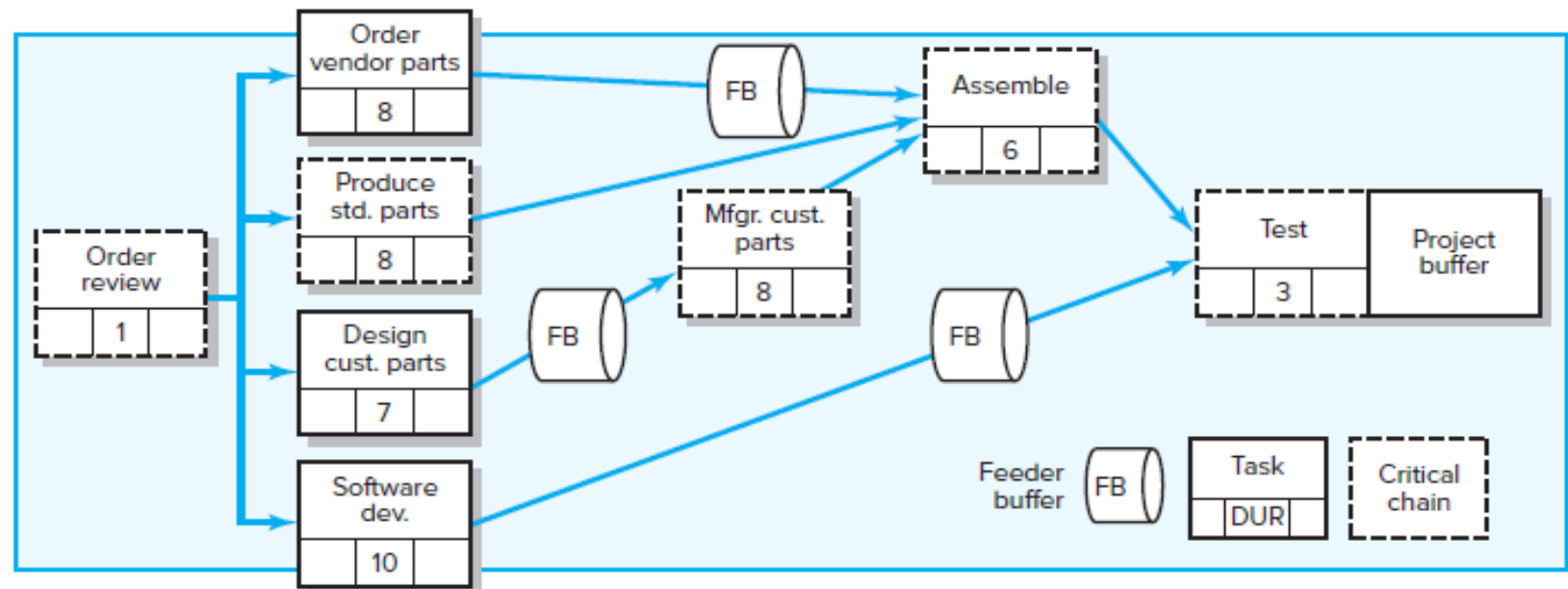


FIGURE A8.3 Air Control Project: CCPM Network



Options for Accelerating Project Completion

In practice

- The methods most used to crash projects are scheduling overtime, outsourcing, and adding resources. Each of these maintains the essence of the original plan.
- Options that depart from the original project plan include do it twice and fast-tracking.

Rethinking of project scope, customer needs, and timing become major considerations for these techniques.

Project Cost–Duration Graph

Project Costs

Indirect Costs

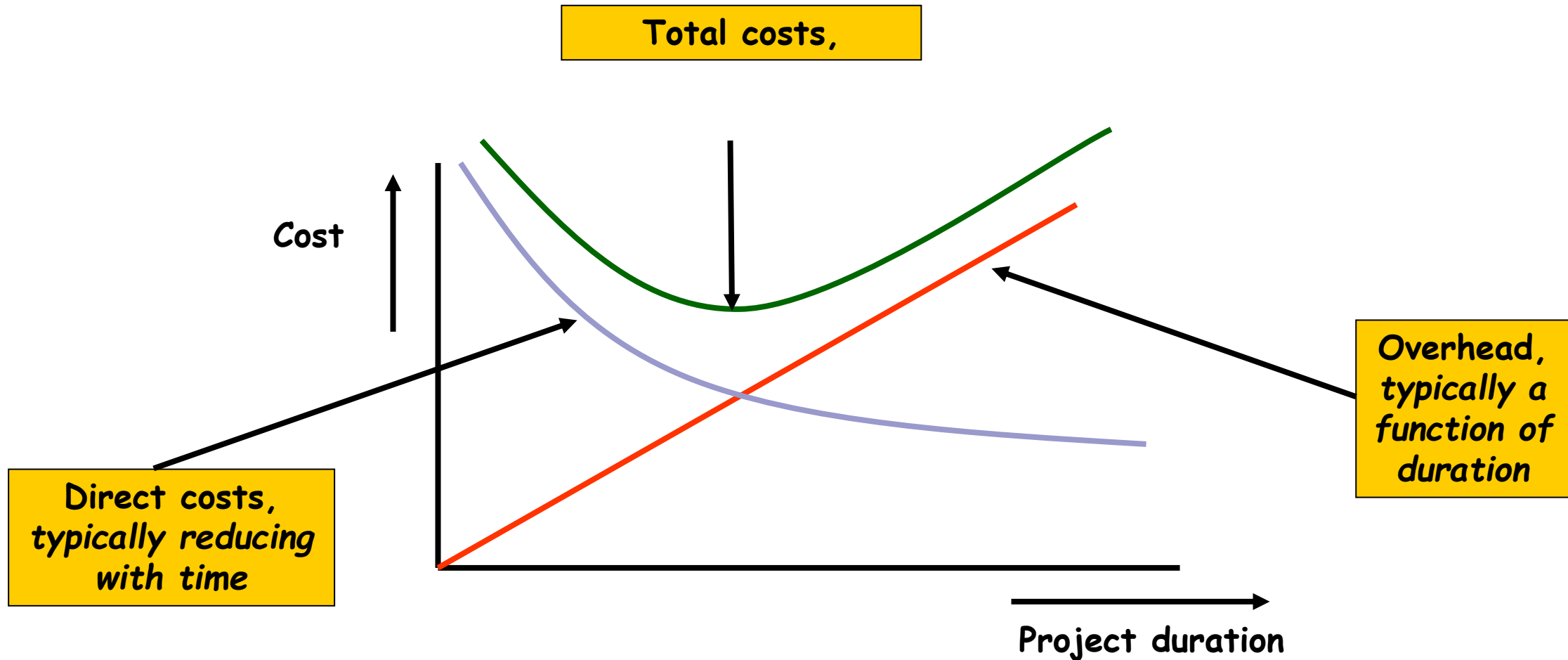
- Generally, represent overhead costs such as supervision, administration, consultants, and interest. Indirect costs cannot be associated with any work package or activity
- That is, any reduction in time should result in a reduction of indirect costs. For example, if the daily costs of supervision, administration, and consultants are \$2,000, any reduction in project duration would represent a savings of \$2,000 per day

Project Costs

Direct Costs

- Commonly represent labor, materials, equipment, and sometimes subcontractors
- Direct costs are assigned directly to a work package and activity
- Direct costs for an activity time represent normal costs, which typically mean low-cost, efficient methods for a normal time.
- When project durations are imposed, direct costs may no longer represent low-cost, efficient methods.
- Costs for the imposed duration date will be higher than for a project duration developed from ideal normal times for activities.
- The sum of the costs of all the work packages or activities represents the total direct costs for the project.

