

Lecture 5: Resources Management

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جامعة الجميع الذكية
EVERYONE'S SMART UNIVERSITY

PMG 605

**Project Resources and
Time Management**

Resources Management

Session Outline

- Introduction
- Overview of the Resource Scheduling Problem
- Classification of a Scheduling Problem
 - Time Constrained Project
 - Resource Constrained Project
- Splitting
- Computer Software for Scheduling Resources
- Benefits of Scheduling Resources
- Multiproject Scheduling Problems

Introduction to Resources Management

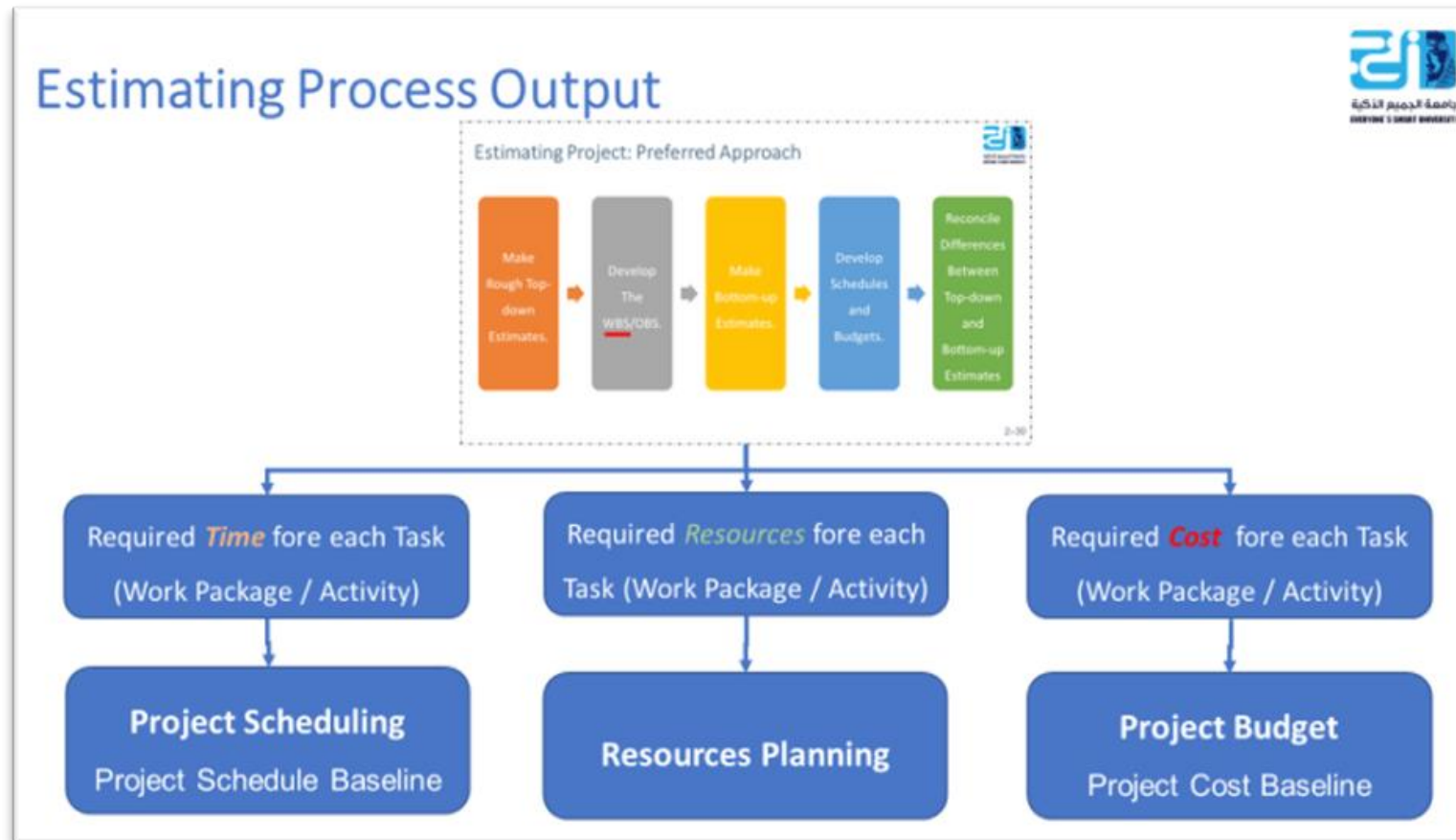


What is Resource Management?

Resource management is planning, organizing, and allocating the resources important to your business to ensure maximum efficiency.

Resource Management

- We have consistently stressed that up-front planning results in big payoffs
- However, there is still a need to plan for resources to execute the work in the short term



Why Resource Management?

- Shortages and mismanagement of resources are frequent causes of substantial delays
- Most project managers have watched worker standing idly by due to
 - lack of materials, or
 - experienced delays due to the wrong piece of equipment used in performing a task
- Proper management of resources—materials, labor, and equipment—can minimize or even eliminate these types of inefficiencies

Resource Allocation

- Scheduling and coordinating resources so that they arrive on-site as needed and are removed when not needed is called **resource allocation** or **resource loading**
- When performed properly, it is the effective and efficient utilization of all resources
- Shortages of material or scheduling the wrong piece of equipment will inevitably lead to a delay in performing the task and may delay the project itself



Resource Allocation

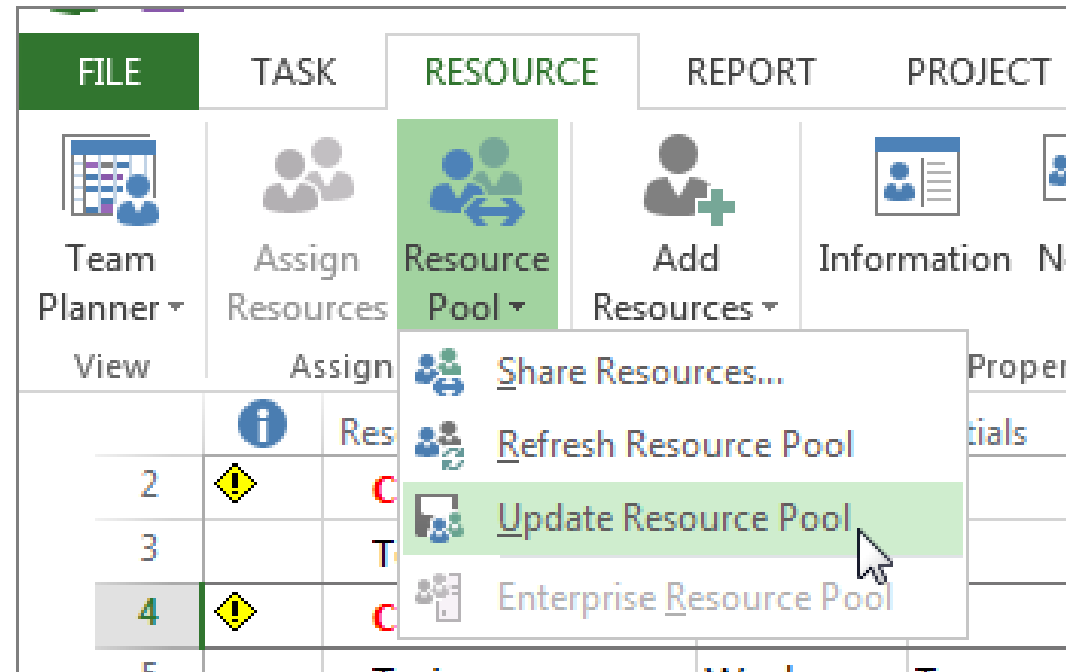
- Allocating too many people to the crew will leave some underutilized and increase the cost per unit of work
- Inversely, too small a crew will result in less being produced per unit of time
- Neither condition is desirable
- It is the goal of resource allocation to maintain sufficient resources to allow the work to proceed in a smooth or even flow

Resource Management

- The estimate tells us how much labor and type of equipment are needed for a task but does not tell us when it is needed
- For that we need to refer to the Schedule Plan
- The Schedule Plan is also silent about conflicting demands for labor or equipment resources
- For example, a single piece of equipment and its crew may be required for two tasks at the same time

Resource Management

- **Resource Pool** is a set of resources available for assignment to project tasks
- A resource pool can be assigned exclusively to a project or task or shared by several projects



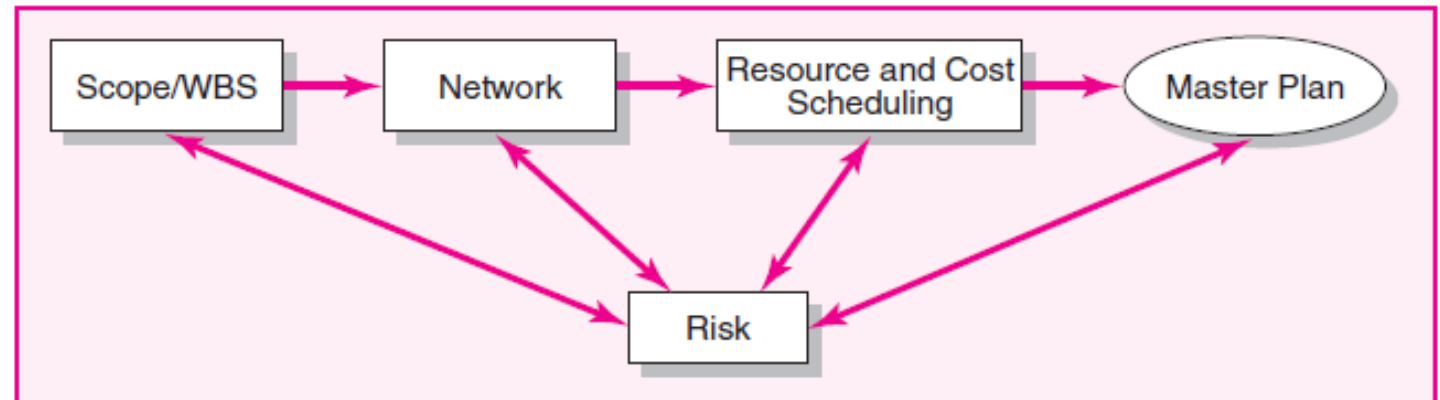
- After staff and other resources were assigned to the project, a project manager listed the following questions that still needed to be addressed:
 - Will the assigned labor and/or equipment be adequate and available to deal with my project?
 - Will outside contractors have to be used?
 - Do unexpected resource dependencies exist? Is there a new critical path?
 - How much flexibility do we have in using resources?
 - Is the original deadline realistic?

