PANA ACADEMY

NEPAL ENGINEERING COUNCIL

LICENSE EXAMINATION PREPARATION COURSE
FOR
CIVIL ENGINEERS
ON

Project planning and scheduling

PANA ACADEMY

10.3 Project Planning and Scheduling

- Project classifications
- Project life cycle phases
- Project planning process
- Project scheduling (bar chart, CPM, PERT)
- Resources levelling and smoothing
- Monitoring/evaluation/controlling.

PANA ACADEMY

Project Definition

Project :

Project is the set of interrelated time bound activities carried out to achieve certain specific objectives with limited resource available.

Every project idea to be successful must be technically feasible, economically viable, Politically suitable and socially acceptable.

Eg:

- Construction of building
- Research and Development
- Running campaign for a political party

Project Characteristics

a) A defined (Specific) goal or objectives- SMART

b) Temporary

c) Constraints

d) Unique

e) Specific Task, not routinely performed

f) Team Work

g) Rapid Expenditure

h) Risk and Uncertainties

i) Planning and Control

j) Defined Deliverables

k) Contracting and Subcontracting

Project Classification

A. According to funding

a. Private sector project:

Private sector responsible for development and sponsorship of project.
Eg: Khimti Hydropower, Kathmandu Mall

b. Government sector project:

Government responsible for development of projects
Eg: Highways, Irrigation, Immunization projects

c. Grant projects

Projects in which investment in project is not repaid by the government to Donors.
Eg: Projects under MCC

d. Loan projects

Projects in which the investments are repaid back to the donor agencies
Eg: Bhairahawa International Airport (Gautam Buddha International Airport)

Project Classification

B. According to the nature of foreign investment

a. Joint Venture Project:

Project funded through collaboration of foreign and local investors. Two or more than two parties are involved in a project.

Note: for Domestic JV , two or more domestic investors can collaborate

Eg: Maruti-Suzuki, Nepal SBI Bank

b. Bilateral Project:

Project financed from the financial resources of friendly donor countries like USAID, KOIKA etc.

Eg: ICTC Building of IOE (By KOIKA)

c. Multilateral Project :

Project financed from the financial resources of multilateral donors like ADB, World Bank, EU, etc.

Eg: Reconstruction of School Buildings after Earthquake in Bagmati, Mahendra Highway Improvement Project

Project Classification

C. According to Techniques

a. Labor intensive projects

Projects in which human forces are used extensively.

Eg: Water Supply Project of Dharan Sub-Metro

b. Capital Intensive Project

Projects in which technology represented by machinery, automation and computerization is used extensively.

Eg: Bheri-Babai Diversion Project (using TBM)

D. According to functions:

a. Disaster Prevention Projects
b. Development Projects
c. Service Sector Projects
d. Environment Friendly Projects

Project Classification

E. According to Orientation:

a. Product Oriented

Project whose priority is development of the product.
Eg: Buildings, Manufacturing industry

b. Process oriented

Project which is more focused on process or work rather than building product
Eg: Immunization Programme, Trainings etc.

F. According to Scale and Size

a. Mega

- Complex project
- Large investment
- Long duration (5 to 10 years)
- Eg: Upper Tamakoshi Project, Puspalal Lokmarga

PANA ACADEMY

Project Classification

F. According to Scale and Size

b.Major Project

Smaller and less complex than mega project
Eg: Middle Marsyangdi Hydropower

c. Medium Project

Smaller and less complex than major project
Eg: Gwarko Flyover construction

d. Small Project

Project of short duration and small investment
Eg: Biogas plant construction

G. According to time frame

a. Normal Project

Project completed in normal time frame

b. Crash Project

Project in which saving in time is achieved by crashing the project but with increased cost

Project Life Cycle

- Project is temporary in nature, so it has certain beginning and end
- Project has to go through various phases , which we call the Project Life Cycle Phases
- Following are the phases of the project life cycle

A. Initiation Phase

It is starting phase and consists of following:

A.1 Conceptual Study:

- It is the initiation of project and consists of formation of creative ideas

A.2 Feasibility Study:

- Feasibility of the project is studied under this phase whether the project is worthy of investment or not

A.3 Market Study:

- In addition to feasibility study, the market study helps to analyze the real scenario of demand and supply

Project Life Cycle

B. Planning phase

B.1 Work Breakdown Structure:

- The major works to be done are identified and divided into smaller units so that the

B.2 Cost and Schedule Planning:

- After breaking down the work, the cost and schedules for each work are calculated.

B.3 Contract terms and conditions

The type of contract to be used is determined in this phase.

PANA ACADEMY

Project Life Cycle

C. Engineering and design

C.1 Preliminary engineering and design

The preliminary concepts of engineering are solved in this phase.

For eg: In case of building, the architectural design , overall layout of the compound etc. are fixed.

C.2 Detailed engineering and design

The detailed concepts of engineering are solved in this phase.

For eg: In case of building, the detailed analysis , detailed cost estimation, etc. are fixed