Project Costs



The first plan is not necessarily the cheapest!

Constructing a Project Cost–Duration Graph

Constructing a Project Cost–Duration Graph

- There are three major steps required to construct a project cost–duration graph:
 1. Find total direct costs for selected project durations.
 2. Find total indirect costs for selected project durations.
 3. Sum direct and indirect costs for these selected durations.
- The graph is then used to compare additional cost alternatives for benefits.

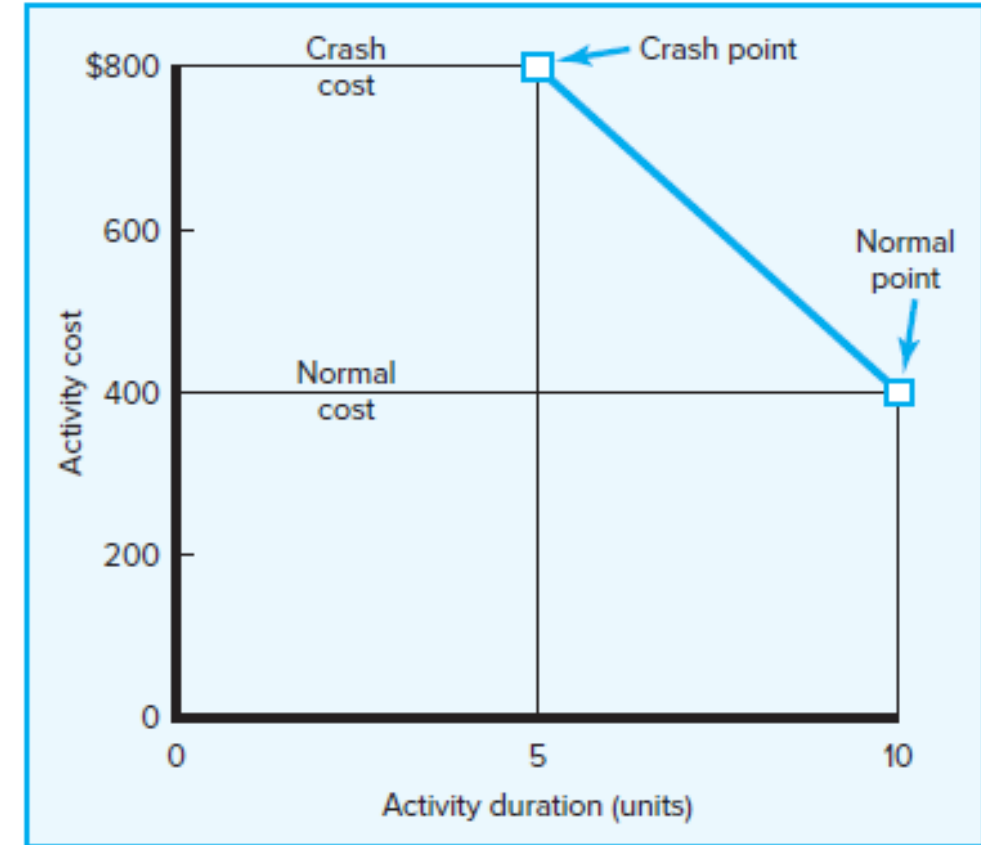
Determining the Activities to Shorten

- The central concern is to decide which activities to shorten and how far to carry the shortening process.
- Basically, managers need to look for critical activities that can be shortened with the smallest increase in cost per unit of time.
- Shortening an activity is called **crashing**.
- The direct cost for completing an activity in its crash time is called **crash cost**.
- The **crash point** represents the maximum time an activity can be compressed.

Activity Graph

- The assumptions underlying the use of this graph are:

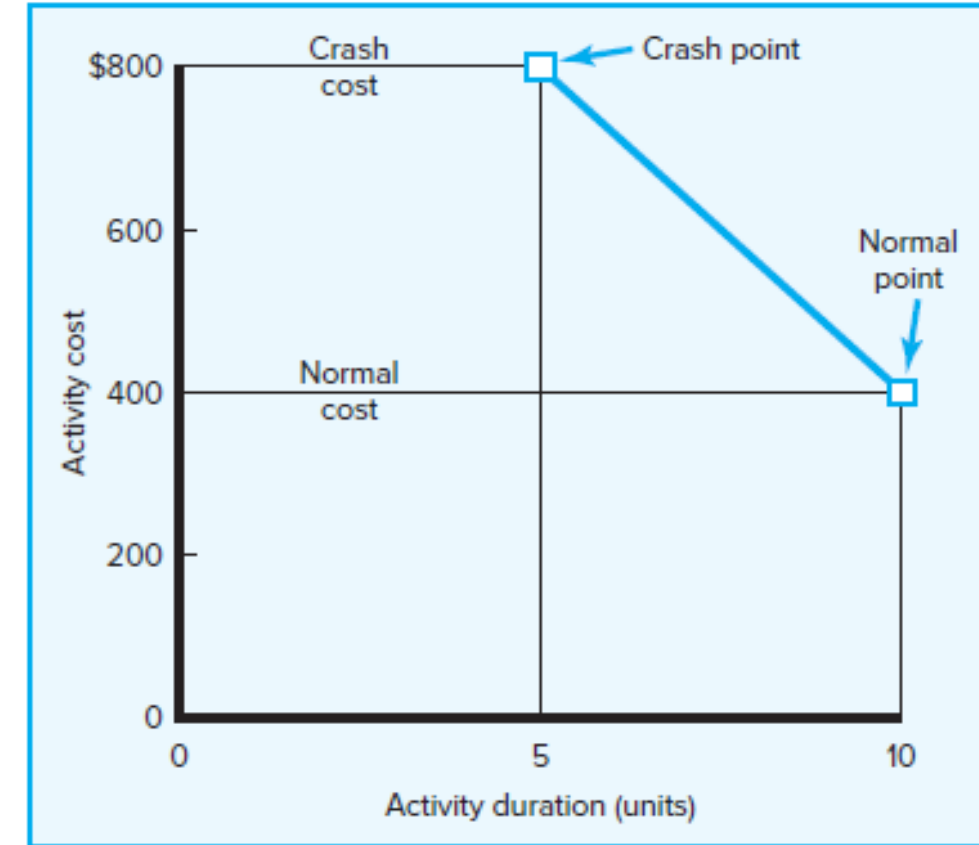
1. The cost-time relationship is linear.
2. Normal time assumes low-cost, efficient methods to complete the activity.
3. Crash time represents a limit—the greatest time reduction possible under realistic conditions.
4. Slope represents cost per unit of time.
5. All accelerations must occur within the normal and crash times.