Any project scheduling system should facilitate finding quick, easy answers to these questions

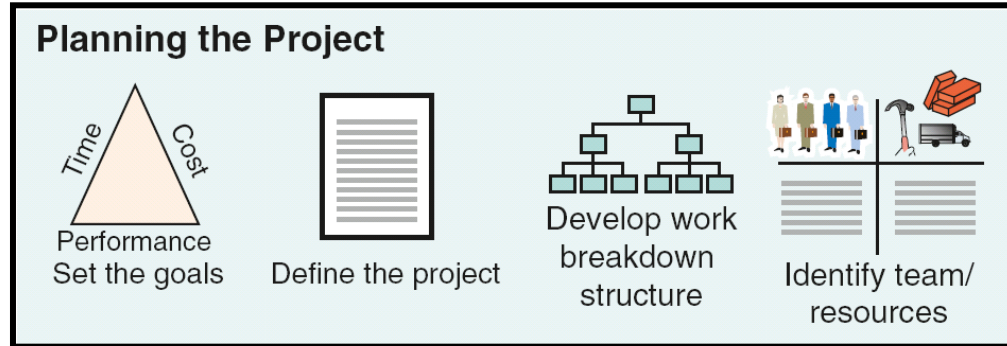
Resource Management Goals

1. To ensure that the correct resource is available at the correct time and in sufficient quantity, and
2. To ensure that the resource is used efficiently

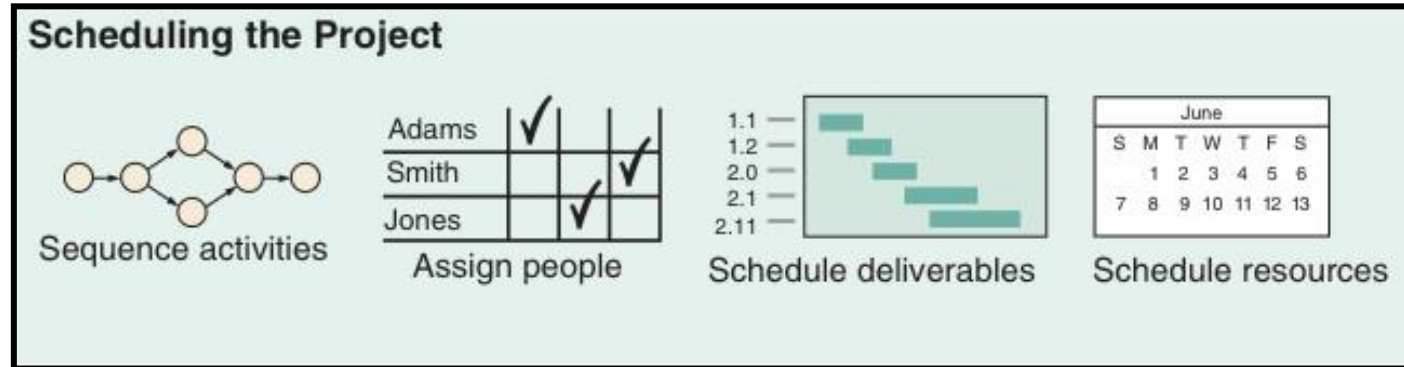
That by Developing Resource and Cost Scheduling Plans



Project Planning, Scheduling, and Controlling

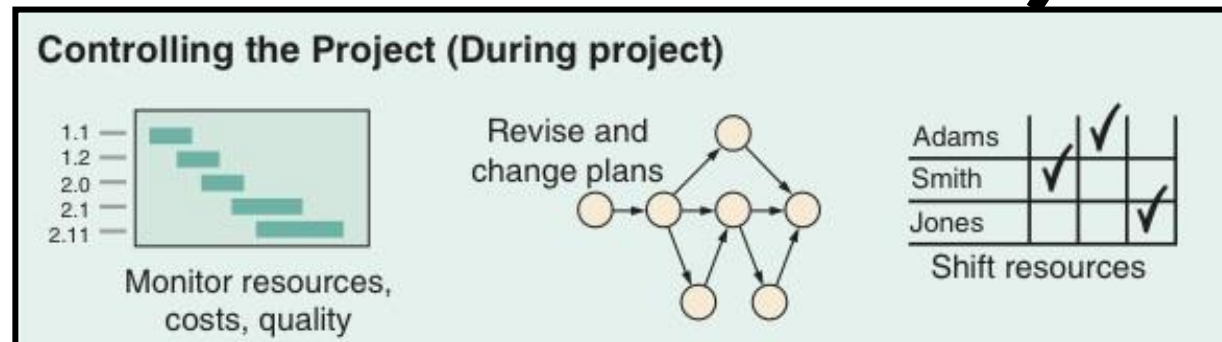


Time/cost estimates
Budgets
Engineering diagrams
Cash flow charts
Material availability details



Budgets
Delayed activities report
Slack activities report

CPM/PERT
Gantt charts
Milestone charts
Cash flow schedules



Overview of the Resource Scheduling Problem

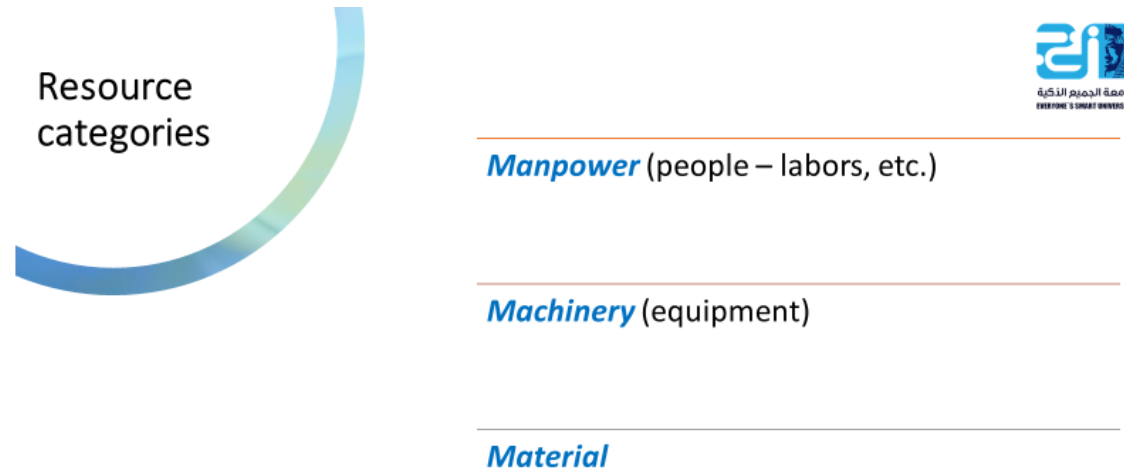


Overview of the Resource Scheduling Problem

- The planned network and activity project duration times found in previous chapters fail to deal with resource usage and availability
- The time estimates for the work packages and network times were made independently with the assumption that resources would be available
- This may or may not be the case.

Types of Resource

- Resources are people, equipment, and material that can be drawn on to accomplish something
- In projects, the availability or unavailability of resources will often influence the way projects are managed



Types of Resource - People

- The most obvious and important project resource
- Human resources are usually classified by the skills they bring to the project—for example, programmer, mechanical engineer, welder, inspector, marketing director, supervisor
- The many differing skills of human resources add to the complexity of scheduling projects.



Types of Resource - Materials

- Project materials cover a large spectrum: for example, chemicals for a scientific project, concrete for a road project, survey data for a marketing project
- Material availability and shortages have been blamed for the delay of many projects
- When it is known that a lack of availability of materials is important and probable, materials should be included in the project network plan and schedule
- For example, delivery and placement of an oil rig tower in a Siberian oil field has a very small-time window during one summer month



Types of Resource - Equipment

- Usually presented by type, size, and quantity.
- In some cases, equipment can be interchanged to improve schedules, but this is not typical
- Equipment is often overlooked as a constraint
- The most common oversight is to assume the resource pool is more than adequate for the project
- For example, if a project needs one earthmoving tractor six months from now and the organization owns four, it is common to assume the resource will not delay the pending project

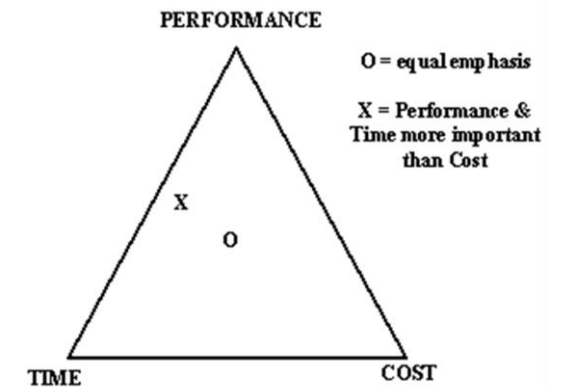


Classification of a Scheduling Problem



Classification of a Scheduling Problem

- The scheduling methods available today require the project manager to classify the project as either
- **Time constrained** or
- **Resource constrained**
- Project managers need to consult their priority matrix to determine which case fits their project



	Time	Performance	Cost
Constrain			
Enhance			
Accept			

Classification of a Scheduling Problem



Time constrained

- project has a defined delivery date that is mandated by contract
- If required, resources can be added to meet the delivery date



Resource constrained

- the resources available to do the project are limited or cannot be exceeded or over allocated
- If production falls behind, the delivery date is extended

