Chapter Six

Project Management

Definition

- What is project?
- well defined set of jobs or tasks which must be completed to finish the project.

Example

- Construction of bridge
- Construction of high ways
- Construction of power plants
- Repair and maintenance
- Design, development, and marketing of new product
- Research and development work

- Project involves large number of interrelated activities which must be completed in specified time in specified sequence and require resources such as personnel, money, material, facilities and or space
- complete it on or before specified time limit at a minimum cost of its completion.

The basic differences and similarities of PERT and CPM

Similarities

- Determination of critical path
- Based on network representation
- Determine the most critical activities to be controlled

Differences

PERT

- Assumes probability distribution
- Emphasises completion
- Used for one time, non repetitive projects
- Helps in identifying critical areas in a project so that necessary adjustment can be made to meet scheduled completion time

CPM

- Assumes duration of activities is known with certainty
- Optimum balancing between scheduled time and cost
- Used for activities of repetitive nature
-

CPM/PERT components

- Events
  - Start or completion of an activity
  - Occur at a particular instance of time
  - Do not consume resource
- There can be different types of events
  - Merge events
- An event which represent joint completion of more than one activity
  - Burst events
- Events which represent start of more than one activity

Activities

- Activities consume time and resource & Are denoted by an arrow with the direction of the arrow showing the progress of the project
- Activities can be classified as:
  - Predecessor activity- it is an activity which must be completed before one or more activities:
  - Successor activity- it is an activity which starts immediately after one or more other activities are completed.
  - Dummy activity- dummy activity is an activity that does not consume any resource/time.
    - A dummy activity is denoted by dotted line in s network diagram

Types of precedence network

- Activity on Node (AON) network- in this type of precedence network each node represents specific task while the arcs represent the ordering between tasks.
- Activity on Arrow (AOA) network –in this type of precedence diagram, at each end of the arrow is node (circle). The nodes represent a point in time when the activity is started or completed. The arrow shows the passage of time required for that activity to be completed.

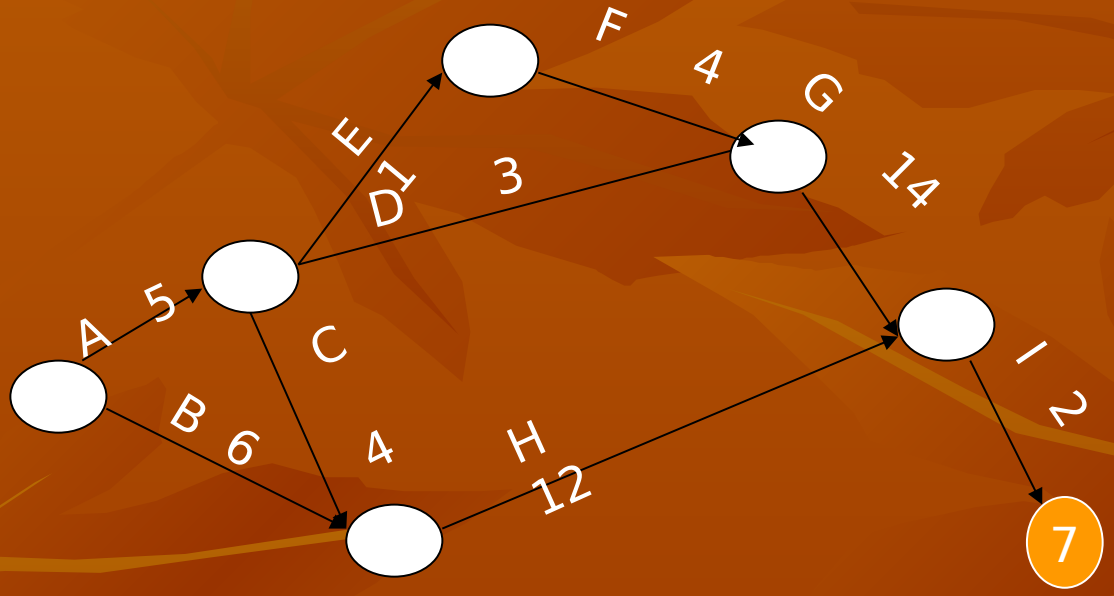
Errors in network

- Looping- cycling network is impossible.
- Dangling – all activities must have starting and ending events. All activities of a project must lead to the last event (completion of the project)

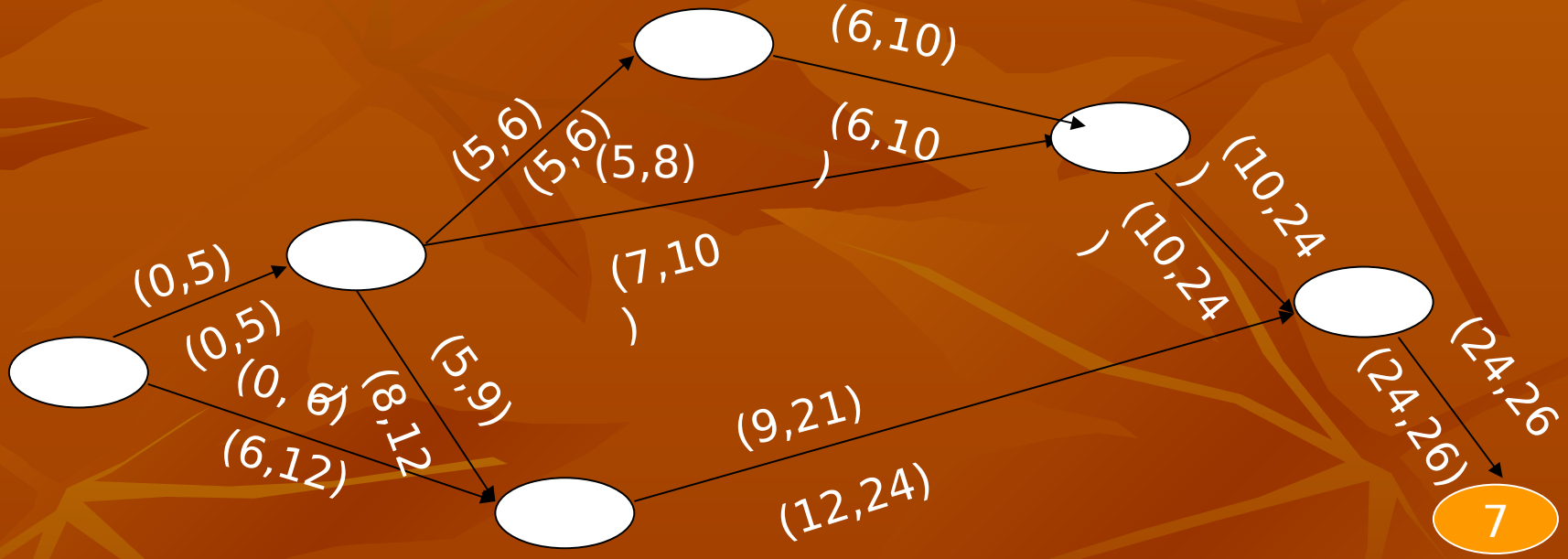
Consider the following Example

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Illustration



Es EF time calculations



Alternative paths

- Path duration
- A-E-F-G-I 26 days
- ADGI 24 days
- ACHI 23 days
- BHI 20 days

When should the activities be started and completed?

Activity	Es	Ef	Ls	Lf	slack
A	0	5	0	5	0
B	0	6	6	12	6
C	5	9	8	12	3
D	5	8	7	10	2
E	5	6	5	6	0
F	6	10	6	10	0
G	10	24	10	24	0
H	9	21	12	24	3
I	24	26	24	26	0

SLACK

- Show for how long an activity can be delayed.
- Slack= Ls- Es

  = Lf - Ef

Probabilistic time estimate

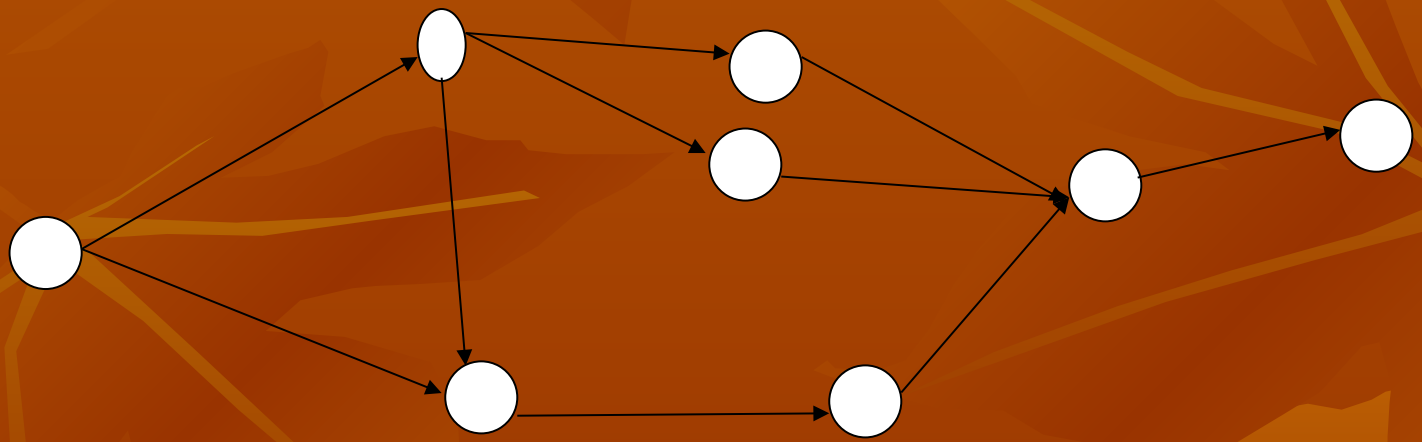
- What happens if activity time are not known and are subject to variation?
- This needs a probabilistic approach which involves three time estimates.
  - Optimistic time
  - Pessimistic time
  - Most likely time
- This time estimates must be given by managers or other experts.

Probabilistic time estimate (cont'd)

- The expected is computed as the average of the three time estimates
- $Te = \frac{a + 4m + b}{6}$
- $\text{Variance} = \left[\frac{(b-a)}{6}\right]^2$
- The size of the variance shows the degree of uncertainty associated with an activity's

Cont’d

- Consider the following example
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SOLUTION

Activities		expected time	variance
A	6	1.78	
B	2		0.44
C	3	0.11	
D	5	1.78	
E	3	0.11	
F	2	0.03	
G	3	0.25	
H	4	0.69	
I	2	0.03	
J	2	0.11	

Variance of each paths

Paths	Variances
A- C- F-J	2.25
A-D-G-J	3.92
A-E-H-I-J	2.72
B-H-I-J	1.27

Crashing activities

- CPM provides the project managers with the option of adding resources to the selected activities to reduce project completion time.
- The resources to be added can be workers, overtime work…..
- Adding additional resource generally adds cost and reduces completion time.

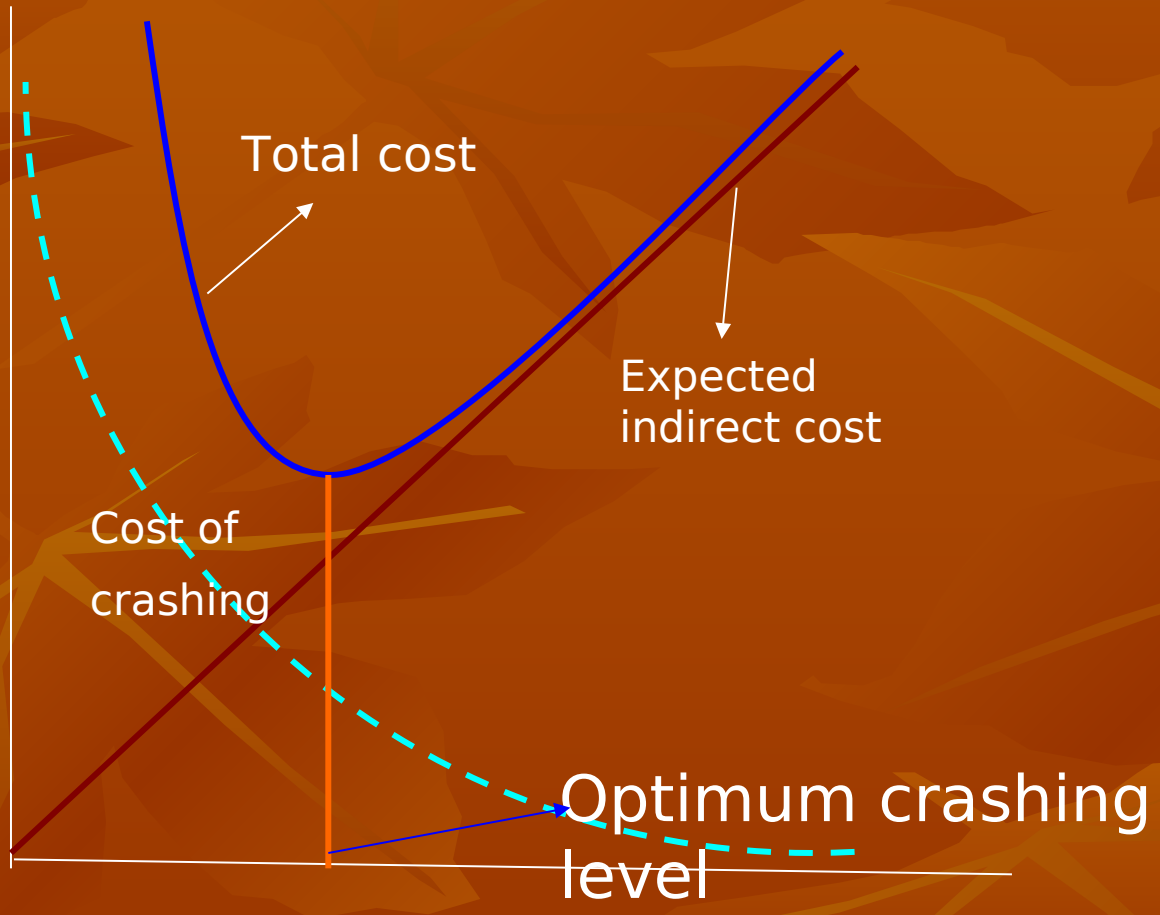
Why project managers opt to reduce project durations

