CHAPTER 6

Resource Utilization

Chapter Concepts

- Taking resource constraints into account when developing a network diagram
- Determining the resource requirements plan for a project
- Leveling the use of resources within the required time frame of the project
- Determining the shortest project schedule with the limited resources available

Learning Outcomes

- Create a network diagram that takes resource constraints into account
- Prepare a resource requirements plan
- Explain resource leveling
- Discuss resource-limited scheduling

Project Human Resource Management

The New House Call

- Project Need
  - ~60 percent of deaths around the globe attributed to chronic diseases
  - Help reduce the occurrence of chronic diseases
- Project
  - Development of mobile healthcare apps
- Budget
  - $1.2 billion USD in 2011
  - Expectation of $11.8 billion USD in 2018

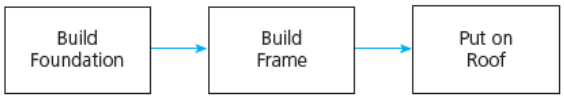
Industrial Sites Get a New Look

- Shanghai, China
  - Change inactive quarry in 300-room luxury hotel that extends 200 feet below the surface
  - Mitigate industrial waste risks and seismic activity
- Baumholder, Germany
  - Repurpose abandoned military sites into civic spaces
  - Respect the communities' physical, cultural, and socioeconomic characteristics
- London, England
  - Transform abandoned industrial district into vibrant region

Technical-Constrained Planning

- Serial relationship – performed in that sequence

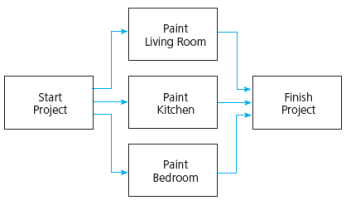
FIGURE 6.1 Technically Constrained Activity Sequence



Resource-Constrained Planning

- Available resources allow for concurrent tasks

FIGURE 6.2 Resource-Constrained Planning



(a) Activity Sequence without Resource Constraints

(b) Activity Sequence Based on Resource Constraints

- Limited resource availability constrains project

Resource Requirements Plan

- Illustrates the expected resource use by time period
- Indicate the amounts and types of resources needed to perform each activity

FIGURE 6.3 Estimated Resource Requirements for Consumer Market Study Project

NAME	ACTIVITIES	WORK DAYS	PERIOD
Susan	1, 2, 3, 4, 8	40	0 to 40
Steve	5, 6, 9	8	38 to 53
Andy	7, 10	17	38 to 55
Jim	11, 12, 13	25	103 to 128
		90	**0 to 128**

Example Painting Project: Resource Requirements

FIGURE 6.4 Required Resources for Painting Project

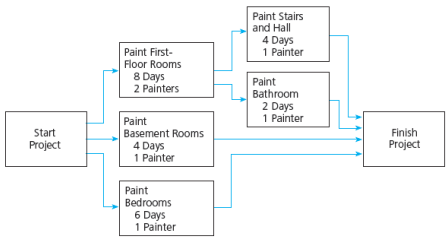


FIGURE 6.5 Resource Requirements Plan for Painting Project

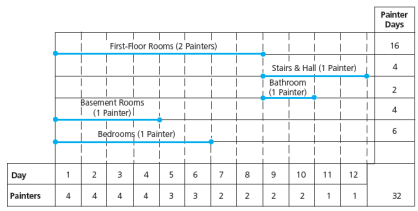
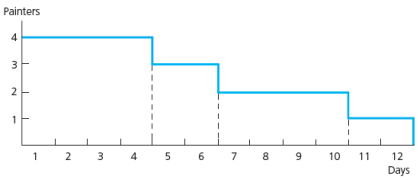
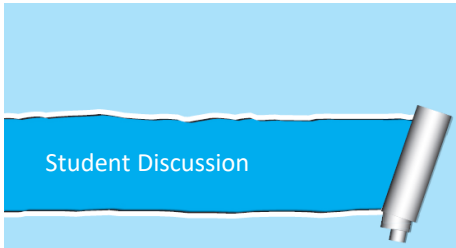


FIGURE 6.6 Resource Utilization for Painters



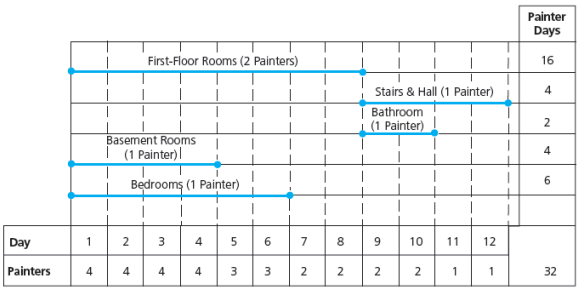
Resource Leveling

- Minimize resource requirement fluctuations
- Resources applied as uniformly as possible
- Attempt to keep project schedule within required time
- Delay start of noncritical activities
- Use positive slack
- Project management information systems assist
- If delay beyond slack and on critical path, project will be delayed beyond required completion time



How to level the painting project?