Classification of a Scheduling Problem

- In scheduling terms,
- **Time Constrained** means time (project duration) is fixed, and resources are flexible
- **Resource Constrained** means resources are fixed, and time is flexible
- One simple test: “If the critical path is delayed, will resources be added to get back on schedule?”
 - If the answer is yes, assume the project is time constrained
 - if the answer no, assume the project is resource constrained
- ***Logical relationship (also called technical constraints) must be respected during Recourse Scheduling Process***

Time Constrained Project

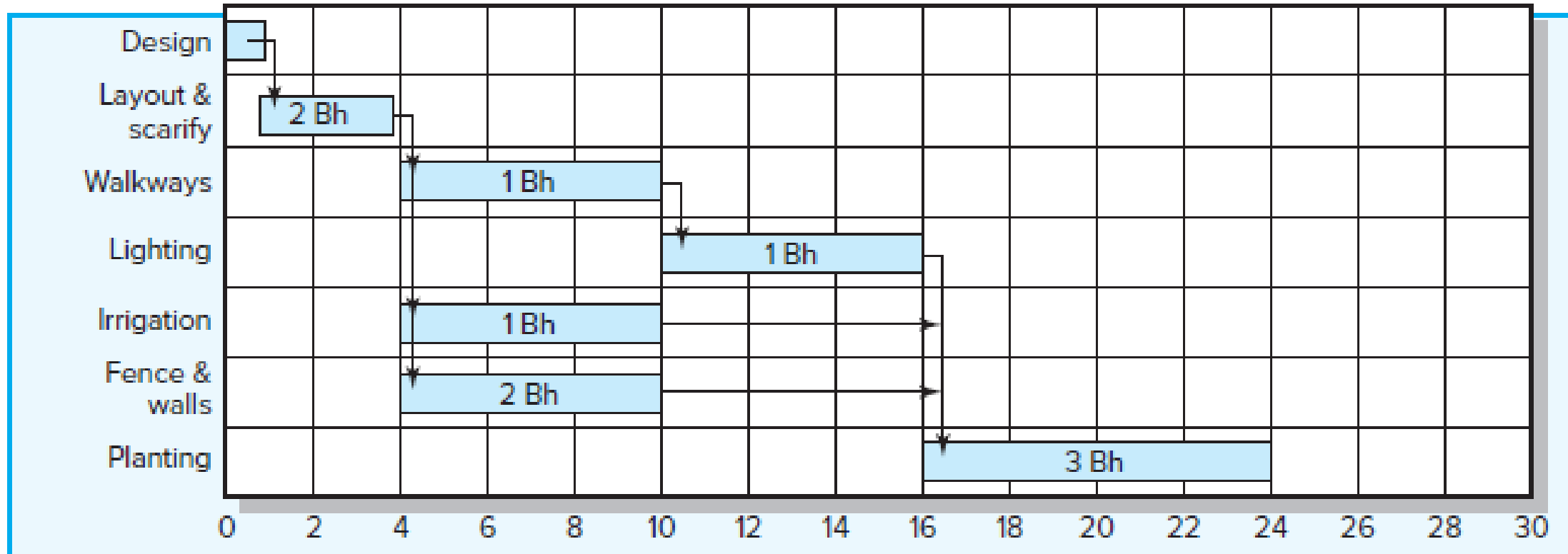


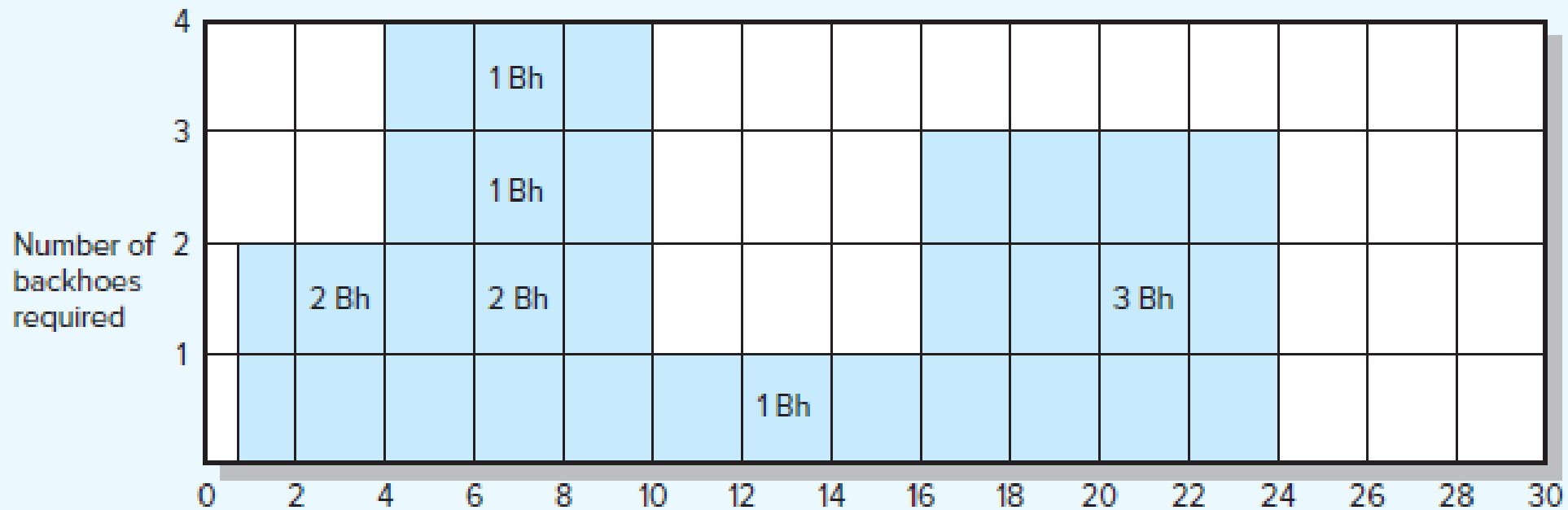
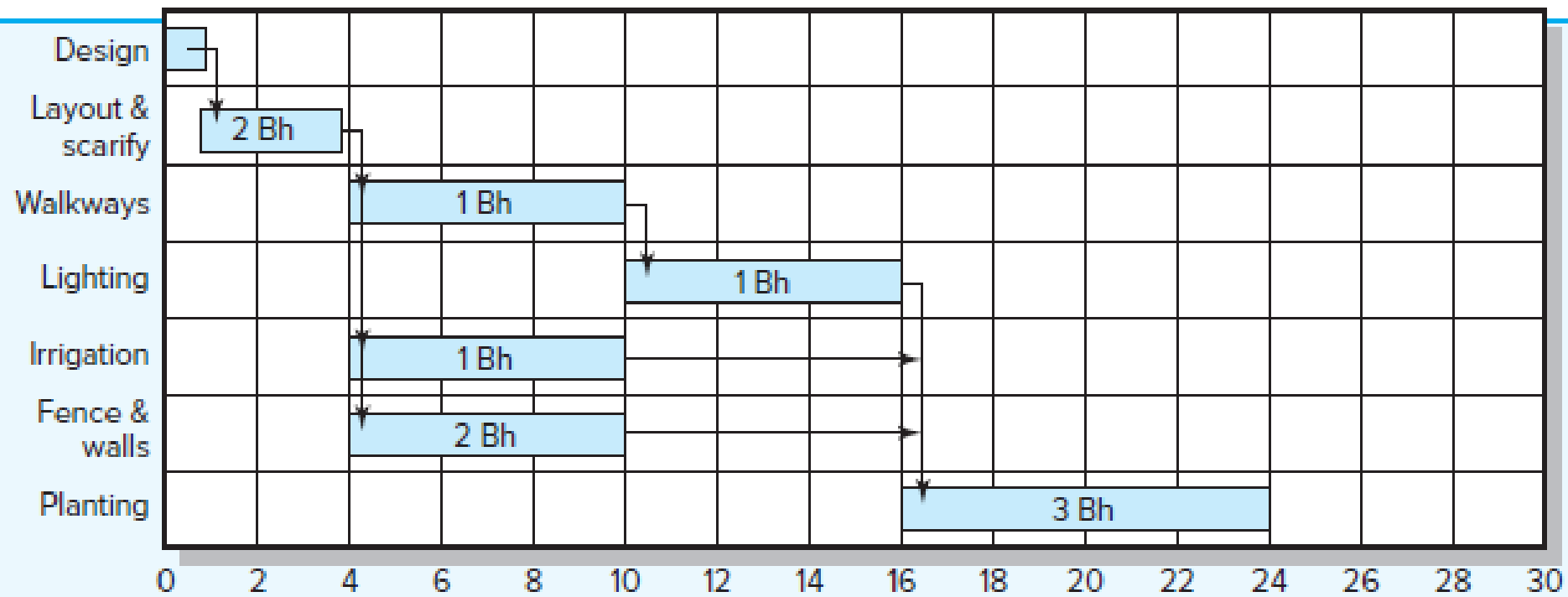
Time Constrained Project

- **Time Constrained** means time (project duration) is fixed, and resources are flexible
- Scheduling time-constrained projects focuses on resource utilization
- Although time is the critical factor, *resource usage should be no more than is necessary and sufficient*
- Practitioners have attacked the utilization problem using resource leveling techniques that balance demand for a resource