- To avoid penalties
- To take advantage of monetary incentives for timely completion of a project
- To free resources for use on other projects

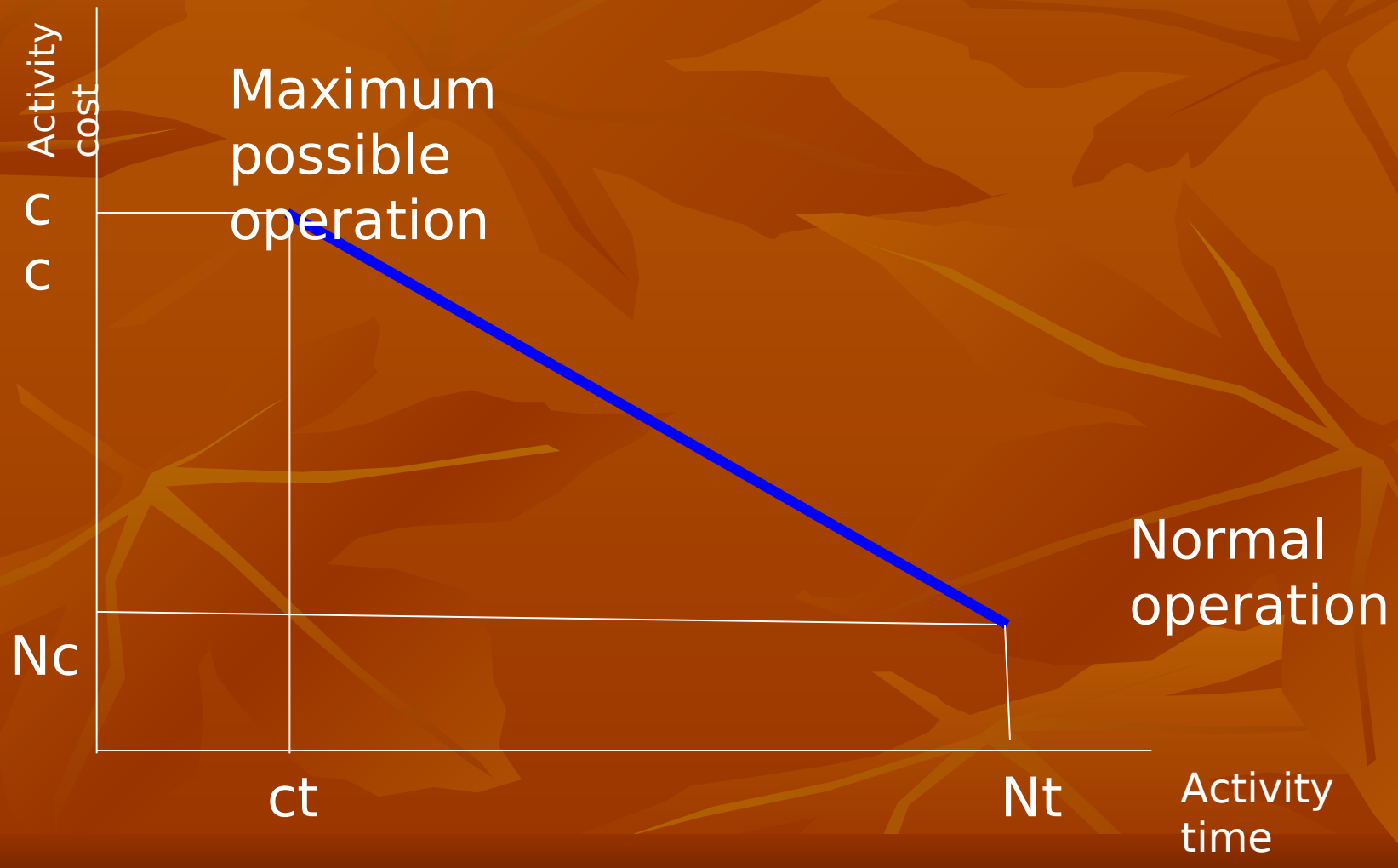
Information needed to make crashing

- Regular time and crash time
- Regular cost and crash cost estimates for each activity
- A list of activities on the critical path

Relationship between project duration and cost



Crashing cost per day



Crashing cost per day

- Slope = vertical change divided by horizontal change

  = (Cc - Nc)/(Ct - Nt)

Example

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Wrap up

- Take a piece of paper
- Write at least three strengths of the course (operations Research)
- Write at least three negative aspects of the course
- Write at least three strengths of the instructor
- Write at least three things you liked about me.