FIGURE 6.5 Resource Requirements Plan for Painting Project



Possible responses to Student Discussion

- How to level the painting project?

FIGURE 6.5 Resource Requirements Plan for Painting Project

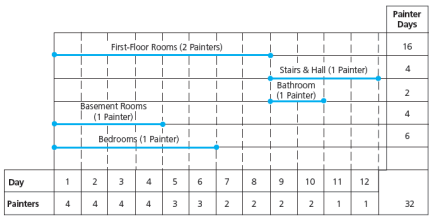


FIGURE 6.6 Resource Utilization for Painters

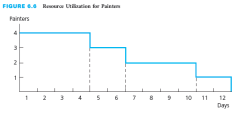


FIGURE 6.7 Resource-leveled Requirements Plan for Painting Project

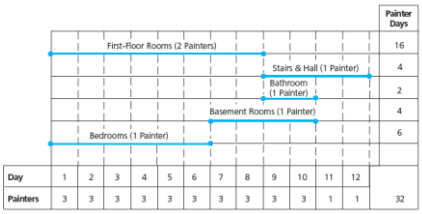
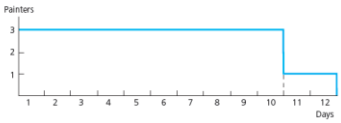


FIGURE 6.8 Resource-leveled Utilization for Painters



Resource-Limited Scheduling

- Develop shortest schedule
- Not exceed fixed available resources
- Extend the project completion time if necessary
- Give activities with the least slack first priority
- Delay lower priority activities

Example Painting Project: Limited Resources

- Limit of two painters

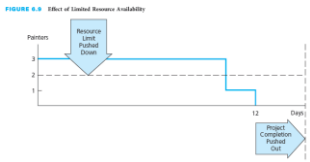
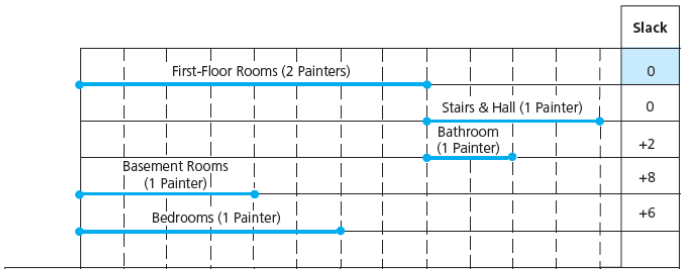


FIGURE 6.10 Resource Requirements Plan for Painting Project

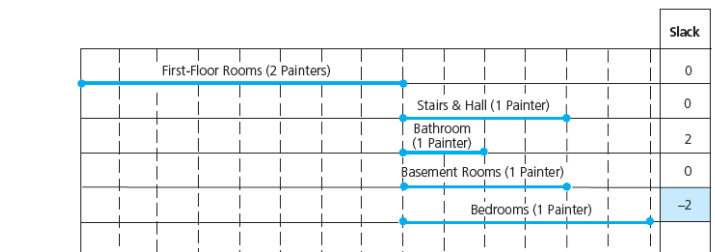


Day	1	2	3	4	5	6	7	8	9	10	11	12
Painters	4	4	4	4	3	3	2	2	2	2	1	1

Example Painting Project: First Resource Allocation

- "First Floor Rooms" has a slack of 0
- Other tasks are delayed

FIGURE 6.11 First Resource Allocation

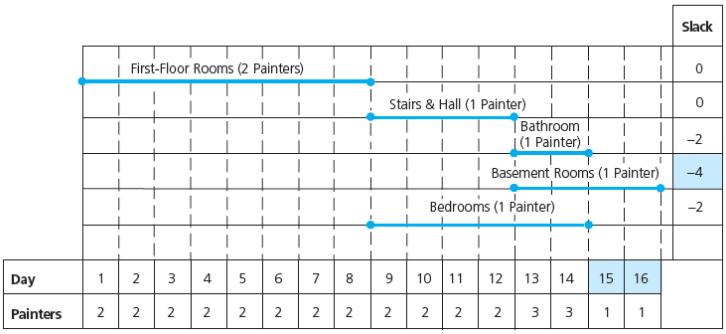


Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Painters	2	2	2	2	2	2	2	2	4	4	3	3	1	1

Example Painting Project: Second Resource Allocation

- Begin “Stairs & Hall” and “Bedrooms”
- Need to address limit for days 13 and 14

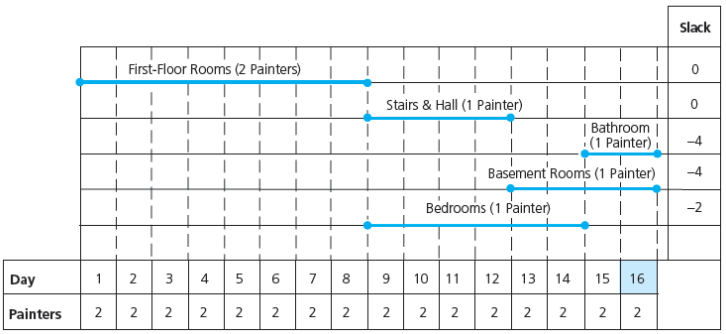
FIGURE 6.12 Second Resource Allocation



Example Painting Project: Third Resource Allocation

- Delay “Bathroom” to days 15 and 16
- Project delayed by 4 days

FIGURE 6.13 Third Resource Allocation



Resource Requirements For Information Systems Development

- Five basic required resources
  - People, hardware, software, data, and network resources
- The more accurate the resource assessment, the more likely the project can be completed on time
- Most common problem – Overallocation
  - Resources assigned to multiple tasks at same time
  - Conflict results in lengthening the time

IS Example: Responsibility Assignment Matrix

FIGURE 4.11 Responsibility Assignment Matrix for Web-based Reporting System Project

WBS Item	Work Item	Beth	Jim	Jack	Rose	Steve	Jaff	Tyler	Cathy	Sharon	Hannah	Joe	Garrt	Maggie	Gene	Greg
	Web-based Reporting System	P	S					S			S			S		
1	**Problem Definition**	P		S	S											
1.1	Gather Data	P	S										S			
1.2	Study Feasibility			P		S	S		S	S						
1.3	Prepare Report	S			P											
2	**System Analysis**		P			S	S									
2.1	Interview Users		P		S						S			S		
2.2	Study Existing System					P										
2.3	Define User Requirements						P									
2.4	Prepare Report		P													
3	**System Design**							P	S	S		S				
3.1	Input & Output					S	S	P								
3.1.1	Menus		S					P								
3.1.2	Data Entry Screens		S					P								
3.1.3	Periodic Reports					P	S						S			
3.1.4	Ad Hoc Queries					S	P						S			
3.2	Processing & Database											P			S	S
3.3	Evaluation	S	S	S					P							
3.4	Prepare Report									P	S					
4	**System Development**			S							P	S	S			
4.1	Software										P	S	S	S		
4.1.1	Packaged Software										P	S	S	S		
4.1.2	Customized Software											S	S	P		
4.2	Hardware							S				P				
4.3	Network												P			
4.4	Prepare Report			P												
5	**Testing**				S									P	S	S
5.1	Software					S	S							P		
5.2	Hardware											S	S		P	
5.3	Network								S		S					P
5.4	Prepare Report				P									S	S	S
6	**Implementation**	P	S	S												
6.1	Training		P								S		S			
6.2	System Conversion	P									S		S			
6.3	Prepare Report	S	S	P												

KEY: P = Primary responsibility; S = Support responsibility.