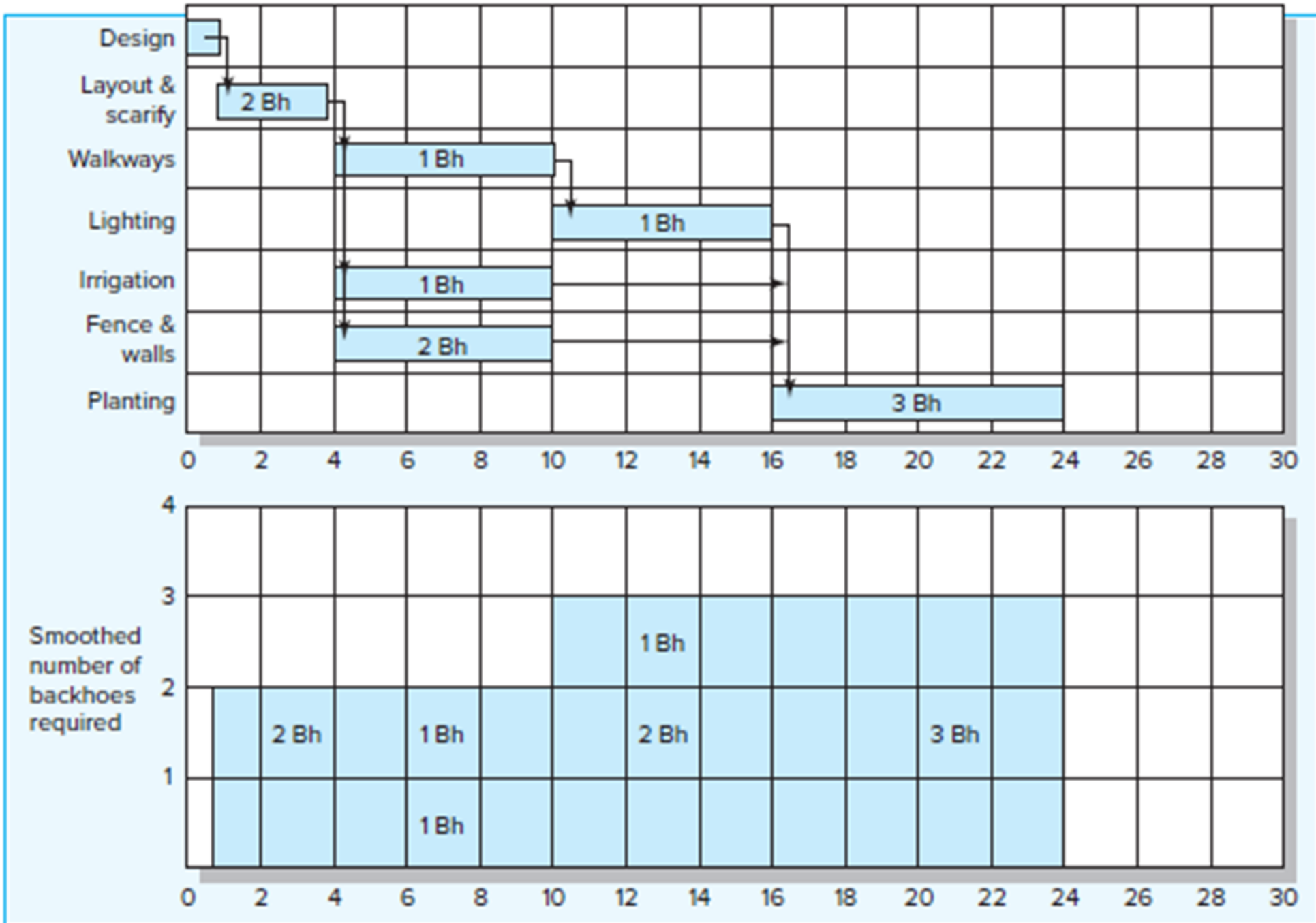
Smoothing Resource Demand

- Also called **Leveling Techniques** delay noncritical activities by using positive slack to reduce peak demand and fill in the valleys for the resources





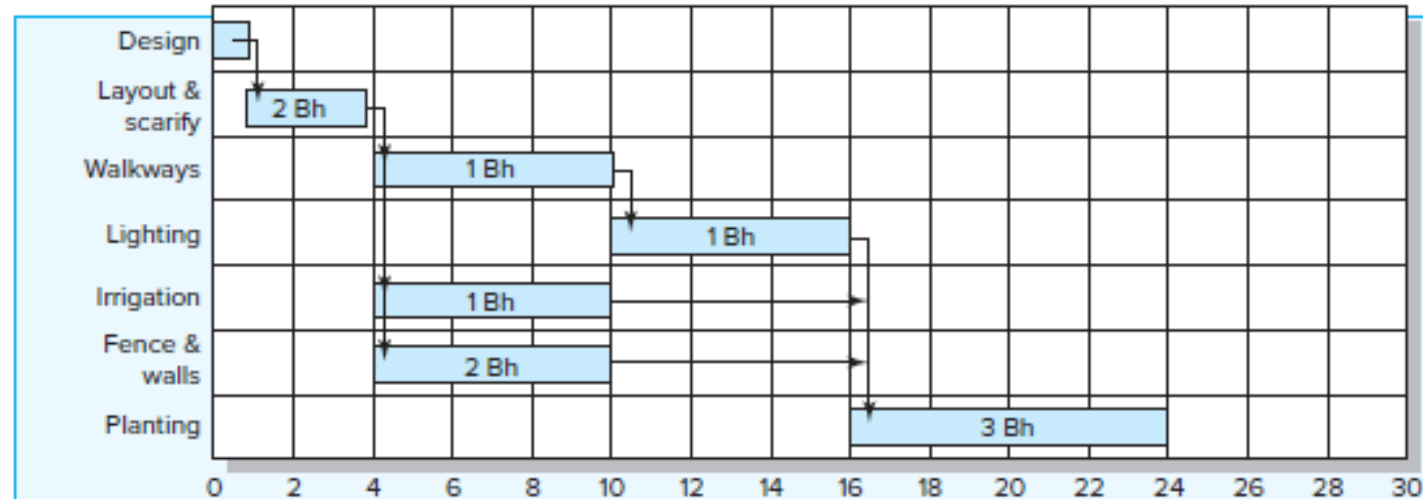
Leveling Techniques - Example



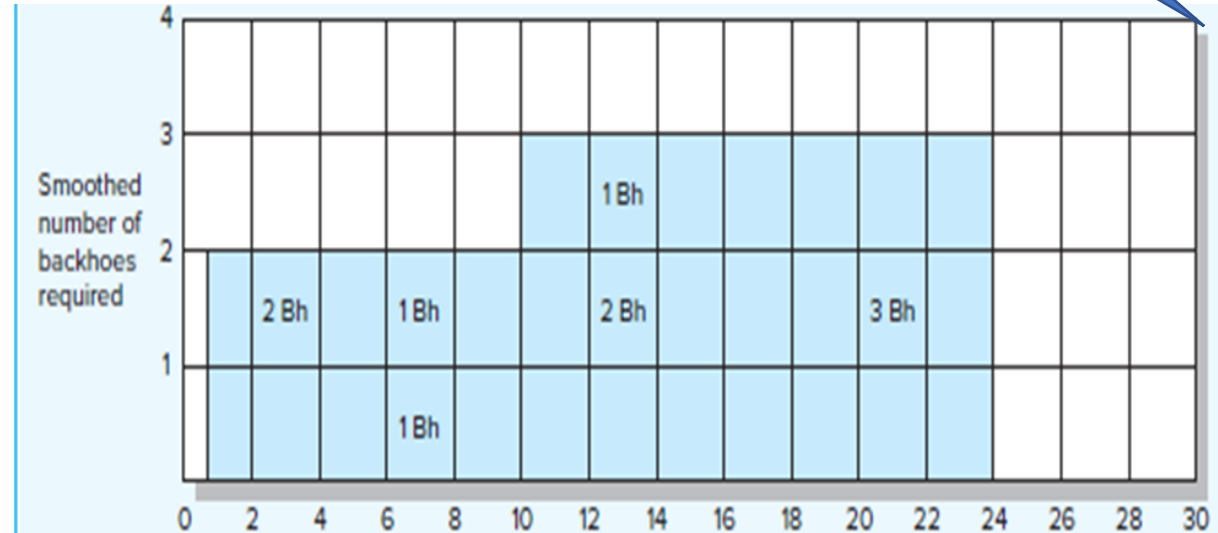
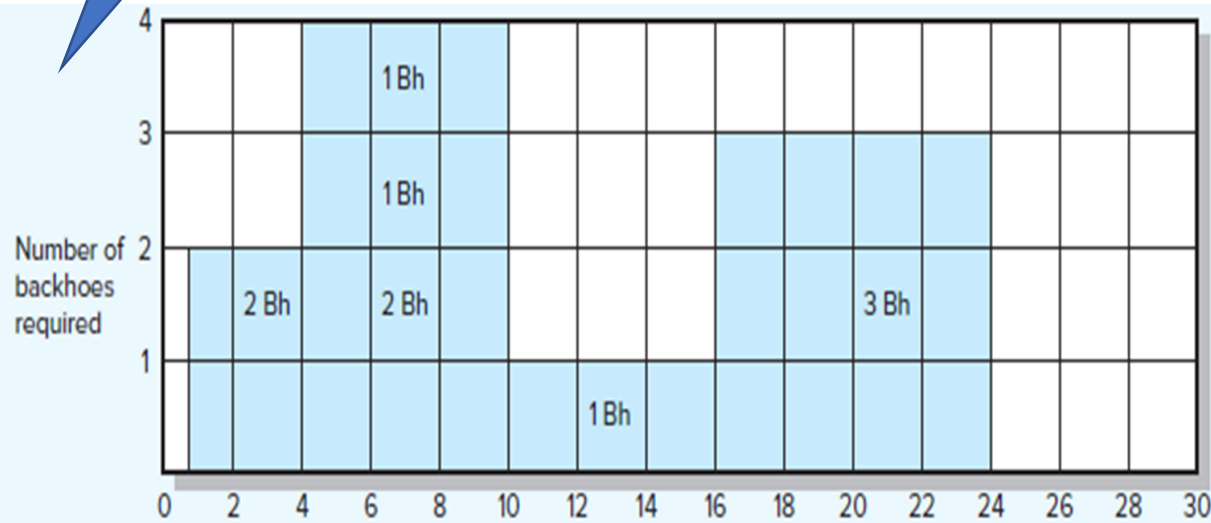
Leveling Techniques - Example