D Implementation phase

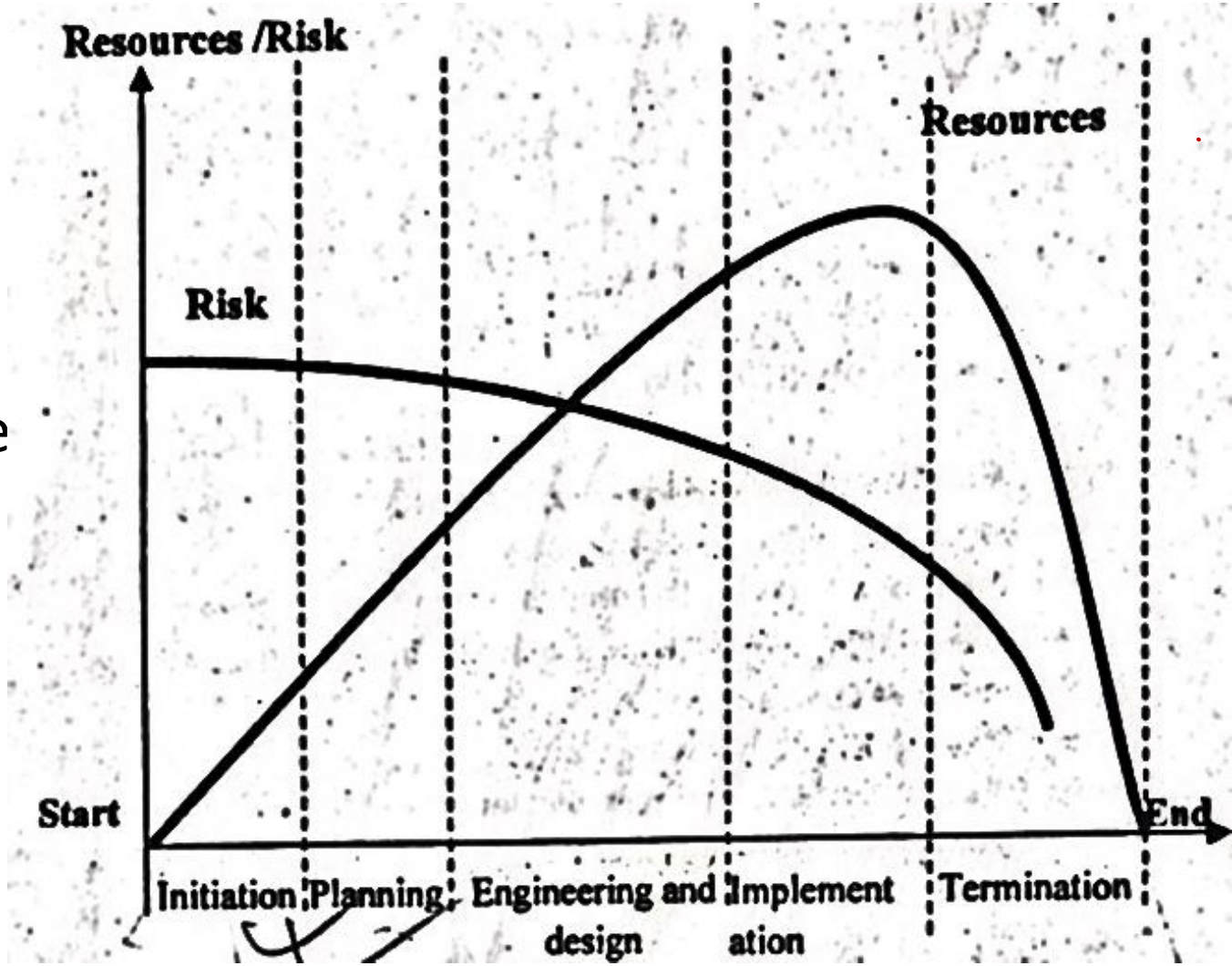
- Consists of actual work
- Monitoring, evaluation and control are done
- The project is completed in this phase

PANA ACADEMY

Project Life Cycle

E. Termination phase/ Divestment / Phase out

- Indicates end of the project
- Overall evaluation of project is done
- Handed over to the beneficiaries
- Resources are transferred to other projects



Project Planning Process

- Planning is thinking ahead of an operation
- Deciding in advance about what to do, how to do, when to do and who is to do it. It provide the end to be achieved.

Importance of project planning:

- Makes objectives clear
- Helps in co-ordination
- Helps in making the project economical
- Helps to reduce the risks
- Helps in controlling and taking corrective actions
- Helps in decision making

PANA ACADEMY

Elements of project planning process
(what is done in project planning?)

- Setting out of the objectives
- Determining the source for project financing , Capital planning and Budgeting
- Managing the resources (money, manpower, machinery, material, minute)
- Scheduling the project
- Setting standards for monitoring, evaluation and control
- Project risk analysis and risk management

PANA ACADEMY

Scheduling

- Scheduling:
  - Deals with allocation of resources to activity with respect to time

  - A schedule is a graphical representation which shows the starting and completion dates of each activity and the sequential relationship among the various activities.

Why Schedule?

- To predict the project completion time and activity completion time
- To control financing and payment
- To serve as a record.
- To support delay claim.
- To manage damage and uncertainties

Note: Work Breakdown Structure is necessary before the project scheduling

Methods of scheduling

- **The Most commonly used methods are :-**
  - **Bar Chart / Gantt Chart**
  - **Milestone chart**
  - **Linked Bar chart**

Network Diagrams

- **Critical Path Method (CPM)**
- **Project Evaluation and Review Technique (PERT)**

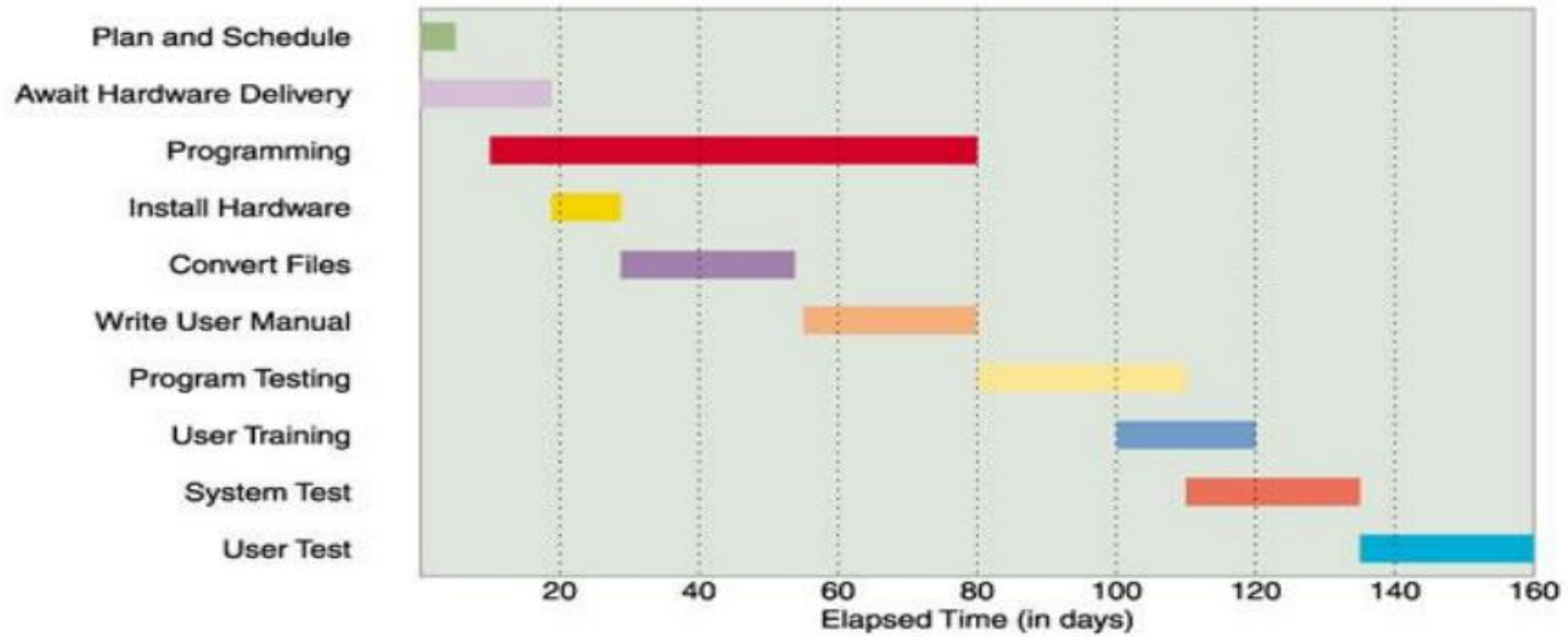
PANA ACADEMY

GANTT CHART

- Developed by Henry Gantt around 1900 AD. (Earliest Method)
- A graphical representation of a Project that shows each task as a horizontal bar whose length is proportional to its time for completion.
- In the GANTT Chart Time is displayed on the horizontal axis and the Tasks/ Activities are arranged vertically from top to bottom, in order of their start dates.
- A detailed GANTT Chart for a large project might be quite complex and hard to understand. To simplify the chart Project manager can combine related activities into one Task

PANA ACADEMY

3.2 Gantt Chart/Bar Chart



PANA ACADEMY

Advantage and Disadvantage of Bar Chart

Advantage:

1. Simple to understand
2. Easy to prepare
3. It can be used to show progress
4. It can be used for resource planning such as manpower, materials and budget
5. It gives clear pictorial model of project

Dis-advantage

1. Physical limit in size of bar chart
2. Cannot be used as control device for large projects
3. The sequence of activities is not clearly defined
4. Uncertainties in activities can not be clearly forecasted
5. Critical activities and float can not be shown

PANA ACADEMY

Mile stone chart (1940)

- Mile stone chart is a modification over bar chart/Gantt chart where important events are identified. Beginning and end of such-activities are called mile-stones. It is usually represented by using triangle

- It can also be represented by circle, squares

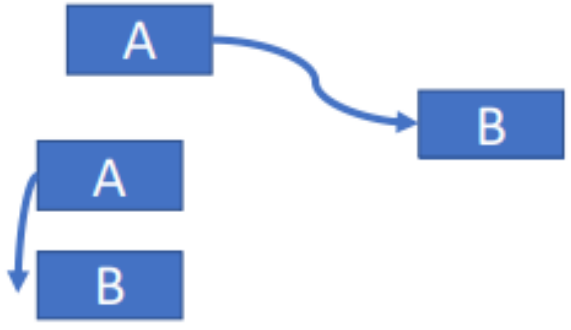
- It can mark specific points in the project where checks can be made to see whether the project is on time or not (e.g. In building milestone points can be laying foundation stone, concreting in foundation etc.)

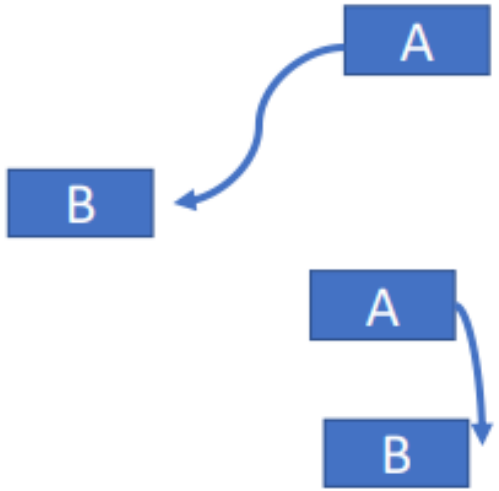
Linked bar chart

- One of the main drawback of simple Gantt/Bar chart is that it does not show the inter-relation ship between activities
- Linked bar chart are used to show the relationship between activities

Types

a) Finish to start
b) Start to start
c) Start to finish
d) Finish to finish

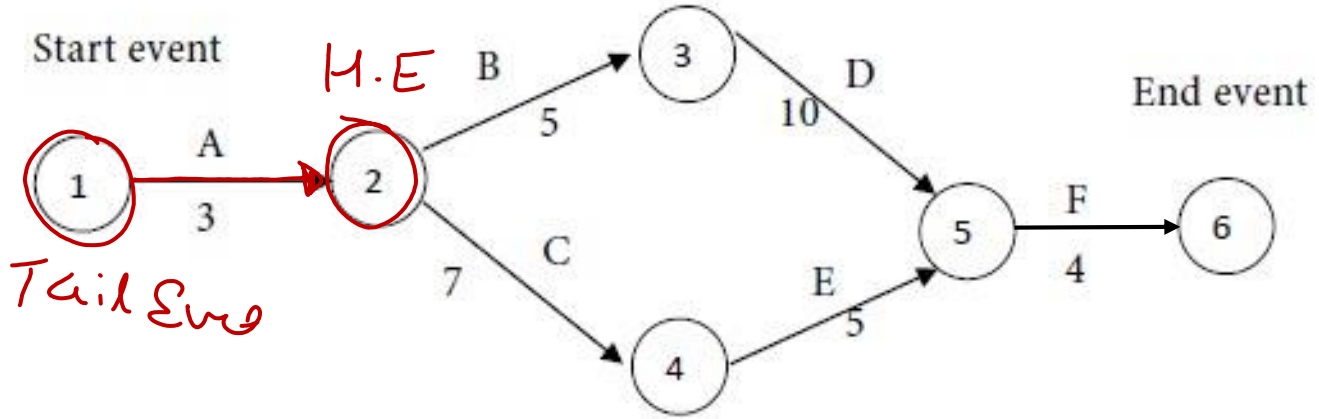




PANA ACADEMY

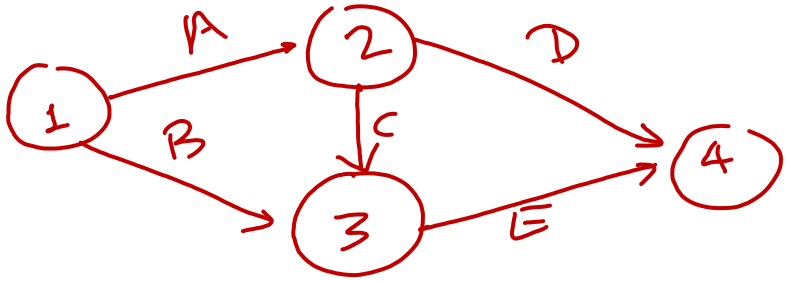
NETWORK DIAGRAM

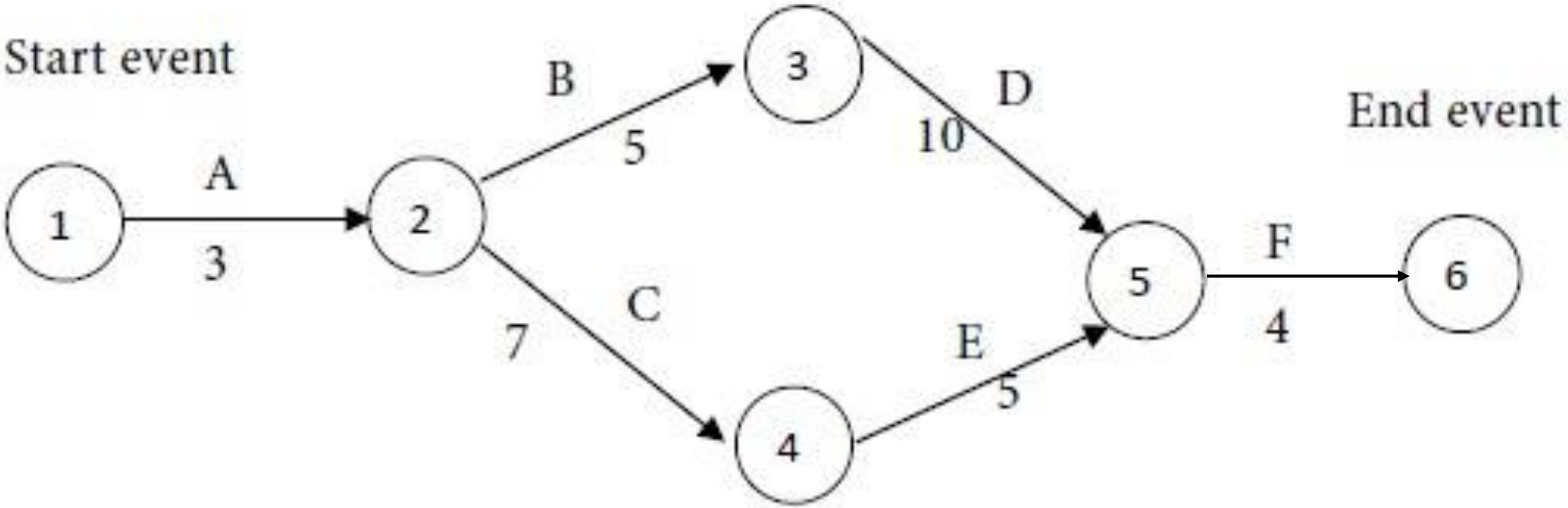
- Is a graphical depiction of Project tasks and their inter-relationships.
- The distinguishing feature of a Network Diagram is that the ordering of Tasks is shown by connecting with its predecessor and successor tasks



PANA ACADEMY

NETWORK DIAGRAM



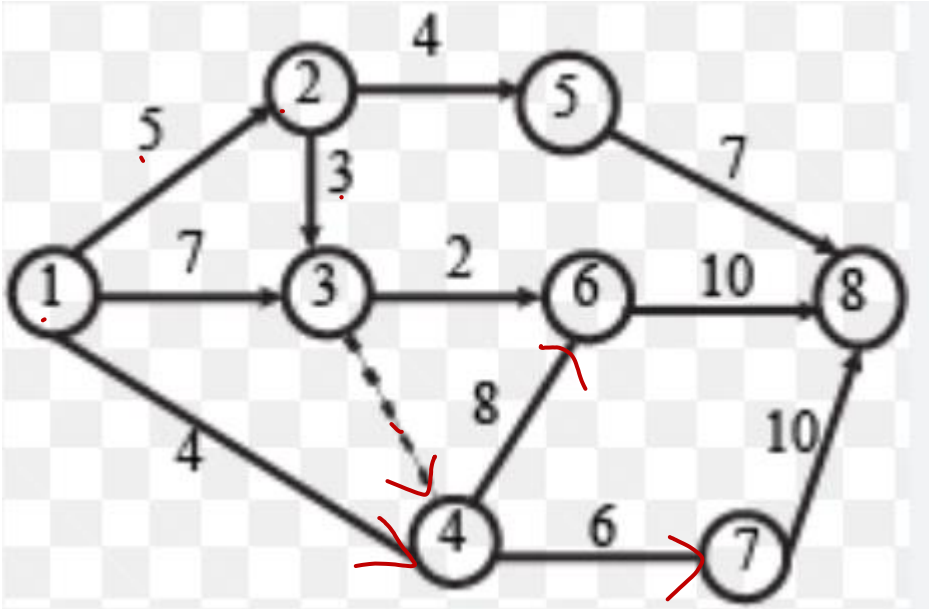


PANA ACADEMY

NETWORK DIAGRAM

Fulkerson's rule :

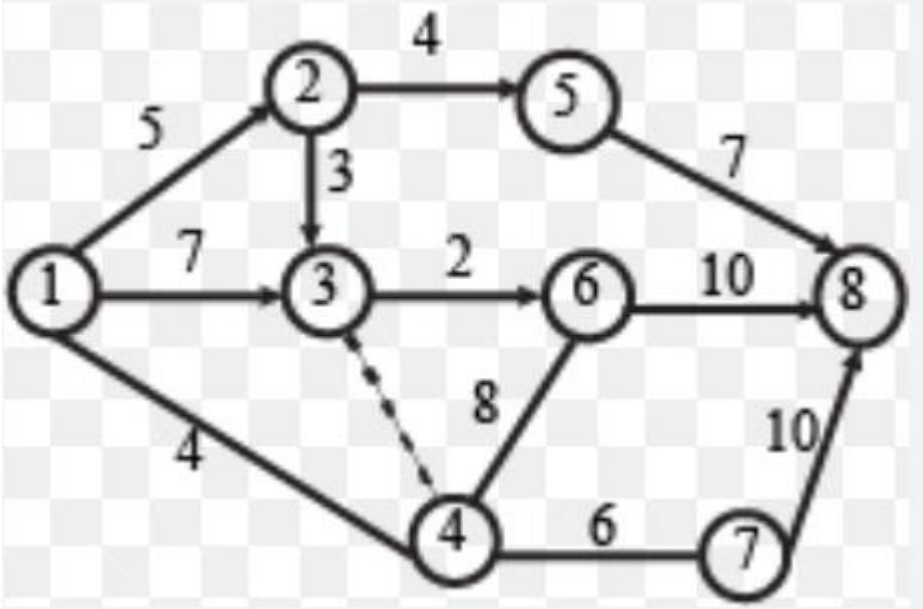
- In network diagram, the nodes and arrows are used to depict the events and activities respectively.
- This rule states that "For any activity, the number on the Tail Event should not be greater than that on the Head Event."



PANA ACADEMY

Fulkerson's Rule for Numbering Events

1. Number the starting event by 1.
2. Delete all arrows emerging from all numbered events. This will create at least one new starting event out of the preceding ones.
3. Number all the new events by 2,3, and so on.
4. Repeat steps 2 and 3 until the final event is numbered.



PANA ACADEMY

Critical Path Method

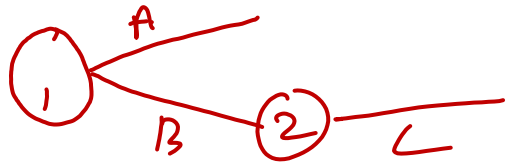
- Devoloped by Margon R. Walker of DU Pont & James E Kelly of Rand Corporation in 1957
- Useful in identification of the critical activities (i.e., the ones whose delay necessarily delay the project).
- Useful in identification of the non-critical activities, and the amount of slack time available when scheduling these activities.

Two forms of Network Diagram:

a. Activity on arrow
b. Activity on node

PANA ACADEMY

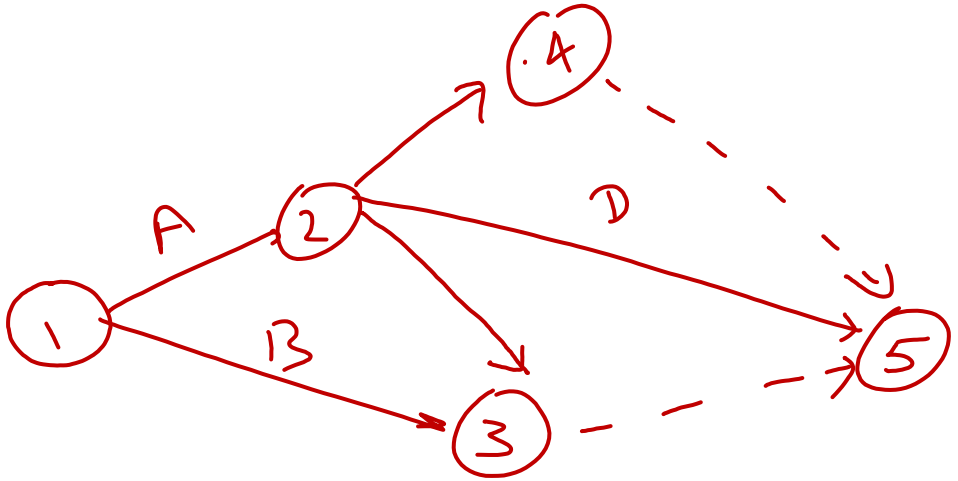
Some definitions



- **Activity** – an effort (task) that requires resources and takes a certain amount of time.
  - Concurrent Activities
  - Serial Activities
- **Activity Duration**
- **Event (Node/ Connector)** – a specific accomplishment or milestone (the start or finish of an activity). It represents specific point in time and does not consume resources.
- **Critical Activity** – an activity that if delayed will hold up the scheduled completion of a project.
- **Critical Path** – the sequence of critical activities that forms a continuous path from the start of a project to its completion.
- **Dummy Activity** – It is an imaginary activity included in a network. It is represented by dotted arrow.

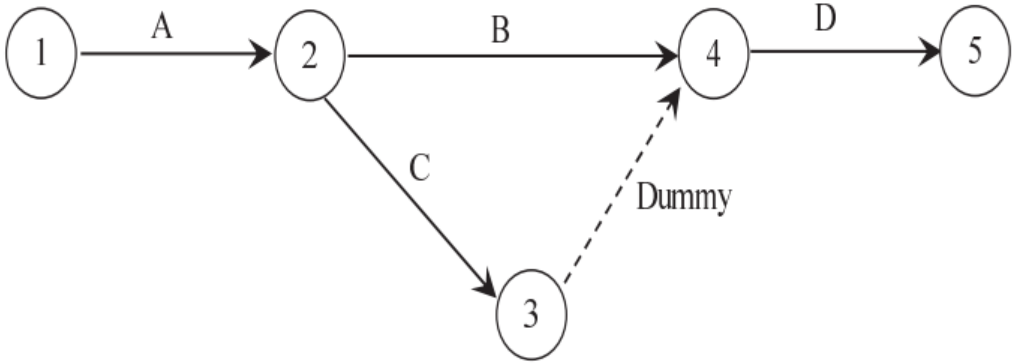
PANA ACADEMY

Dummy Activity

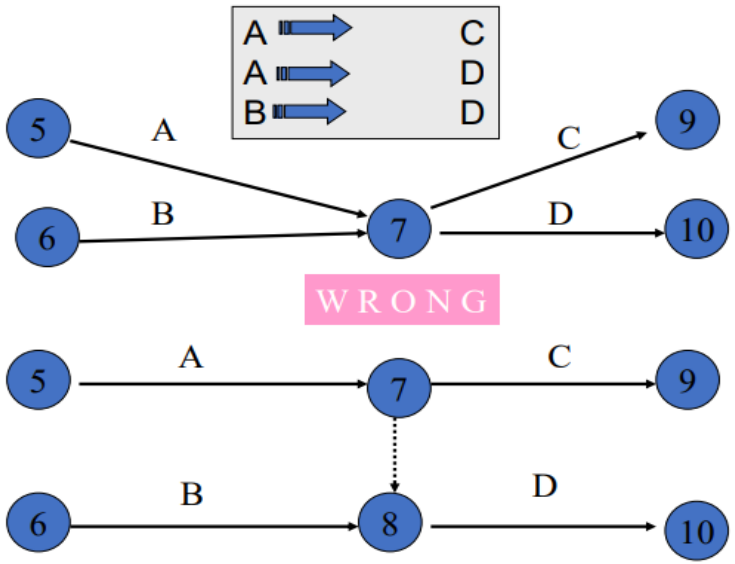


PANA ACADEMY

Dummy Activity



Dummy activity



The error shown in this figure is called wagon wheel error.

←

Note: Dummy activity doesn't consume any resources (i.e. 5 Ms)

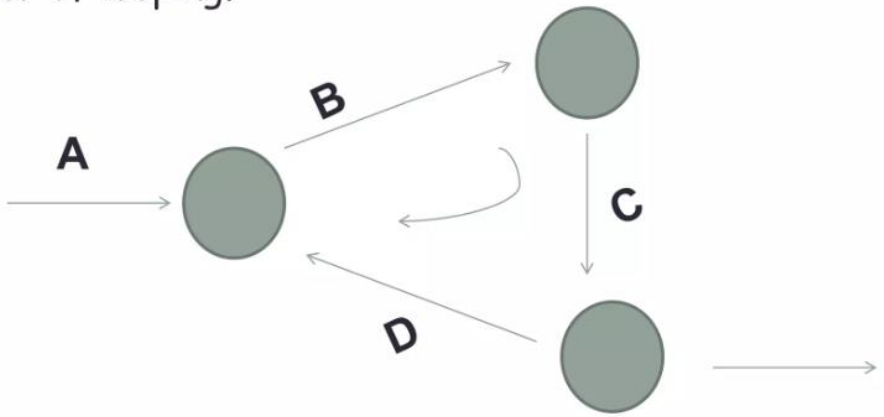
Therefore, Waiting is not a dummy activity as it consumes time i.e resource

It is used to identify and maintain the proper precedence relationship between activities that are not connected by events.

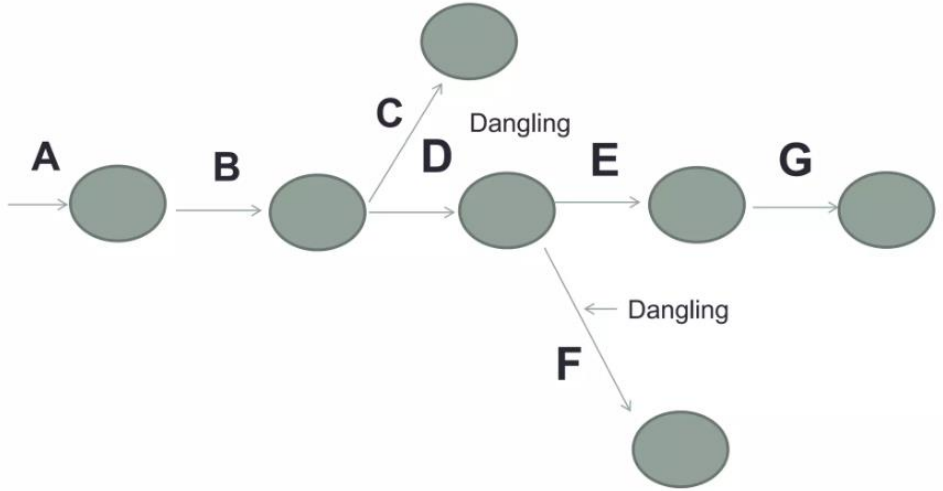
Error in Network Diagram

PANA ACADEMY

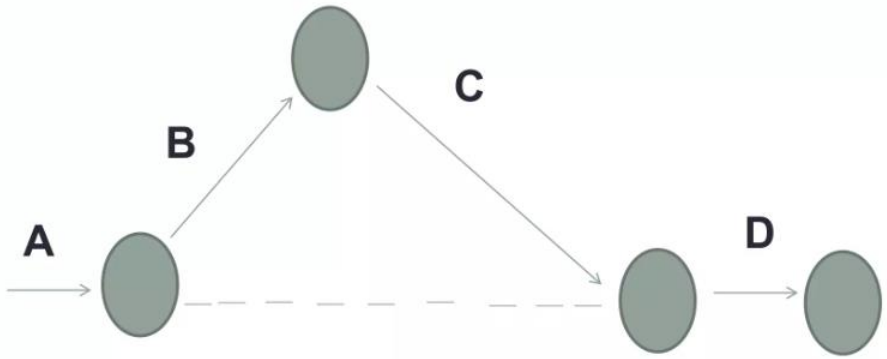
Looping error is also called as cycling error in a network diagram. Making an endless loop in a network is called as error of looping.

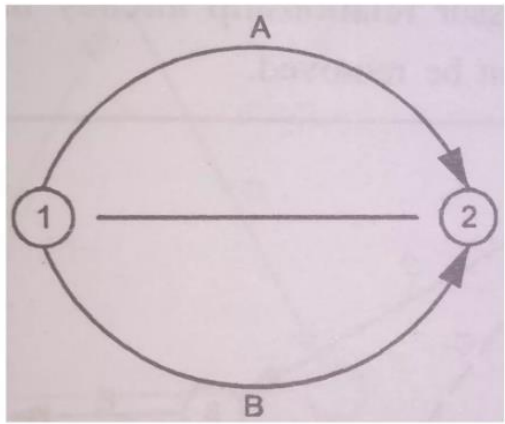


Whenever an activity is disconnected from the network it is called dangling error.

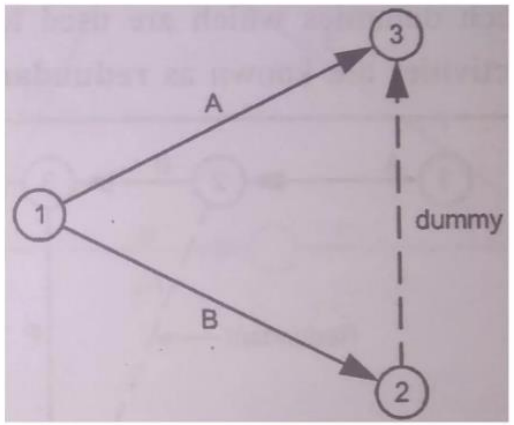


When the dummy activity is introduced and it is not required, it is called redundancy errors.





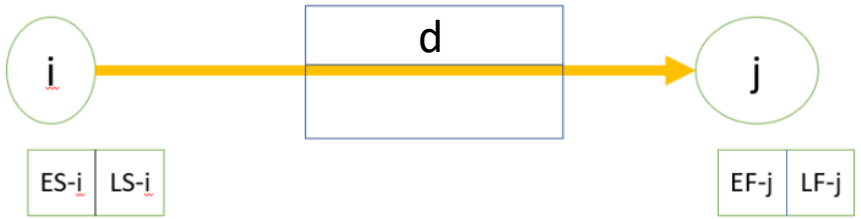
(a)Ambiguous representation (incorrect)



(b) Grammatically correct representation

Making a Network Diagram

- Predecessor and successor of all activities are found
- The network diagram is drawn to fulfill the Predecessor and successor of activities
- Numbering of nodes is done to fulfill the Fulkerson's rule.
- Starting and finishing time of each activity is written in the nodes with following rule



- Duration is written at top

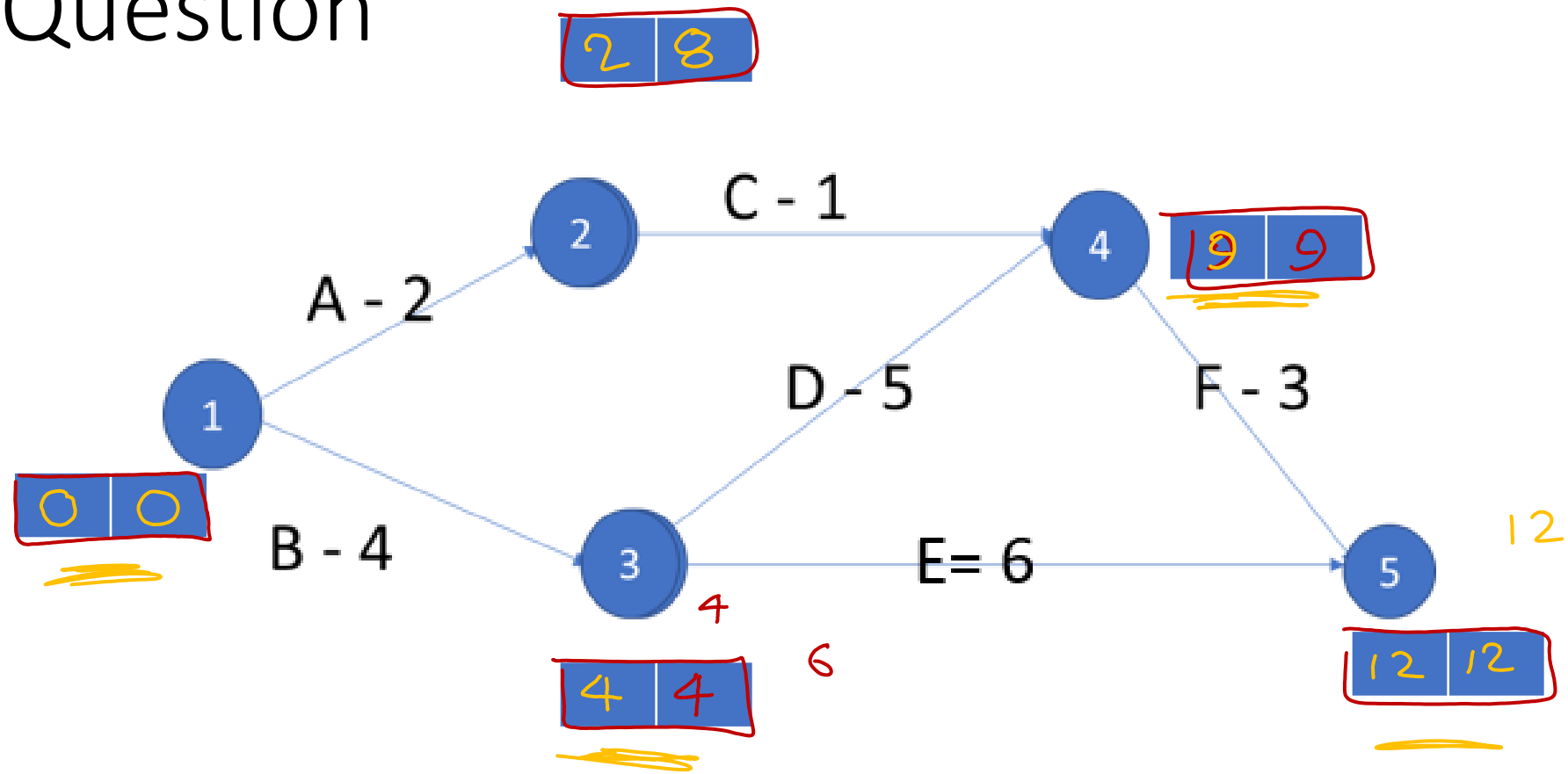
Note: In this figure,

ES-i = Early start of activity ij EF-j = Early finish of activity ij

LS-i = Late start of activity ij LF-j = Late finish of activity ij

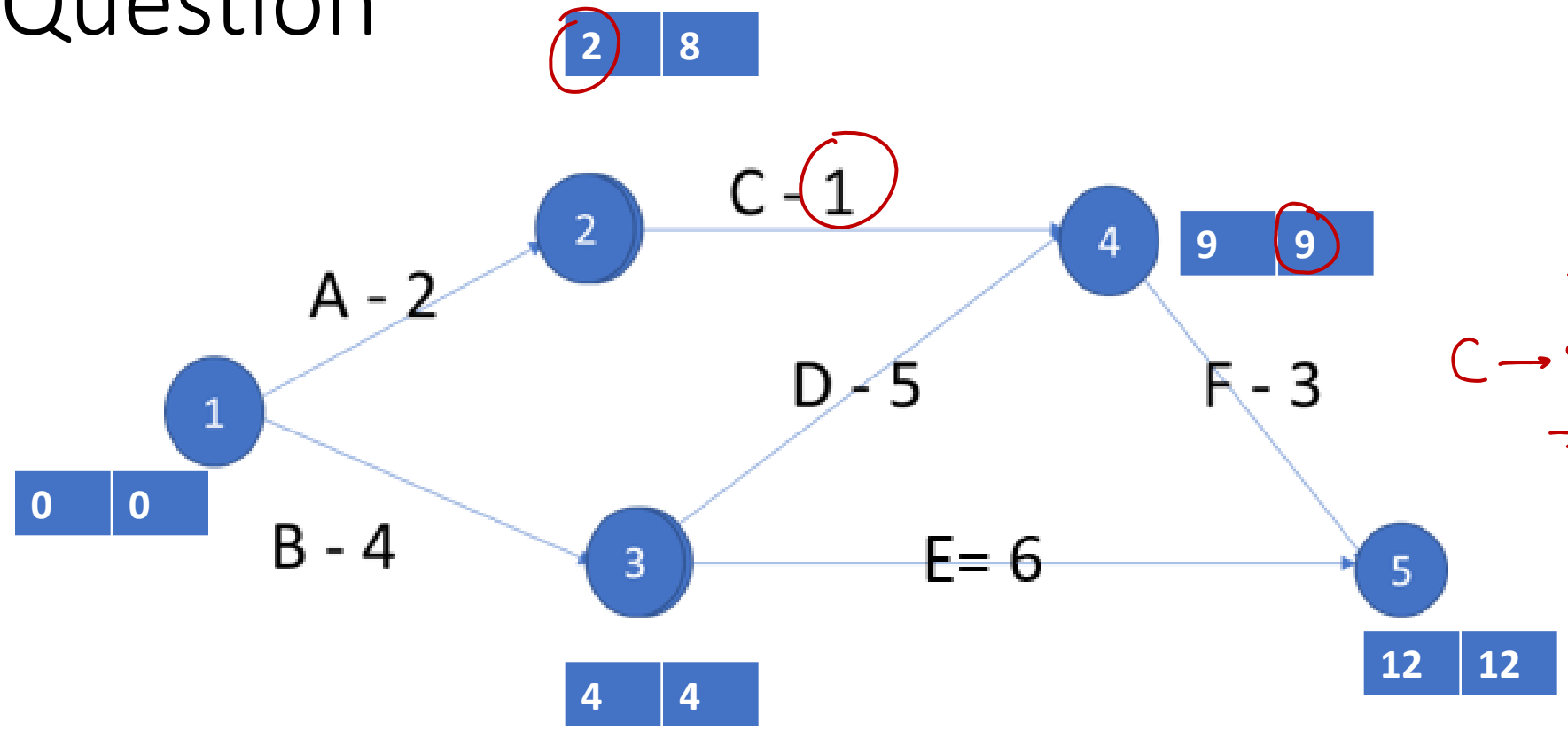
But in network diagrams only ES-i and LF – j represent their true meanings

Question



Critical Path = 1-3-4-5
Critical activities = B, D and F
Project duration = 12 days

Question



Critical Path = 1-3-4-5
Critical activities = B, D and F
Project duration = 12 days

PANA ACADEMY

By considering following activities of a project, the project duration will be

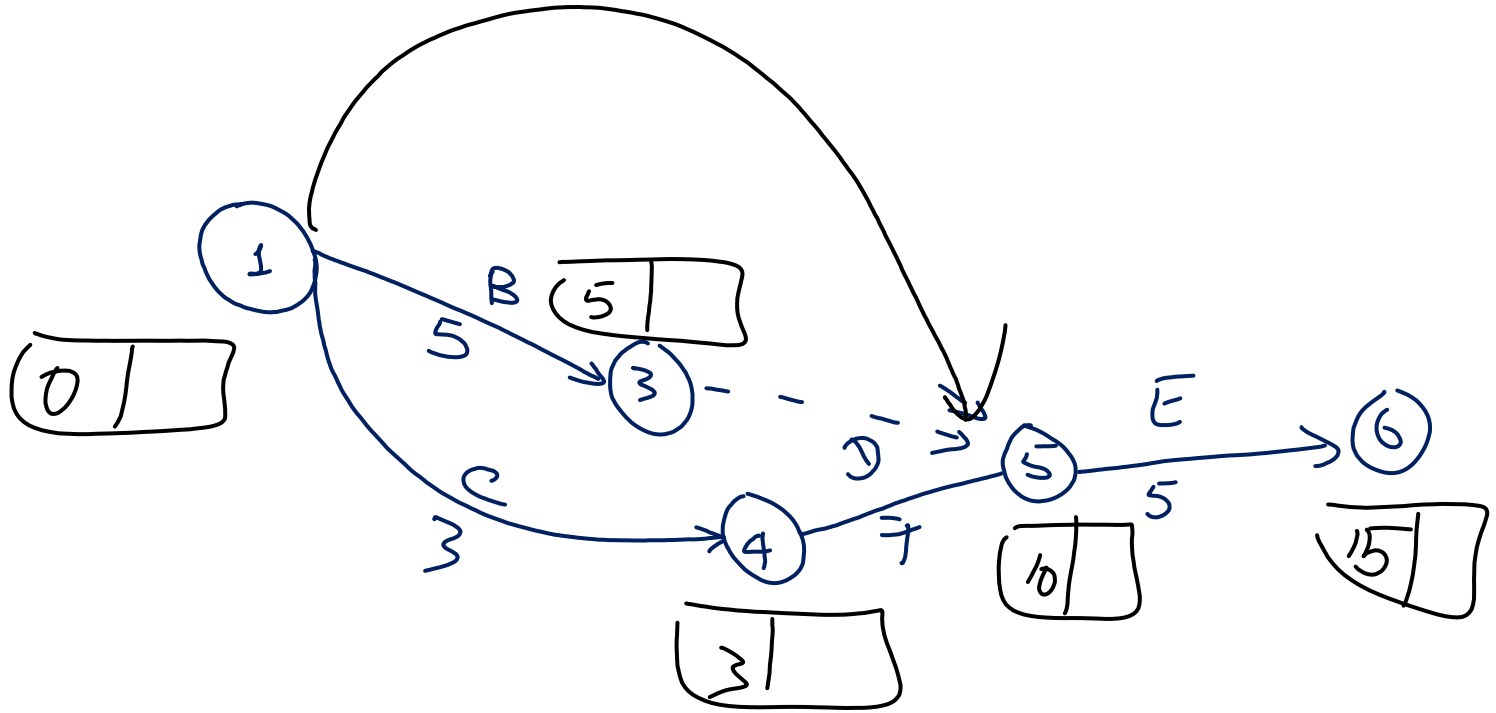
Activity	A	B	C	D	E
Immediate predecessors	-	-	-	C	A, B, D
Duration (days)	4	5	3	7	5

a) 9 days

b) 10 days

c) 15 days

d) 24 days



PANA ACADEMY

Floats

- Float is free time available for non-critical activities in a network
- Critical activities don't have floats
- Float is calculated for activity and slack is for event in a network diagram
- An activity has four types of floats

a) Total float

b) Free Float

c) Independent Float and

d) Interfering float

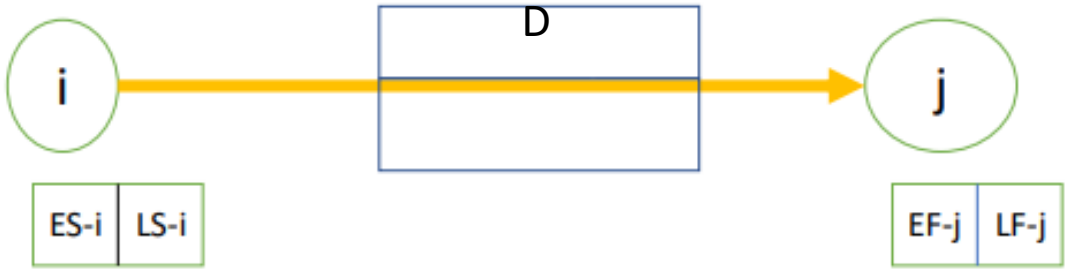
- Total float (TF) - Maximum time by which the completion of the activity can be delayed without affecting the project completion time. If an activity is delayed by a time equal to its total float, that activity and all other subsequent activities in that path become critical
- Free Float (FF)- Delay that can be permitted in an activity so that succeeding activity in the path are not affected.

• Independent float (IF)- spare time available for the activity, if preceding activity is finished as late as possible and succeeding activity started as early as possible

• