Managing Service Projects

Learning Objectives

- Describe the nature of project management.
- Illustrate the use of a Gantt chart.
- Construct a project network.
- Perform critical path analysis on a project network.
- Allocate limited resources to a project.
- Crash activities to reduce the project completion time.
- Analyze a project with uncertain activity times.
- Use the earned value chart to monitor a project.
- Discuss the reasons why projects fail to meet performance, time, and cost objectives.

The Nature of Project Management

- Characteristics of projects: purpose, life cycle, interdependencies, uniqueness, and conflict.
- Project management process: planning (work breakdown structure), scheduling, and controlling.
- Selecting the project manager: credibility, sensitivity, ability to handle stress, and leadership.
- Building the project team: forming, storming, Norming, and performing.
- Principles of effective project management: direct people individually and as a team, reinforce excitement, keep everyone informed, manage healthy conflict, empower team, encourage risk taking and creativity.
- Project metrics: cost, time, performance.

Work Breakdown Structure

- 1.0 move the hospital (project)
  1.1 move patients (task)
  1.1.1 arrange for ambulance (subtask)
- 1.1.1.1 prepare patients for move
  1.1.1.2 box patients personnel effects
  1.2 move furniture
  1.2.1. Contract with moving company

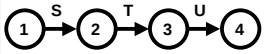
Project Management Questions

- What activities are required to complete a project and in what sequence?
- When should each activity be scheduled to begin and end?
- Which activities are critical to completing the project on time?
- What is the probability of meeting the project completion due date?
- How should resources be allocated to activities?

Activity Relationships

Activity Relationship

S precedes T, which precedes U.

AOA	AON
	

Activity Relationships

Activity Relationship

S and T must be completed before U can be started.

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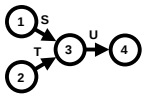
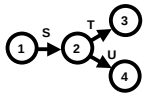
	

Activity Relationships

Activity Relationship

T and U cannot begin until S has been completed.

AOA	AON
	

Activity Relationships

Activity Relationship

U and V cannot begin until both S and T have been completed.

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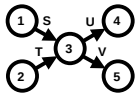	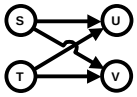

Activity Relationships

Activity Relationship

U cannot begin until both S and T have been completed; V cannot begin until T has been completed.

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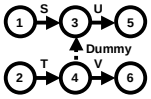	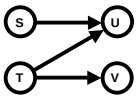

Activity Relationships

Activity Relationship

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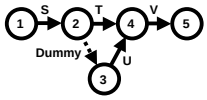
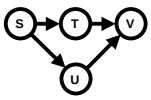
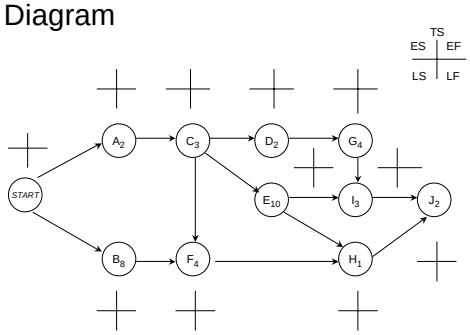
	

An Easy Example

Tennis Tournament Activities

ID	Activity Description	Network Node	Immediate Predecessor	Duration (days)
1	Negotiate for Location	A	-	2
2	Contact Seeded Players	B	-	8
3	Plan Promotion	C	1	3
4	Locate Officials	D	3	2
5	Send RSVP Invitations	E	3	10
6	Sign Player Contracts	F	2,3	4
7	Purchase Balls and Trophies	G	4	4
8	Negotiate Catering	H	5,6	1
9	Prepare Location	I	5,7	3
10	Tournament	J	8,9	2

Tennis Tournament Activity on Node Diagram



Notation for Critical Path Analysis

Item	Symbol	Definition
Activity duration	*t*	The expected duration of an activity
Early start	*ES*	The earliest time an activity can begin if all previous activities are begun at their earliest times
Early finish	*EF*	The earliest time an activity can be completed if it is started at its early start time
Late start	*LS*	The latest time an activity can begin without delaying the completion of the project
Late finish	*LF*	The latest time an activity can be completed if it is started at its latest start time
Total slack	*TS*	The amount of time an activity can be delayed without delaying the completion of the project