Leveling Techniques - Example

Before Leveling



After Leveling



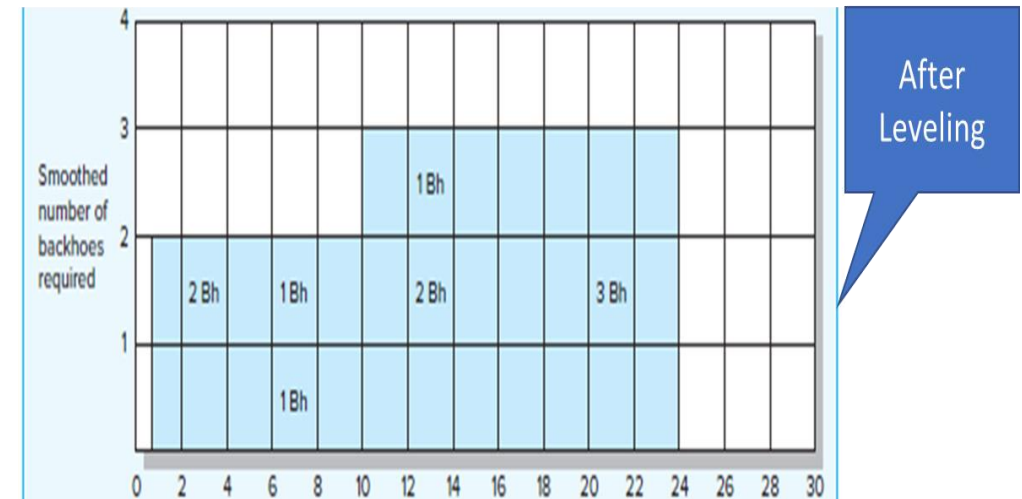
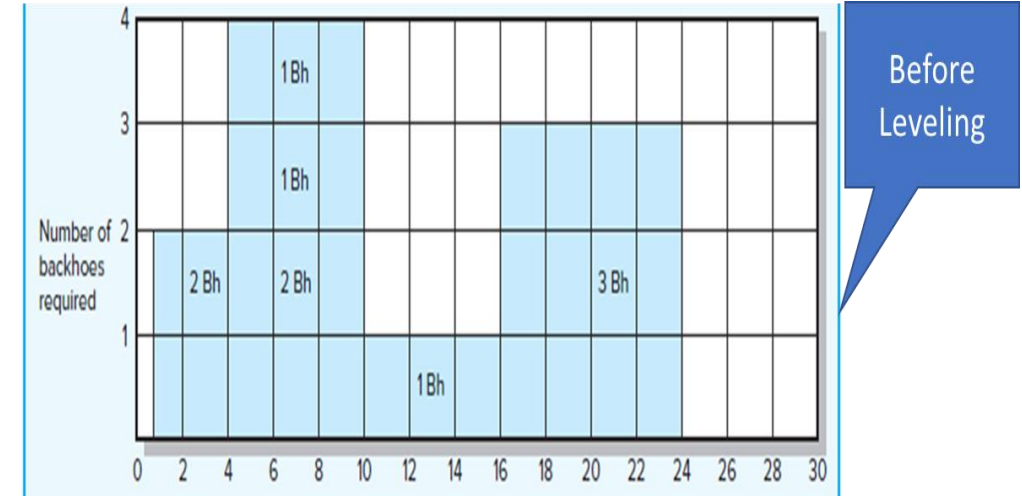
Leveling Techniques (also called Smoothing)

- **Advantages**

- The peak of demand for the resource was reduced
- Resources over the life of the project have been reduced
- The fluctuations in resource demand were minimized

- **Disadvantages**

- Loss of flexibility that occurs from reducing slack.
- Increases in the criticality of all activities.



Resource Constrained Project



Resource Constrained Project

- **Resource Constrained** means resources are fixed, and time is flexible
- One research study of more than 50 projects found that planned project network durations were increased 38 percent when resources were scheduled
- The traditional critical path concept of sequential activities from the start to the end of the project is no longer meaningful
- The resource constraints can break the sequence and leave the network with a set of disjointed critical activities
- Conversely, parallel activities can become sequential. Activities with slack on a time-constrained network can change from critical to noncritical

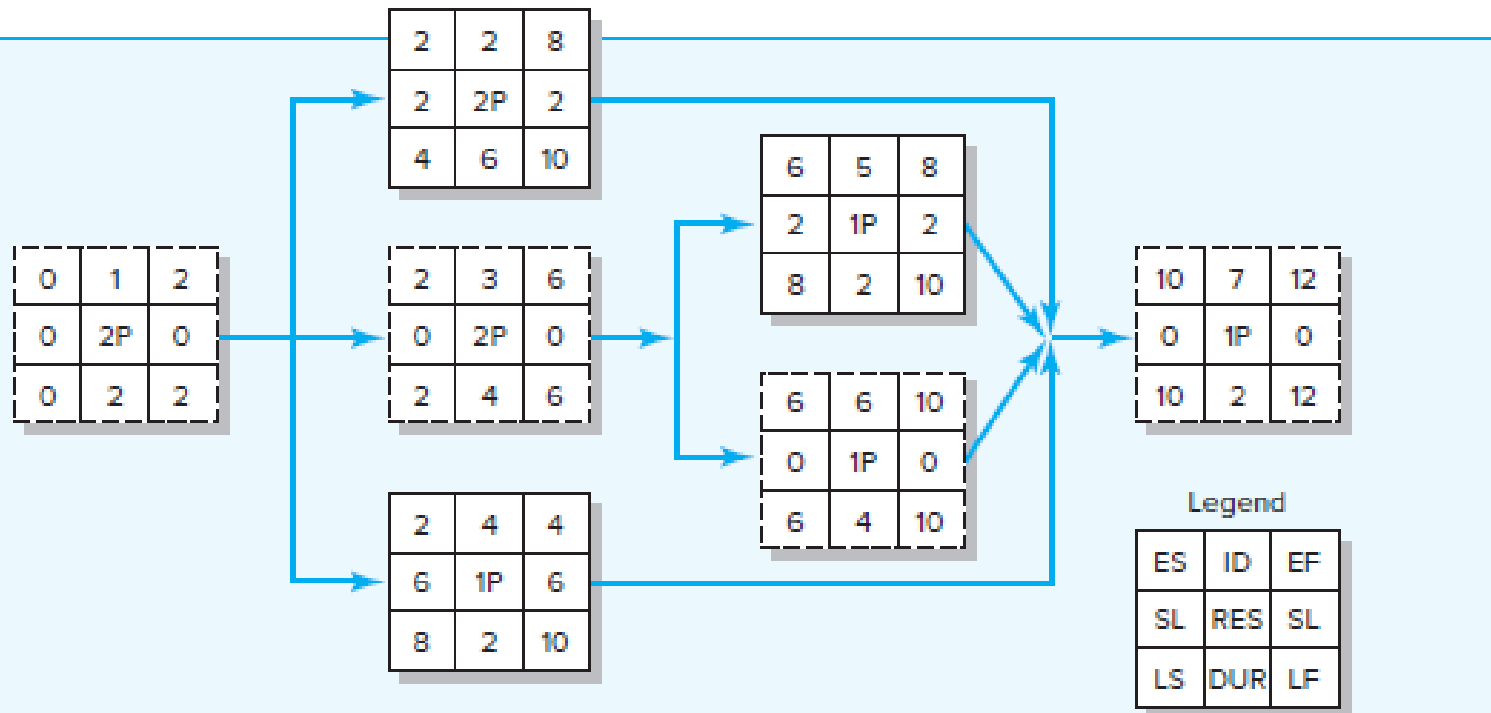
Resource Constrained Project

- 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

Heuristics (Rules-of-Thumb)

- In any period when two or more activities require the same resource, the priority rules are applied (with respect to logical relationship and resource availability)
 1. Minimum slack: the first activity placed in the schedule would be the activity with the least slack (rule 1)
 2. Smallest (least) duration: if all activities have the same slack, the activity with the smallest duration would be placed in the schedule first (rule 2)
 3. Lowest activity identification number: the tie is broken by the lowest activity identification number (rule 3)

Parallel Method - Example



ES resource load chart

ID	RES	DUR	ES	LF	SL	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	2P	2	0	2	0	2	2													
2	2P	6	2	10	2			2	2	2	2	2	2	2						
3	2P	4	2	6	0			2	2	2	2									
4	1P	2	2	10	6			1	1											
5	1P	2	6	10	2							1	1							
6	1P	4	6	10	0							1	1	1	1					
7	1P	2	10	12	0											1	1			
Total resource load						2P	2P	5P	5P	4P	4P	4P	4P	1P	1P	1P	1P			

Resource
available =
3 programmers
(3P)

Rules-of-Thumb

1. Minimum slack
2. Smallest duration
3. Lowest activity ID#

Parallel Method - Example

ES resource load chart

ID	RES	DUR	ES	LF	SL	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	2P	2	0	2	0	2	2													
2	2P	6	2	10	2			2	2	2	2	2	2							
3	2P	4	2	6	0			2	2	2	2									
4	1P	2	2	10	6			1	1											
5	1P	2	6	10	2							1	1							
6	1P	4	6	10	0							1	1	1	1					
7	1P	2	10	12	0											1	1			
Total resource load						2P	2P	5P	5P	4P	4P	4P	4P	1P	1P	1P	1P			

Resource-constrained schedule through period 2-3

ID	RES	DUR	ES	LF	SL	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	2P	2	0	2	0	2	2													
2	2P	6	2 ³	10	2 ¹			X												
3	2P	4	2	6	0			2	2	2	2									
4	1P	2	2	10	6			1	1											
5	1P	2	6	10	2															
6	1P	4	6	10	0															
7	1P	2	10	12	0															
Total resource load						2P	2P	3P	3P	2P	2P									
Resource available						3P	3P	3P	3P	3P	3P	3P	3P	3P	3P	3P	3P			

Resource
available =
3 programmers
(3P)

Rules-of-Thumb

1. Minimum slack
2. Smallest duration
3. Lowest activity ID#

Resource-constrained schedule through period 5–6

ID	RES	DUR	ES	LF	SL	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	2P	2	0	2	0	2	2													
2	2P	6	2	10	2			X	X	X	X									
3	2P	4	2	6	0			2	2	2	2									
4	1P	2	2	10	6			1	1											
5	1P	2	6	10	2															
6	1P	4	6	10	0															
7	1P	2	10	12	2											X	X			
Total resource load						2P	2P	3P	3P	2P	2P									
Resource available						3P	3P	3P	3P	3P	3P	3P	3P	3P	3P	3P	3P			

Parallel Method - Example

Resource
available =
3 programmers
(3P)

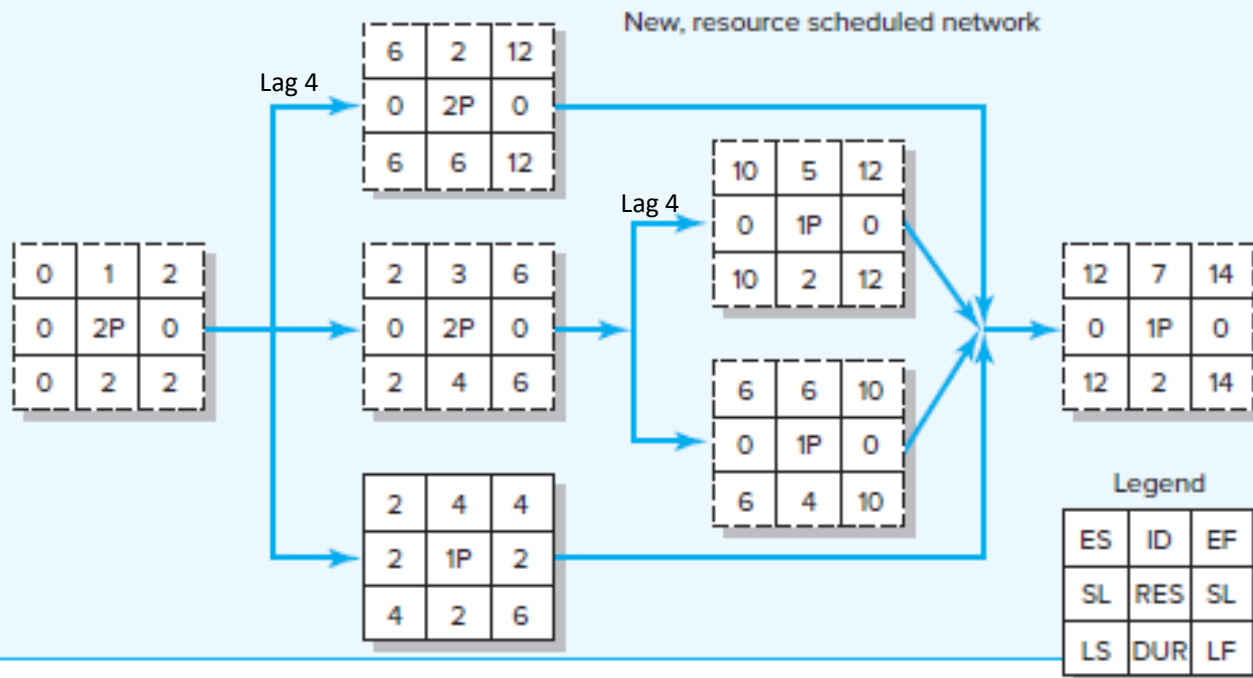
Rules-of-Thumb

1. Minimum slack
2. Smallest duration
3. Lowest activity ID#

Parallel Method - Example

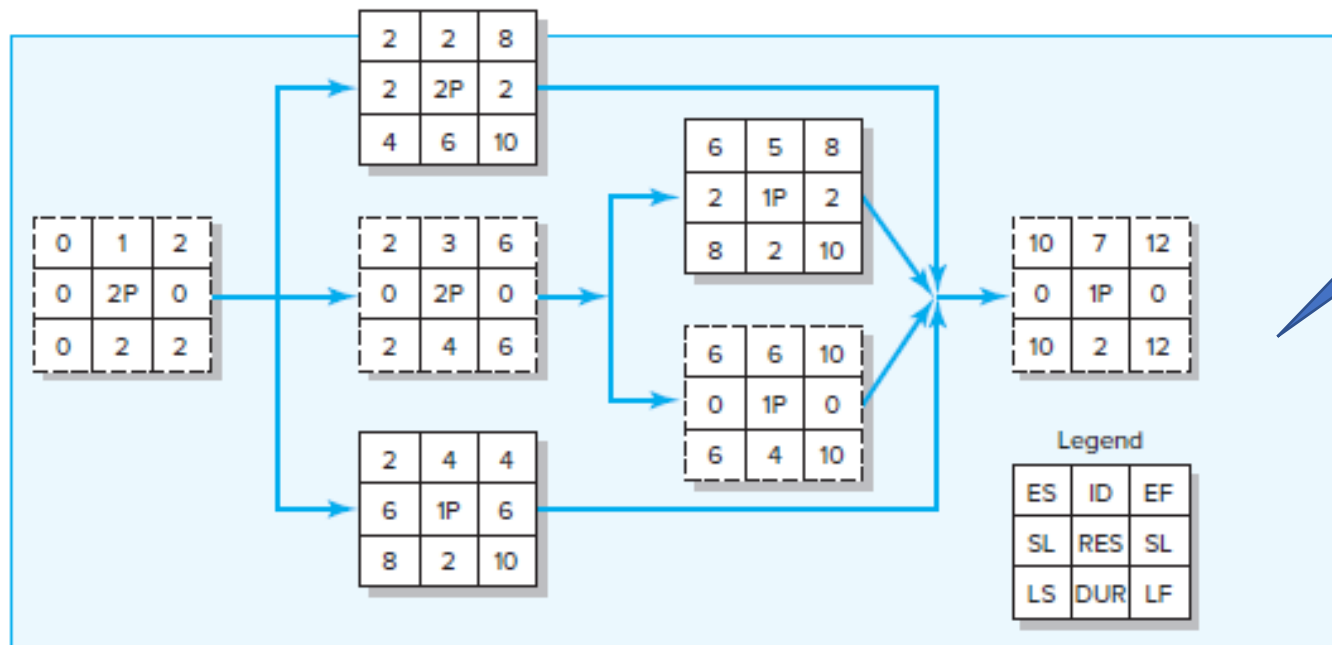
Final resource-constrained schedule

ID	RES	DUR	ES	LF	SL	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	2P	2	0	2	0	2	2													
2	2P	6	2	8	2			X	X	X	X	2	2	2	2	2	2			
3	2P	4	2	6	0			2	2	2	2									
4	1P	2	2	6	2			1	1	SL	SL									
5	1P	2	8	10	2							X	X	X	X	1	1			
6	1P	4	6	10	0							1	1	1	1					
7	1P	2	10	12	2											X	X	1	1	
Total resource load						2P	2P	3P	3P	2P	2P	3P	3P	3P	3P	3P	3P	1P	1P	
Resource available						3P	3P	3P	3P	3P	3P	3P	3P	3P	3P	3P	3P	3P	3P	

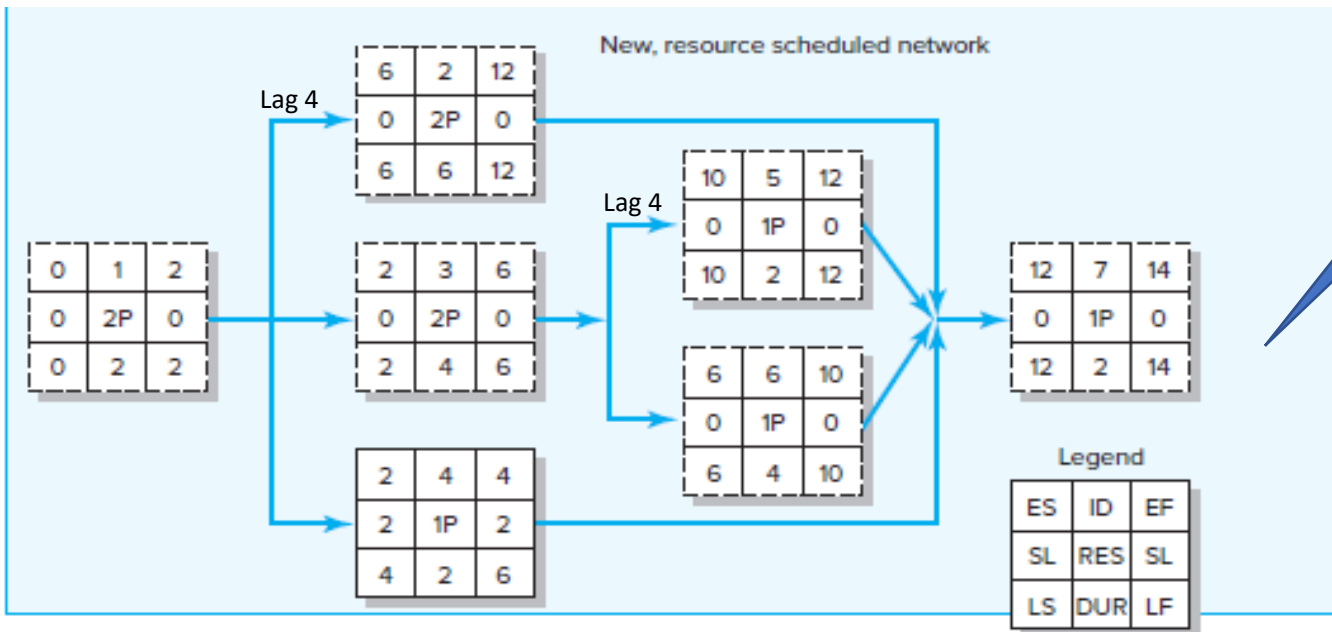


Resource
available =
3 programmers
(3P)

- Rules-of-Thumb
1. Minimum slack
 2. Smallest duration
 3. Lowest activity ID#



Parallel Method - Example



After

Resource
available =
3 programmers
(3P)