Activity Graph

- Knowing the slope of activities allows managers to compare which critical activities to shorten

$$\begin{aligned}\text{Cost slope} &= \frac{\text{Crash cost} - \text{Normal cost}}{\text{Normal time} - \text{Crash time}} \\ &= \frac{CC - NC}{NT - CT} = \frac{\$800 - \$400}{10 - 5} \\ &= \frac{\$400}{5} = \$80 \text{ per unit of time}\end{aligned}$$



Example 1

$$\text{Cost slope} = \frac{\text{Crash cost} - \text{Normal cost}}{\text{Normal time} - \text{Crash time}}$$

Activity ID	Slope	Maximum crash time	Direct costs			
			Normal		Crash	
			Time	Cost	Time	Cost
A	<u>\$20</u>	<u>1</u>	3	\$50	2	\$70
B	<u>40</u>	<u>2</u>	6	80	4	160
C	<u>30</u>	<u>1</u>	10	60	9	90
D	<u>25</u>	<u>4</u>	11	50	7	150
E	<u>30</u>	<u>2</u>	8	100	6	160
F	<u>30</u>	<u>1</u>	5	40	4	70
G	<u>0</u>	<u>0</u>	6	<u>70</u>	6	70
Total direct cost			\$450			

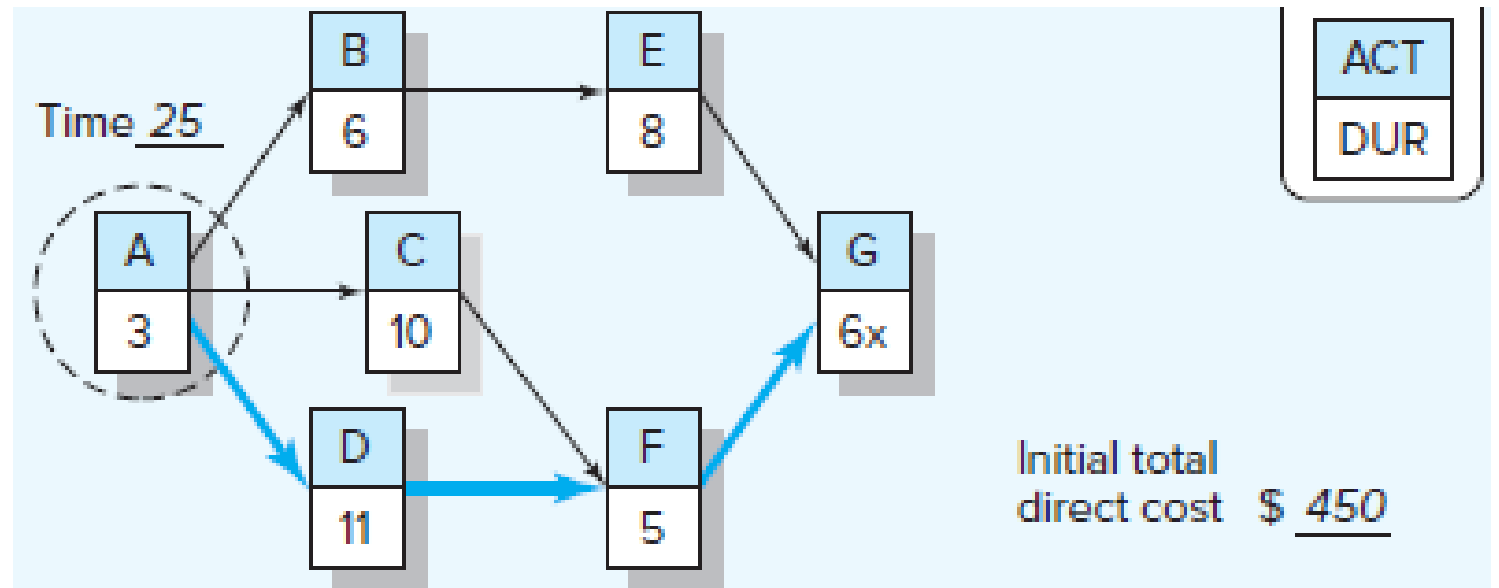
Example 1

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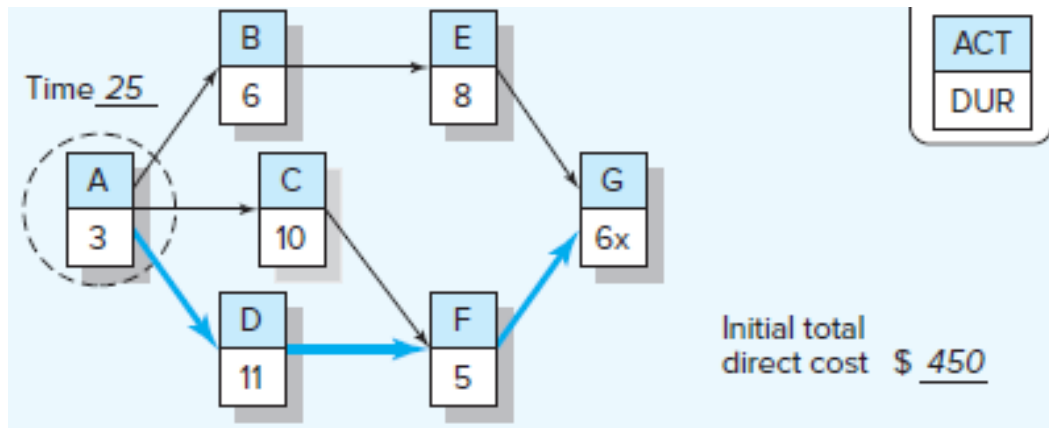
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C	30	1	10	60	9	90
D	25	4	11	50	7	150
E	30	2	8	100	6	160
F	30	1	5	40	4	70
G	0	0	6	70	6	70