Scheduling Formulas

$$ES = EF\ (predecessor)\ \ (max) \qquad (1)$$

$$EF = ES + t \qquad (2)$$

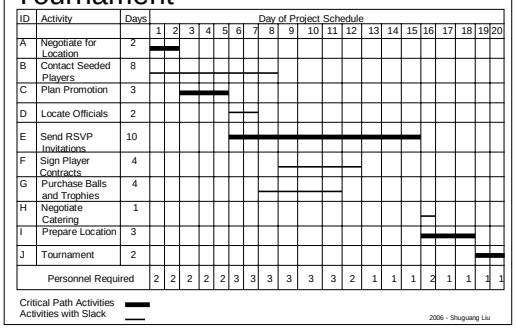
$$LF = LS\ (successor)\ \ (min) \qquad (3)$$

$$LS = LF - t \qquad (4)$$

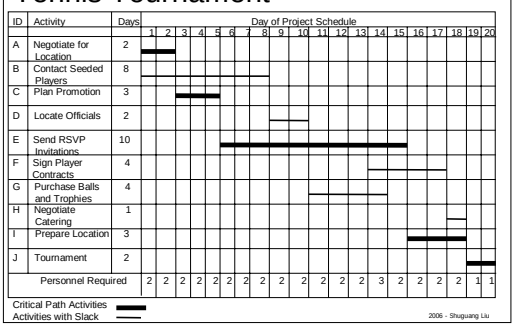
$$TS = LF - EF \qquad (5)$$

$$\text{or} \quad TS = LS - ES \qquad (6)$$

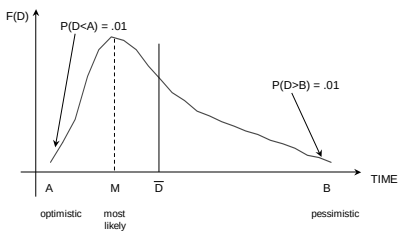
Early Start Gantt Chart for Tennis Tournament



Resource Leveled Schedule for Tennis Tournament



Incorporating Uncertainty in Activity Times



Formulas for Beta Distribution of Activity Duration

Expected Duration

$$\bar{D} = \frac{A + 4M + B}{6}$$

Variance

$$V = \left[\frac{B - A}{6}\right]^2$$

Note: (B - A)= Range or 6σ

Activity Means and Variances for Tennis Tournament

Activity	A	M	B	$\bar{D}$	V
A	1	2	3		
B	5	8	11		
C	2	3	4		
D	1	2	3		
E	6	9	18		
F	2	4	6		
G	1	3	11		
H	1	1	1		
I	2	2	8		
J	2	2	2		

Uncertainly Analysis

Assumptions

1. Use of Beta Distribution and Formulas For D and V
2. Activities Statistically Independent
3. Central Limit Theorem Applies (Use "student t" if less than 30 activities on CP)
4. Use of Critical Path Activities Leading Into Event Node

Result

Project Completion Time Distribution is Normal With:

$\mu = \sum \bar{D}$ For Critical Path Activities

$\sigma^2 = \sum V$ For Critical Path Activities

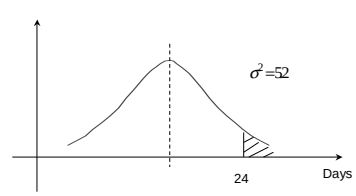
Completion Time Distribution for Tennis Tournament

Critical Path Activities	D	V
A	2	4/36
C	3	4/36
E	10	144/36
I	3	36/36
J	2	0

μ = 20 188/36 = 5.2 = σ^2

Question

What is the probability of an overrun if a 24 day completion time is promised?



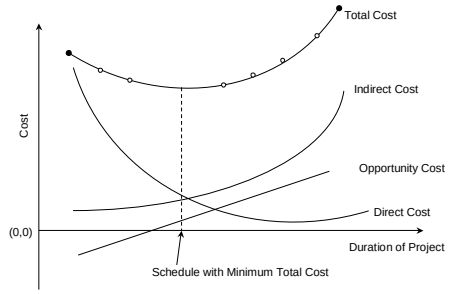
$$Z = \frac{X - \mu}{\sigma}$$

$$Z = \frac{24 - 20}{\sqrt{5.2}}$$

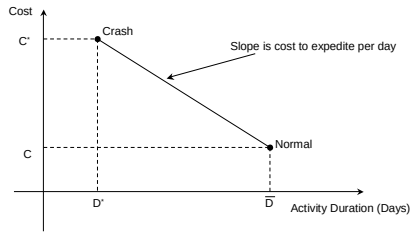
$$Z = 1.75$$

P (Time > 24) = .5 - .4599 = .04 or 4%

Costs for Hypothetical Project



Activity Cost-time Tradeoff



Cost-time Estimates for Tennis Tournament

	Time Estimate		Direct Cost		Expedite Cost
Activity	Normal	Crash	Normal	Crash	Slope
A	2	1	5	15	
B	8	6	22	30	
C	3	2	10	13	
D	2	1	11	17	
E	10	6	20	40	
F	4	3	8	15	
G	4	3	9	10	
H	1	1	10	10	
I	3	2	8	10	
J	2	1	12	20	
			Total	115	