Rules-of-Thumb

1. Minimum slack
2. Smallest duration
3. Lowest activity ID#

Period	Action
See Figure 8.4	
0–1	Only activity 1 is eligible. It requires 2 programmers. Load activity 1 into schedule.
1–2	No activities are eligible to be scheduled.
2–3	Activities 2, 3, and 4 are eligible to be scheduled. Activity 3 has the least slack (0)— apply rule 1. Load Activity 3 into schedule. Activity 2 is next with slack of 2; however, activity 2 requires 2 programmers and only 1 is available. Delay activity 2. Update: ES = 3, slack = 1. The next eligible activity is activity 4, since it only requires 1 programmer. Load activity 4 into schedule.
See Figure 8.5	
3–4	Activity 2 is eligible but exceeds limit of 3 programmers in pool. Delay activity 2. Update: ES = 4, slack = 0.
4–5	Activity 2 is eligible but exceeds limit of 3 programmers in pool. Delay activity 2. Update: ES = 5, LF = 11, slack = –1. Delay activity 7. Update: ES = 11, LF = 13, slack = –1.
5–6	Activity 2 is eligible but exceeds limit of 3 programmers in pool. Delay activity 2. Update: ES = 6, LF = 12, slack = –2. Delay activity 7. Update: ES = 12, LF = 14, slack = –2.
6–7	Activities 2, 5, and 6 are eligible with slack of –2, 2, and 0, respectively. Load activity 2 into schedule (rule 1). Because activity 6 has 0 slack, it is the next eligible activity. Load activity 6 into schedule (rule 1). The programmer limit of 3 is reached. Delay activity 5. Update: ES = 7, slack = 1.
7–8	Limit is reached. No programmers available. Delay activity 5. Update: ES = 8, slack = 0.
8–9	Limit is reached. No programmers available. Delay activity 5. Update: ES = 9, LF = 11, slack = –1.
9–10	Limit is reached. No programmers available. Delay activity 5. Update: ES = 10, LF = 12, slack = –2.
10–11	Activity 5 is eligible. Load activity 5 into schedule. (Note: Activity 6 does not have slack because there are no programmers available— 3 maximum.)
11–12	No eligible activities.
12–13	Activity 7 is eligible.

Parallel Method - Example

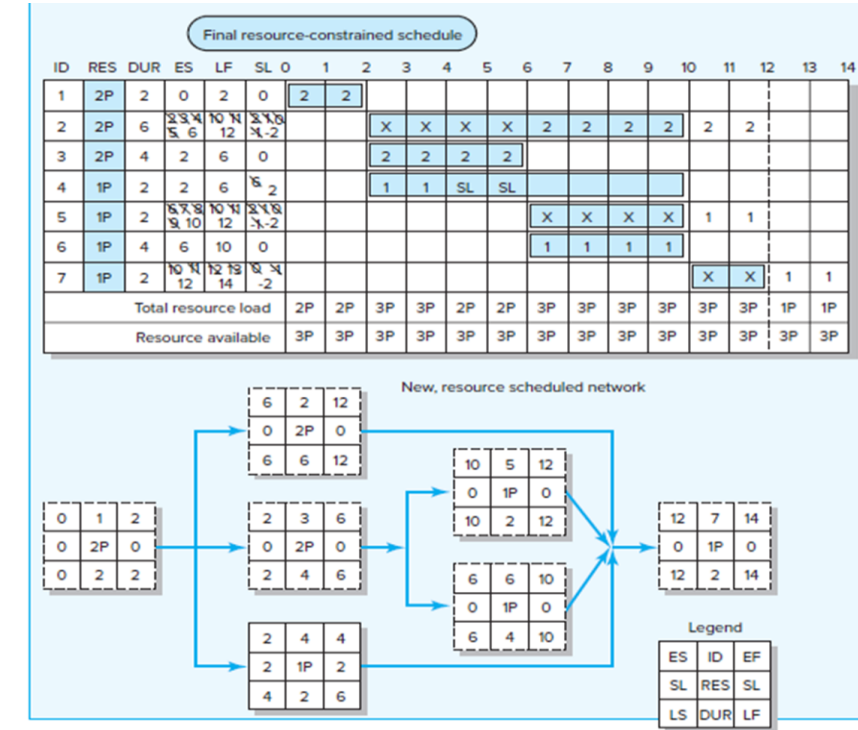
Resource
available =
3 programmers
(3P)

Rules-of-Thumb

1. Minimum slack
2. Smallest duration
3. Lowest activity ID#

The 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
- Activities with slack can change from noncritical to critical



Splitting



Splitting

- A scheduling technique use to get 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
- Planners should avoid the use of splitting as much as possible, except in situations where splitting costs are known to be small or when there is no alternative for resolving the resource problem

Splitting

Activity 1

Activity duration without splitting

Activity
1A

Activity
1B

Activity
1C

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

Activity
1A

Activity
1B

Activity
1C

Shutdown

Start-up

Activity duration split with shutdown and start-up

Computer Software for Scheduling Resources



Computer Software for Scheduling Resources

- Fortunately, project management software is capable of assessing and resolving complicated resource-constrained schedules using heuristics like what was described
- It is important to note that the software is not “managing” the project
- The software is simply a tool the project manager uses to view the project from different perspectives and conditions

Computer Software for Scheduling Resources

Resource Leveling

Leveling calculations

☐ Automatic ☒ Manual

Look for overallocations on a Day by Day basis

☒ Clear leveling values before leveling

Leveling range for 'Project1'

☒ Level entire project

☐ Level From: Dec 5 To: Dec 5

Resolving overallocations

Leveling order: Priority, Standard

☐ Level only within available slack

☐ Leveling can adjust individual assignments on a task

☐ Leveling can create splits in remaining work

☐ Level resources with the proposed booking type

☐ Level manually scheduled tasks

Help Clear Leveling... Level All OK Cancel

Residential Construction.mpp - Project Professional

Resource Sheet Tools

File Task Resource Report Project View Format Tell me what you want to do

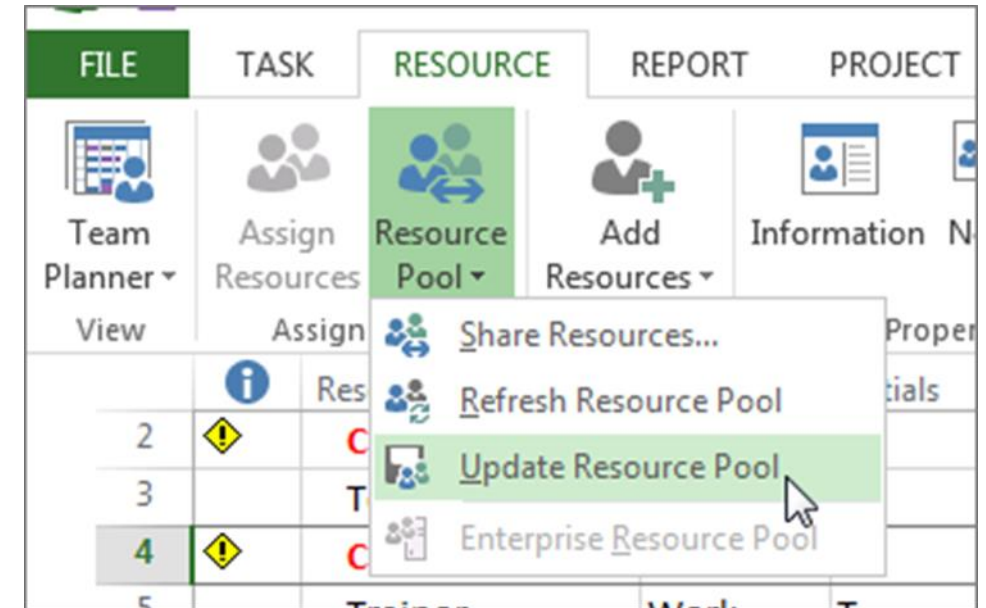
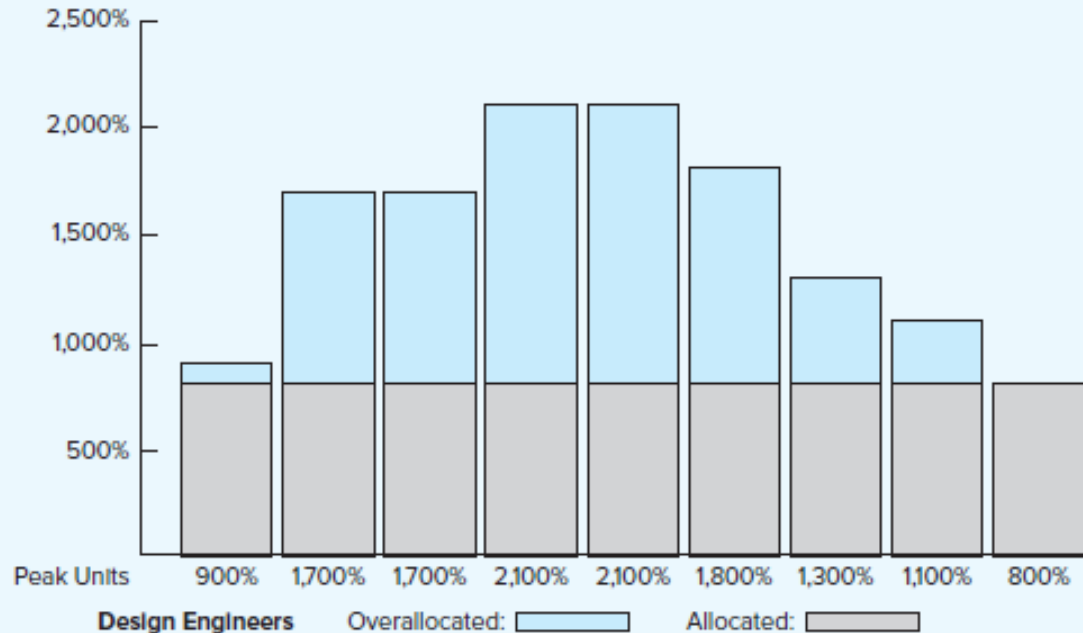
Clipboard Font Schedule Tasks Insert

	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt.	Cost/Use	Accrue	Base
1	Concrete contractor	Work		C		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
2	Finish carpentry contractor	Work		F		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
3	Fencing contractor	Work		F		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
4	Masonry contractor	Work		M		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
5	General contractor	Work		G		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
6	Architect	Work		A		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
7	Owner	Work		O		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
8	Mortgage lender	Work		M		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
9	Inspector	Work		I		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
10	Electric company	Work		E		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
11	Site excavation contractor	Work		S		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
12	Electric contractor	Work		E		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
13	Plumbing contractor	Work		P		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
14	Framing contractor	Work		F		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
15	Roofing contractor	Work		R		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
16	Heating and AC contractor	Work		H		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
17	Insulation contractor	Work		I		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
18	Drywall contractor	Work		D		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard
19	Painting contractor	Work		P		100%	\$0.00/hr	\$0.00/hr	\$0.00	Prorated	Standard

Computer Software for Scheduling Resources

Resource Name	Work	Jan 15						Jan 21		
		T	W	T	F	S	S	M	T	W
Design engineers	3,024 hrs	72h	136h	136h	168h	168h	144h	104h	88h	64h
Architectural decisions	200 hrs									
Internal specs	480 hrs	40h	40h	40h						
External specs	224 hrs									
Feature specs	320 hrs	32h								
Voice recognition SW	320 hrs				32h	32h	32h	32h	32h	32h
Case	64 hrs				16h	16h	16h	16h		
Screen	48 hrs				24h	24h				
Database	800 hrs		32h	32h	32h	32h	32h	32h	32h	32h
Microphone-soundcard	80 hrs		16h	16h	16h	16h	16h			
Digital devices	168 hrs		24h	24h	24h	24h	24h	24h	24h	
Computer I/O	120 hrs		24h	24h	24h	24h	24h			
Review design	200 hrs									

FIGURE 8.8B
Resource Loading
Chart for
EMR Project,
January 15-23



Snapshot from Practice - Assessing Resource Allocation



One of the strengths of today's project management software is the ability to identify and provide options for resolving resource allocation problems. A project manager who uses MS Project

to plan projects shared with us the following checklist for dealing with resource conflicts after preliminary assignment of resources has been made.

1. Assess whether you have overallocation problems (see *Red* in the resource sheet view).
2. Identify where and when conflicts occur by examining the resource usage view.
3. Resolve the problem by
 - a. Replacing overallocated resources with appropriate resources that are available. Then ask if this solves the problem.If not:
 - b. Use the leveling tool and choose the level within slack option.
 - i. Does this solve the problem? (Are resources still overallocated?)

- ii. Check the sensitivity of the network and ask if this is acceptable.

If not:

- c. Consider splitting tasks.
 - i. Make sure to readjust task durations to take into account additional start-up and shut-down time.

4. If 3 does not work then either:

- a. Use level tool default option and ask if you can live with the new completion date.

If not:

- b. Negotiate for additional resources to complete the project. If not possible
 - c. Consider reducing project scope to meet deadline.

While this checklist makes specific references to MS Project, the same steps can be used with most project management software.

Benefits of Scheduling Resources



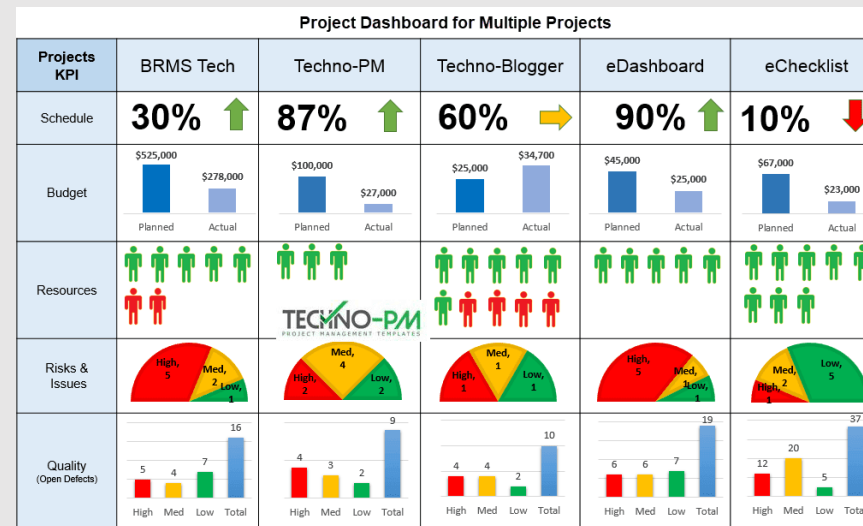
Benefits of Scheduling Resources

- If resources are truly limited and activity time estimates are accurate, the resource-constrained schedule will materialize as the project is implemented—not the time-constrained schedule!
- Failure to schedule limited resources can lead to serious problems for a project manager
- The benefit of creating this schedule before the project begins **leaves time for considering reasonable alternatives**
- If the scheduled delay is unacceptable or the risk of being delayed too high, the assumption of being resource constrained can be reassessed

Benefits of Scheduling Resources

- Resource schedules provide the information needed to prepare time-phased work package budgets with dates
- Once established, they provide a quick means for a project manager to gauge the impact of unexpected events such as equipment breakdowns, or transfer of project personnel
- Resource schedules also allow project managers to assess how much flexibility they have over certain resources

Multiproject Scheduling Problems



Multiproject Scheduling Problems

1. Overall schedule slippage. Because projects often share resources, delays in one project can have a ripple effect and delay other projects
 - work on one software development project can grind to a halt because the coders scheduled for the next critical task are late in completing their work on another development project
2. Inefficient resource utilization. Because projects have different schedules and requirements, there are peaks and valleys in overall resource demands
 - a firm may have a staff of 10 electricians to meet peak demands when, under normal conditions, only 5 electricians are required
3. Resource bottlenecks. Delays and schedules are extended as a result of shortages of critical resources that are required by multiple projects



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Summary of Today Session

Why Resource Management?



- Shortages and mismanagement of resources are frequent causes of substantial delays
- Most project managers have watched tradesmen standing idly by due to
 - lack of materials, or
 - experienced delays due to the wrong piece of equipment used in performing a task
- Proper management of resources—materials, labor, and equipment—can minimize or even eliminate these types of inefficiencies

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Resource Allocation



- Allocating too many people to the crew will leave some underutilized and increase the cost per unit of work
- Inversely, too small a crew will result in less being produced per unit of time
- Neither condition is desirable
- It is the goal of resource allocation to maintain sufficient resources to allow the work to proceed in a smooth or even flow.

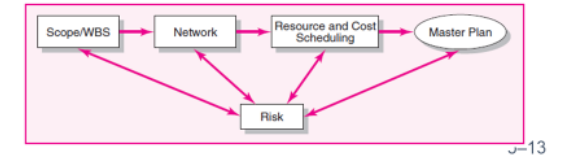
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Resource Management Goals



1. To ensure that the correct resource is available at the correct time and in sufficient quantity, and
2. To ensure that the resource is used efficiently

By Developing Resource and Cost Scheduling Plans



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Classification of a Scheduling Problem



Time constrained

- project has a defined delivery date that is mandated by contract.
- If required, resources can be added to meet the delivery date.
- The delivery date takes precedence over resource availability, and it is implied that additional resources will be added to accelerate the work if required.



Resource constrained

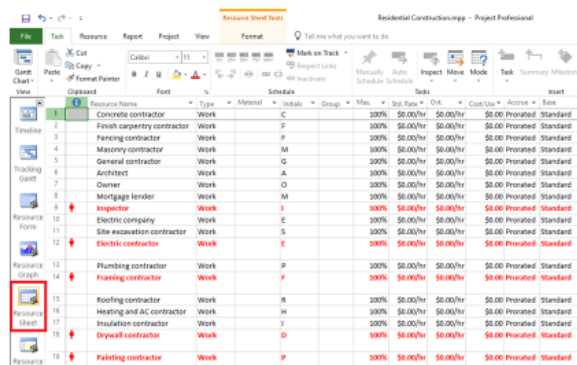
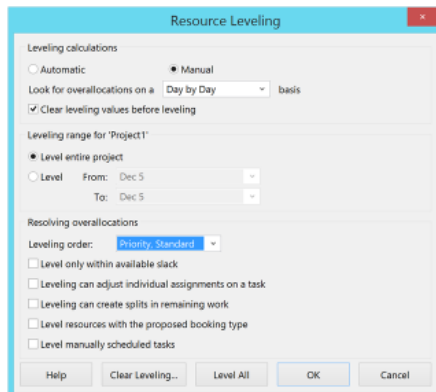
- the resources available to do the project are limited or cannot be exceeded or over allocated.
- If production falls behind, the delivery date is extended.

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Benefits of Scheduling Resources

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- Failure to schedule limited resources can lead to serious problems for a project manager
- The benefit of creating this schedule before the project begins **leaves time for considering reasonable alternatives**
- If the scheduled delay is unacceptable or the risk of being delayed too high, the assumption of being resource constrained can be reassessed

Computer Software for Scheduling Resources



Task	Resource Name	Type	Material	Units	Start	Finish	Duration	Cost	Rate	Standard
1	Concrete contractor	Work	C	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
2	Finish carpentry contractor	Work	F	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
3	Fencing contractor	Work	F	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
4	Masonry contractor	Work	M	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
5	General contractor	Work	G	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
6	Architect	Work	A	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
7	Owner	Work	O	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
8	Mortgage lender	Work	M	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
9	Inspector	Work	I	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
10	Electric company	Work	E	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
11	Site excavation contractor	Work	S	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
12	Electric contractor	Work	E	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
13	Plumbing contractor	Work	P	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
14	Painting contractor	Work	P	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
15	Roofing contractor	Work	R	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
16	Heating and AC contractor	Work	H	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
17	Insulation contractor	Work	I	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
18	Drywall contractor	Work	D	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard
19	Painting contractor	Work	P	100%	0.00/0.00	0.00/0.00	0.00	0.00	0.00	Standard

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Resources

Project Management

The Managerial Process

Fifth Edition

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