Total direct cost **\$450**

Path	Duration
A-B-E-G	3+6+8+6 = 23
A-C-F-G	3+10+5+6 = 24
A-D-F-G	3+11+5+6 = 25

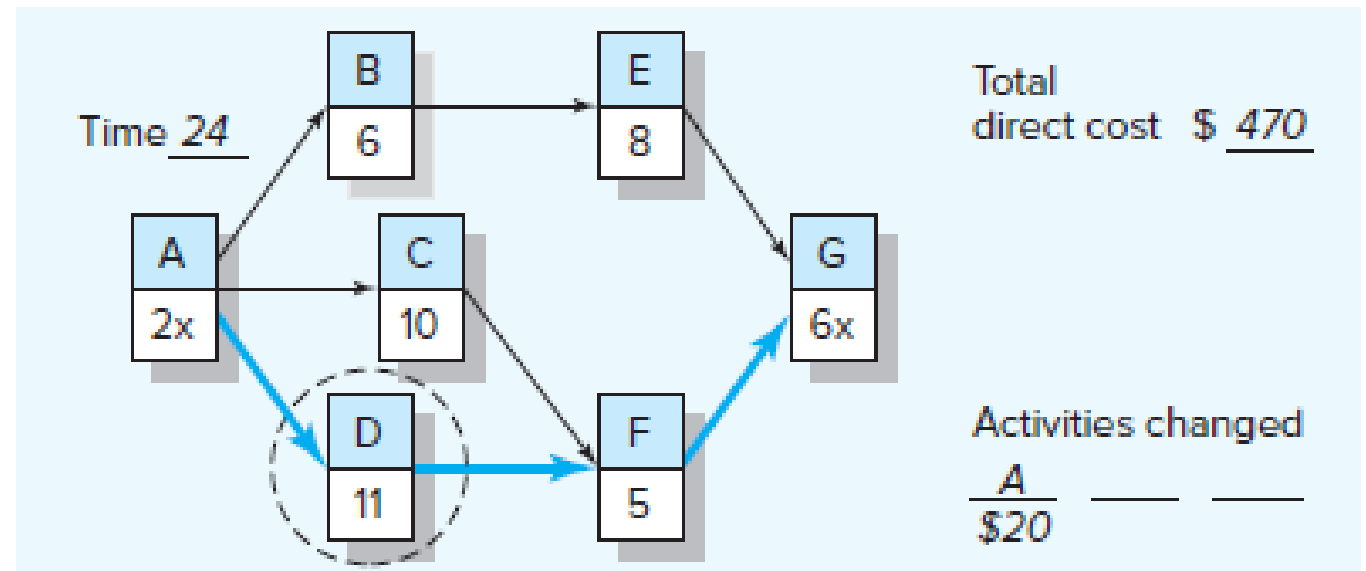


Example 1

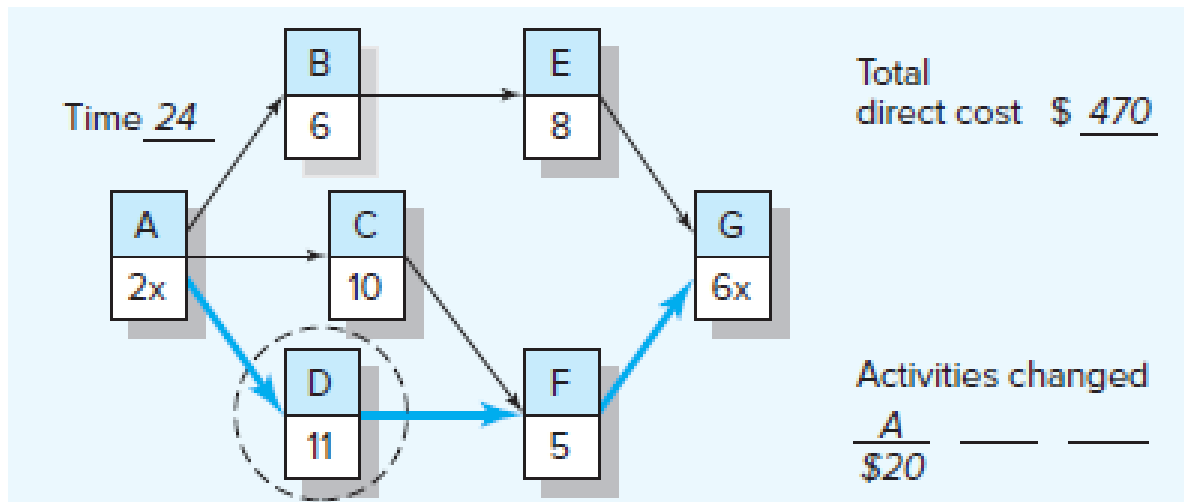


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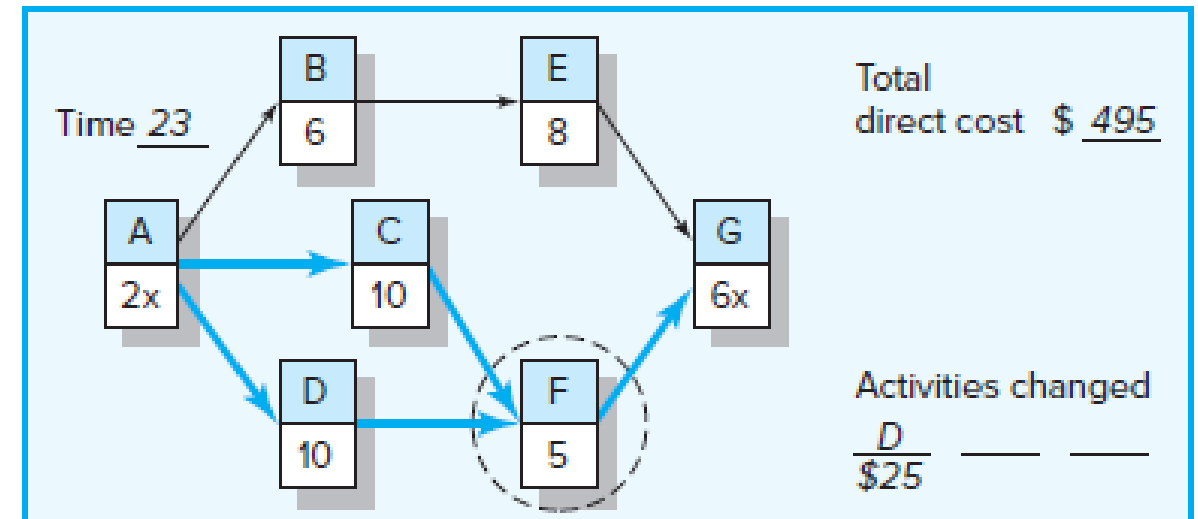


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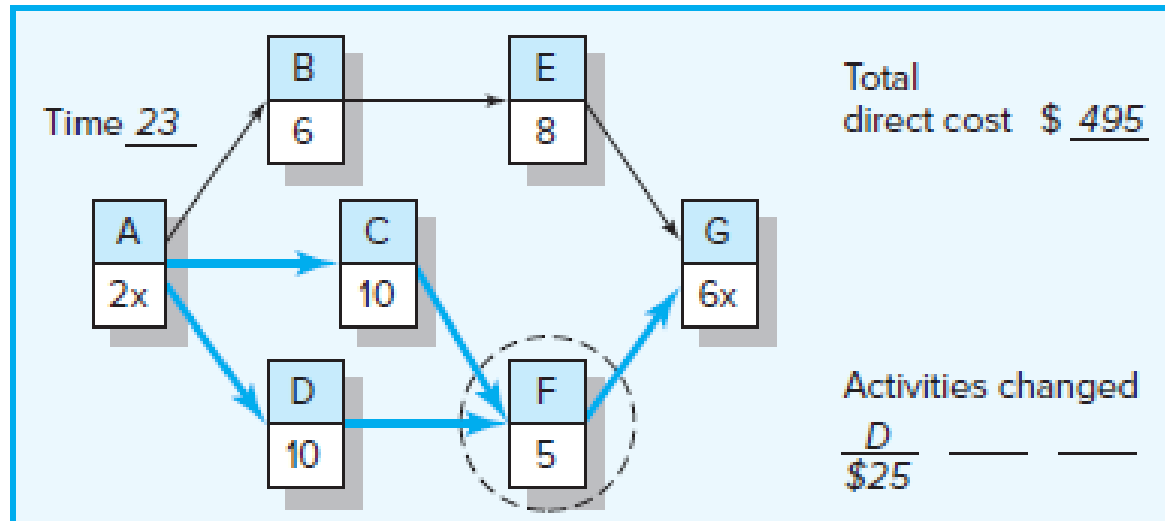


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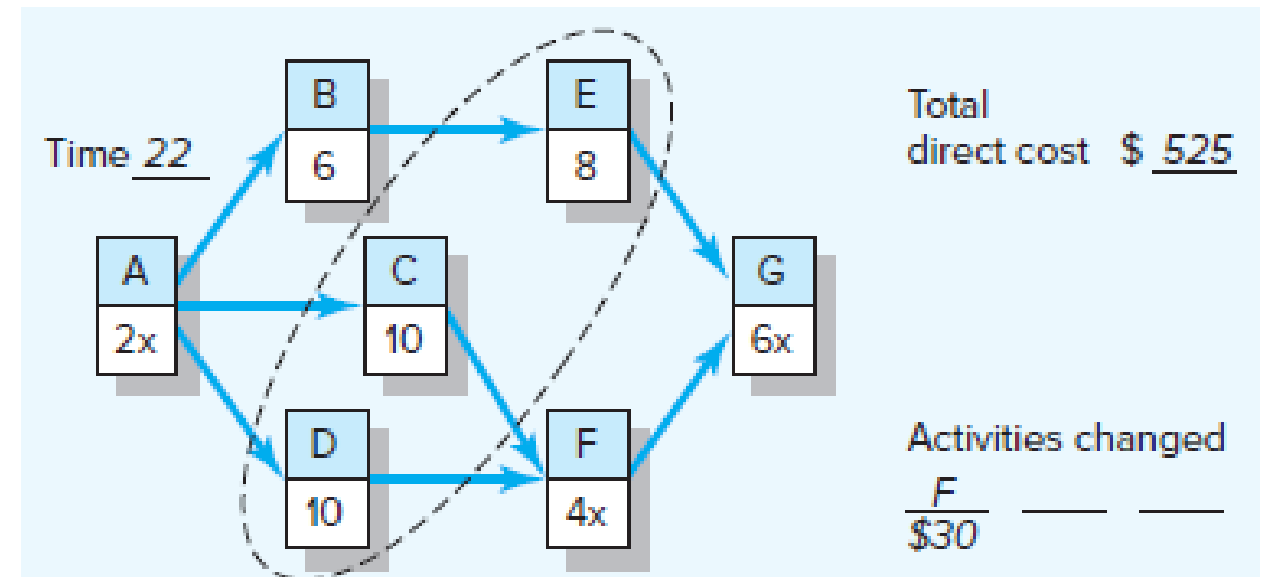


Example 1

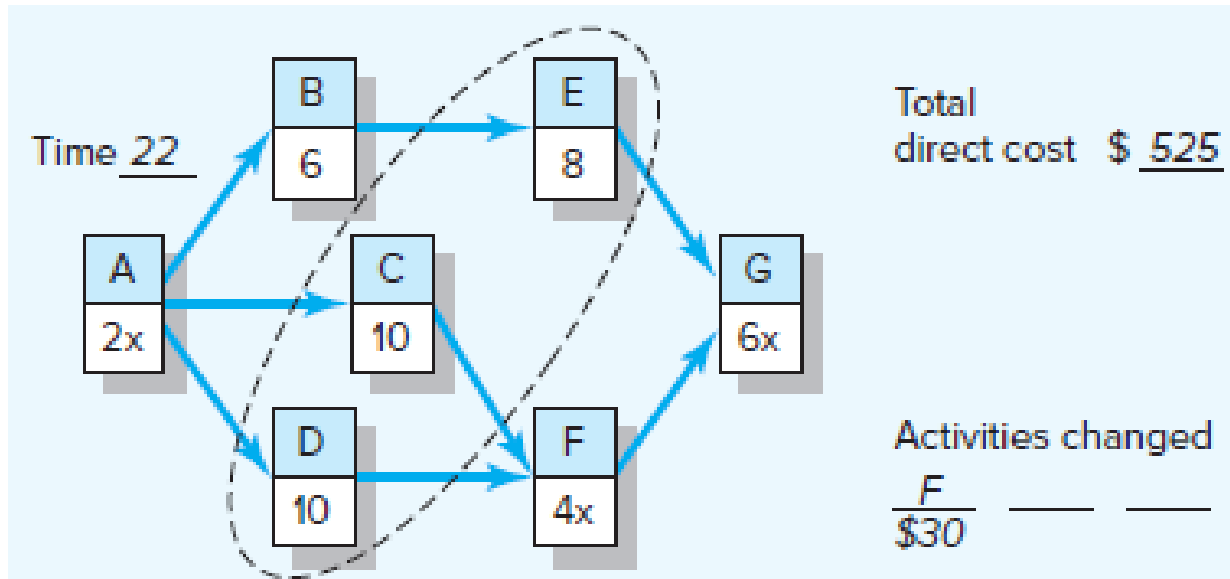


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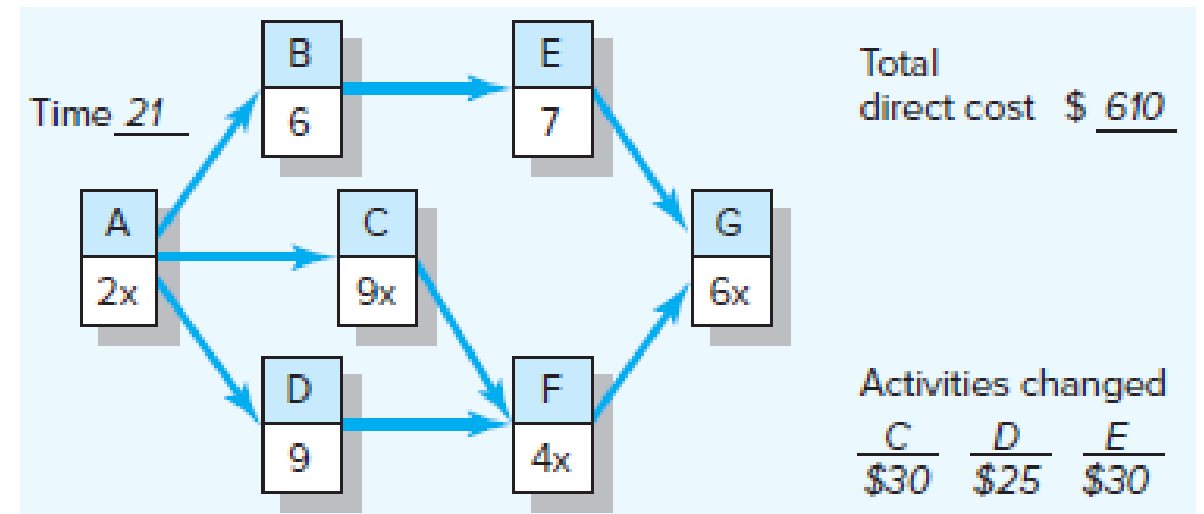


Example 1



Path	Duration
A-B-E-G	2+6+7+6 = 21
A-C-F-G	2+9+4+6 = 21
A-D-F-G	2+9+4+6 = 21

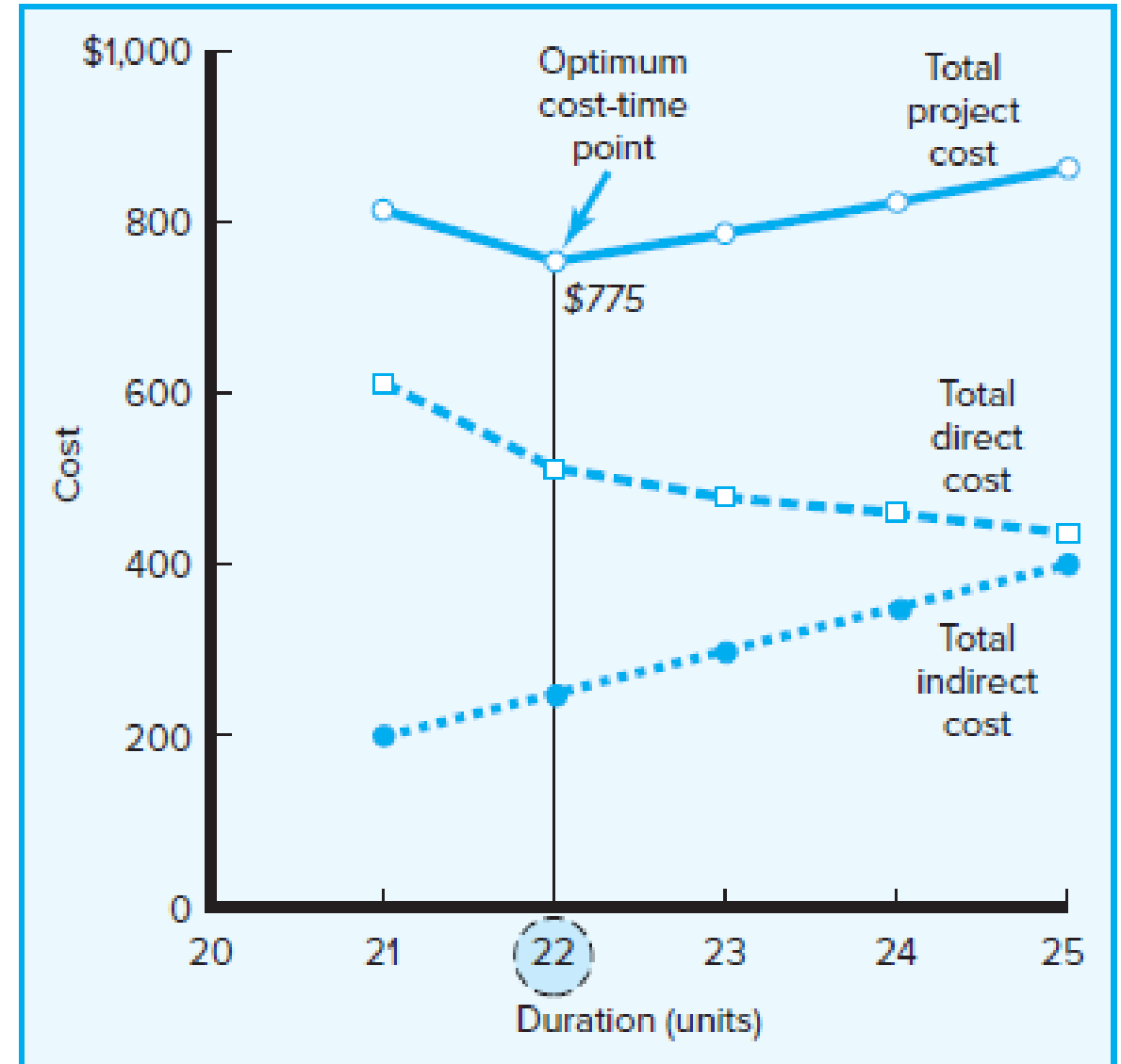
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E	30	2	8	100	6	160
F	30	1	5	40	4	70
G	0	0	6	70	6	70
Total direct cost			\$450			



Example 1

- Indirect Cost Saving = \$50 / Duration unit

Project duration	Direct costs	+	Indirect costs	=	Total costs
25	450		400		\$850
24	470		350		820
23	495		300		795
22	525		250		775
21	610		200		810



Practical Considerations

Practical Considerations

- The inherent risks involved in crashing particular activities need to be considered.
- There are rare situations in which activities cannot be crashed by single time units. Instead, crashing is “all or nothing.”
- Resource availability, not cost, may dictate which activities are crashed

Crashing Example 2

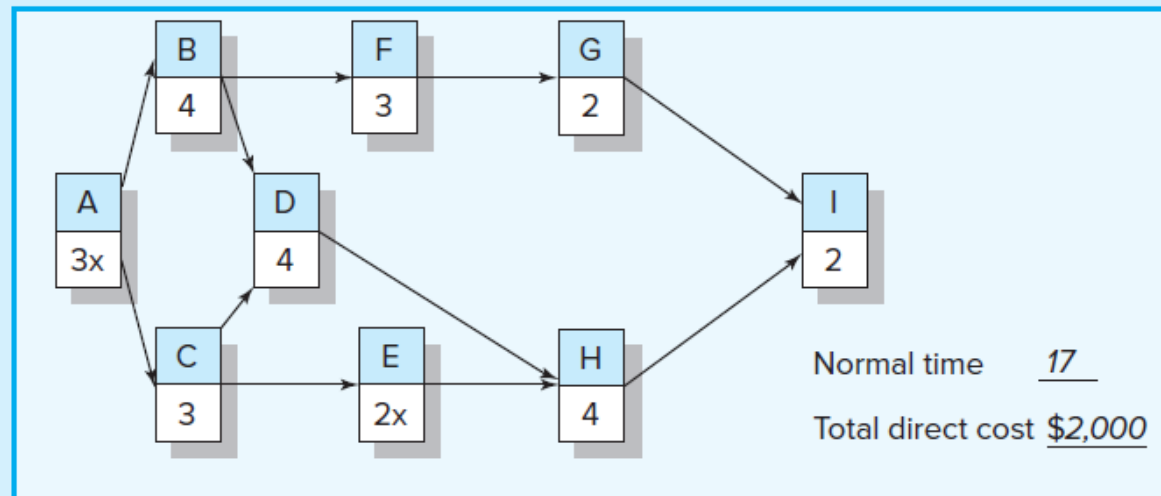
Example 2

8.* Use the information contained below to compress one time unit per move using the least cost method. Reduce the schedule until you reach the crash point of the network. For each move identify what activity(ies) was crashed, the adjusted total cost, and explain your choice if you have to choose between activities that cost the same.

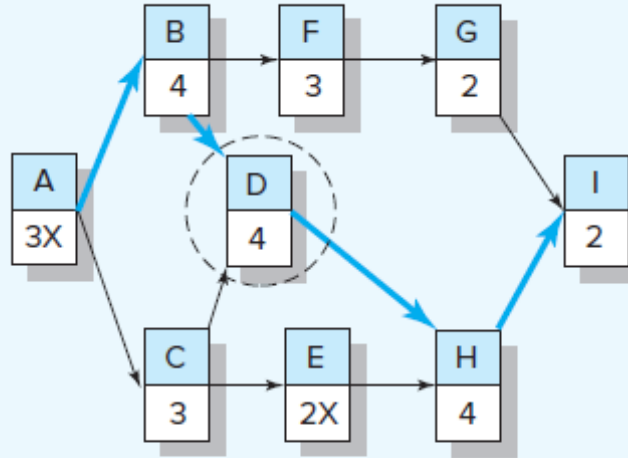
If the indirect cost for each duration is \$1,500 for 17 weeks, \$1,450 for 16 weeks, \$1,400 for 15 weeks, \$1,350 for 14 weeks, \$1,300 for 13 weeks, \$1,250 for 12 weeks, \$1,200 for 11 weeks, and \$1,150 for 10 weeks, what is the optimum cost-time schedule for the project? What is the cost?

Example 2

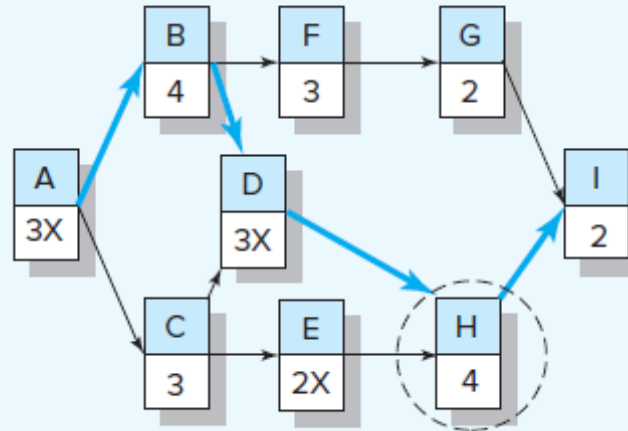
Act.	Crash Cost (Slope)	Maximum Crash Time	Normal Time	Normal Cost
A	0	0	3	150
B	100	1	4	200
C	60	1	3	250
D	40	1	4	200
E	0	0	2	250
F	30	2	3	200
G	20	1	2	250
H	60	2	4	300
I	200	1	2	200



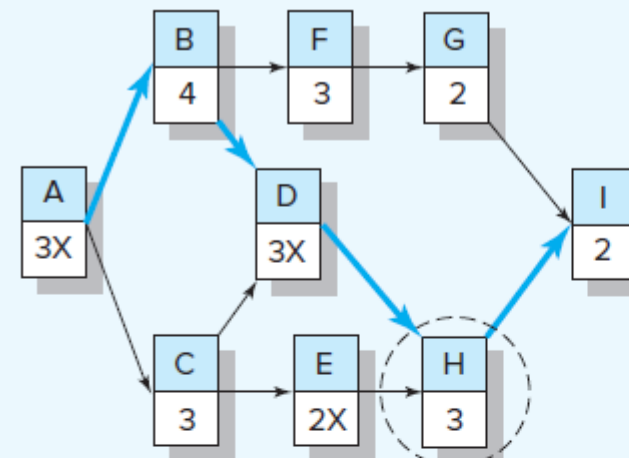
Example 2 Solution



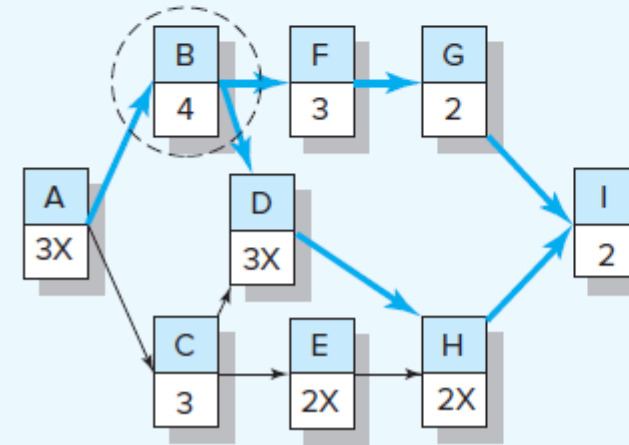
Normal time: 17
Total direct cost: 2000
 $CP=A+B+D+H+I$



Time: 16
Total direct cost: 2040
 $CP=A+B+D+H+I$
Activities changed:
D

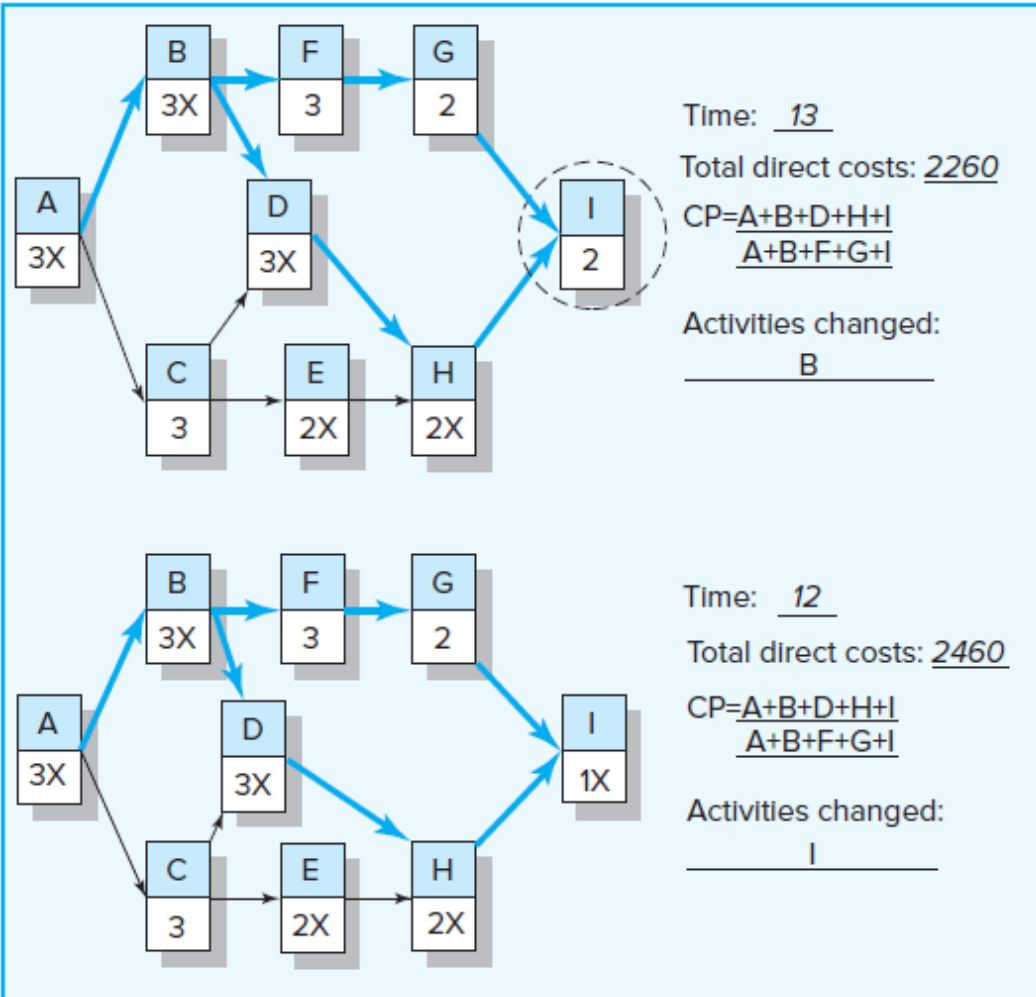


Time: 15
Total direct cost: 2100
 $CP=A+B+D+H+I$
Activities changed:
H



Time: 14
Total direct cost: 2160
 $CP=A+B+D+H+I$
 $A+B+F+G+I$
Activities changed:
H

Example 2 Solution



Duration	Direct Cost	Indirect Cost	Total Cost
17	2,000	1,500	3,500
16	2,040	1,450	3,490
15	2,100	1,400	3,500
14	2,160	1,350	3,560
13	2,260	1,300	3,660
12	2,460	1,250	3,860

The optimum time-cost schedule would be 16 weeks at a cost of \$3,490.



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Summary of Today Session

Reasons For Imposed Project Duration Dates



- Time-to-market pressures
- Unforeseen delays
- Incentive contracts (bonuses for early completion)
- Imposed deadlines and contract commitments
- Overhead and public goodwill costs
- Pressure to move resources to other projects

7-6

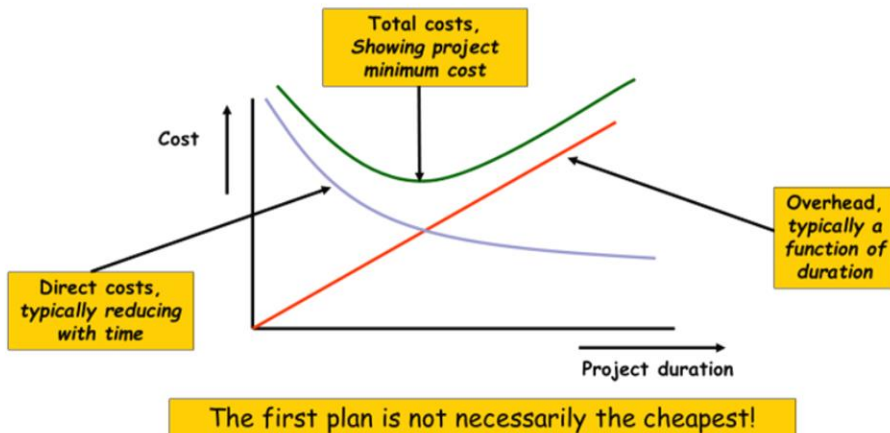
Options for Accelerating Project Completion



- Resources *Not* Constrained
 - Adding resources
 - Outsourcing project work
 - Scheduling overtime
 - Establishing a core project team
 - Do it twice—fast and then correctly
- Resources Constrained
 - Improve the Efficiency of the Project Team
 - Fast-tracking
 - Critical-chain
 - Reducing project scope
 - Compromise quality

7-13

Project Costs



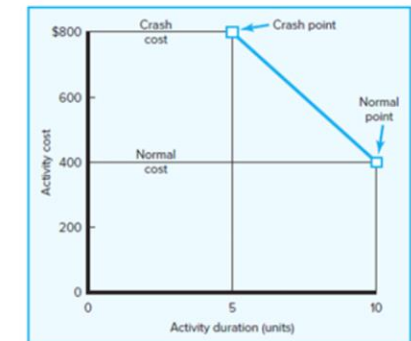
7-32

Activity Graph



- The assumptions underlying the use of this graph are:

1. The cost-time relationship is linear.
2. Normal time assumes low-cost, efficient methods to complete the activity.
3. Crash time represents a limit—the greatest time reduction possible under realistic conditions.
4. Slope represents cost per unit of time.
5. All accelerations must occur within the normal and crash times.



7-37

Resources

Project Management

The Managerial Process

Fifth Edition

By: Erik W. Larson

Oregon State University

Clifford F. Gray

Oregon State University



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