Progressive Crashing

Project Duration	Activity Crashed	Direct Cost	Indirect Cost	Opportunity Cost	Total Cost
20	Normal	115	45	8	168
19		41	41	6	
18		37	37	4	
17		33	33	2	
16		29	29	0	
15		25	25	-2	
14		21	21	-4	
13		17	17	-6	
12		13	13	-8	

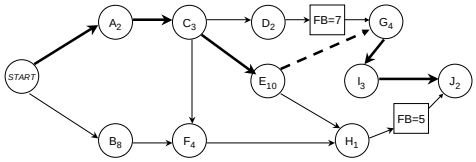
Project Paths	Normal Duration		Duration After Crashing Activity	
A-C-D-G-I-J	16			
A-C-E-I-J	20			
A-C-E-H-J	18			
A-C-F-H-J	12			
B-F-H-J	15			

Applying Theory of Constraints to Project Management

- Why does activity safety time exist and is subsequently lost?
  1. The "student syndrome" procrastination phenomena.
  2. Multi-tasking muddles priorities.
  3. Dependencies between activities cause delays to accumulate.
- The "critical chain" is the longest sequence of dependent activities and common (contended) resources.
- Measure project progress as % of critical chain completed.
- Replacing safety time with buffers
  - feeding buffer (FB) protects the critical chain from delays.
  - Project buffer (PB) is a safety time added to the end of the critical chain to protect the project completion date.
  - Resource buffer (RB) ensures that resources (e.G. Rental equipment) are available to perform critical chain activities.

Accounting for Resource Contention Using Feeding Buffer

NOTE: E and G cannot be performed simultaneously (same person)

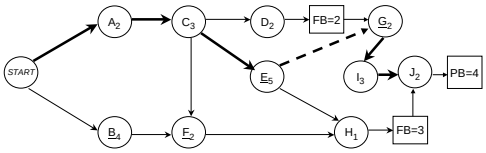


Set feeding buffer (FB) to allow one day total slack

Project duration based on Critical Chain = 24 days

Incorporating Project Buffer

NOTE: Reduce by ½ all activity durations > 3 days to eliminate safety time



Redefine Critical Chain = 17 days

Reset feeding buffer (FB) values

Project buffer (PB) = ½ (Original Critical Chain-Redefined Critical Chain)

Sources of Unexpected Problems

Cost	Time	Performance
• Difficulties require more resources • Scope of work increases • Initial bids or estimates were too low • Reporting was poor or untimely • Budgeting was inadequate • Corrective control was not exercised in time • Price changes of inputs	• Delay owing to technical difficulties • Initial time estimates were optimistic • Task sequencing was incorrect • Required resources not available as needed • Necessary preceding tasks were incomplete • Client-generated changes • Unforeseen government regulations	• Unexpected technical problems arise • Insufficient resources are available • Insurmountable technical difficulties • Quality or reliability problems occur • Client requires changes in specifications • Complications with functional areas • A technological breakthrough occurs

Earned Value Chart

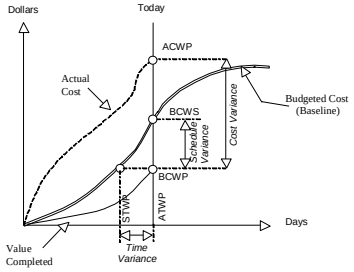


Figure 16.17 Earned Value Chart

Topics for Discussion

- Give an example that demonstrates trade-off inherent in projects among cost, time, and performance.
- Illustrate the four stages of team building from your own experience.
- Are Gantt charts still viable project management tools? Explain.
- Explain why the PERT estimate of expected project duration is always optimistic.
- What purpose does a project history report serve?
- Discuss the differences among time variance, cost variance, and schedule variance.

Interactive Exercise

- Prepare a work breakdown structure (WBS) for a homecoming dance.