IS Example: Resource Requirements

FIGURE 6.14 Resource Requirements for Web-based Reporting System Project

RESOURCE NAME	ACTIVITIES	ACTIVITY WORK HOURS	TOTAL WORK HOURS	PERIOD
Beth	1.1 Gather Data	24	72	1–3
	1.3 Prepare Problem Definition Report	8		55–56
	3.3 Evaluation	16		5
	6.2 System Conversion	16		31–32
	6.3 Prepare Implementation Report	8		59
Jim	1.1 Gather Data	24	192	16
	2.1 Interview Users	40		6–10
	2.4 Prepare Systems Analysis Report	8		16
	3.1.1 Menus	32		17–20
	3.1.2 Data Entry Screens	32		21–24
	3.3 Evaluation	16		31–32
	6.1 Training	32		55–58
	6.3 Prepare Implementation Report	8		59
Jack	1.2 Study Feasibility	32	72	1–4
	3.3 Evaluation	16		31–32
	4.4 Prepare Software Development Report	16		50–51
	6.3 Prepare Implementation Report	8		59
Rose	1.3 Prepare Problem Definition Report	8	56	55–56
	2.1 Interview Users	40		6–10
	5.4 Prepare Testing Report	8		33
Steve	1.2 Study Feasibility	32	208	1–4
	2.2 Study Existing System	64		6–13
	3.1.3 Periodic Reports	32		17–20
	3.1.4 Ad Hoc Queries	32		21–24
	5.1 Software Testing	48		48–53
Jeff	1.2 Study Feasibility	32	184	1–4
	2.3 Define User Requirements	40		11–15
	3.1.3 Periodic Reports	32		17–20
	3.1.4 Ad Hoc Queries	32		21–24
	5.1 Software Testing	48		48–53
Tyler	3.1.1 Menus	32	144	16
	3.1.2 Data Entry Screens	32		21–24
	4.2 Hardware Development	80		31–40
Cathy	1.2 Study Feasibility	32	80	1–4
	3.3 Evaluation	16		31–32
	5.3 Network Testing	32		48–51
Sharon	1.2 Study Feasibility	32	48	1–4
	3.4 Prepare Systems Design Report	16		29–30
Hannah	2.1 Interview Users	40	136	6–10
	3.4 Prepare Systems Design Report	16		29–30
	4.1.1 Packaged Software	16		31–32
	5.3 Network Testing	32		48–51
	6.1 Training	32		55–58

FIGURE 6.14 (*Continued*)

RESOURCE NAME	ACTIVITIES	ACTIVITY WORK HOURS	TOTAL WORK HOURS	PERIOD
Joe	3.2 Processing & Database	80	192	17–26
	4.2 Hardware Development	80		31–40
	5.2 Hardware Testing	32		48–51
Gerri	1.1 Gather Data	24	200	1–3
	3.1.3 Periodic Reports	32		17–20
	3.1.4 Ad Hoc Queries	32		21–24
	4.3 Network Development	48		31–36
	5.2 Hardware Testing	32		48–51
	6.1 Training	32		55–58
Maggie	2.1 Interview Users	40	216	6–10
	4.1.1 Packaged Software	16		31–32
	4.1.2 Customized Software	104		33–45
	5.1 Software Testing	48		48–53
	5.4 Prepare Testing Report	8		54
Gene	3.2 Processing & Database	80	120	17–26
	5.2 Hardware Testing	32		48–51
	5.4 Prepare Testing Report	8		54
Greg	3.2 Processing & Database	80	120	17–26
	5.3 Network Testing	32		48–51
	5.4 Prepare Testing Report	8		54
Training materials	6.1 Training			55–58
Packaged software	4.1.1 Packaged Software			31–32
Travel	2.1 Interview Users			6–10
		2,040	2,040	

Project Management Information Systems

- Handle resource considerations within a project
- Create and maintain a list of resources
- Store availability, rate, and costs for resources
- Assign resources and calculate cost
- Assign calendar to record availability
- Resolve overallocations for best solution

Critical Success Factors

- **Resources can constrain the project schedule** because the quantities of various types of resources available to perform the project activities may be limited.
- It is necessary **to estimate the types and quantities** of resources required to perform each activity.
- If sufficient resources are not available when required, some activities **may have to be delayed** until a later time when resources become available to perform the activities.
- **Resource leveling**, or smoothing, is a method for developing a schedule that attempts to minimize the fluctuations in requirements for resources. It levels the resources so that they are **applied as uniformly as possible** without extending the project schedule beyond its required completion time.
- **Resource-limited scheduling** is a method for developing the shortest schedule when the quantity of resources is fixed. It **will extend the project** completion time if necessary.

Summary

- The consideration of resources adds another dimension to planning and scheduling; resources can constrain a project.
- Resources can include people, materials, equipment, tools, facilities, and other crucial elements to a project.
- A resource requirements plan illustrates the expected utilization of resources by time period during the time span of the project.
- Resource leveling, or smoothing, is a method for developing a schedule that attempts to minimize the fluctuations in requirements for resources when the project completion time is fixed.
- Resource-limited scheduling is a method for developing the shortest schedule when the quantity of available resources is fixed, and may extend the project completion time in order to keep within the resource limits.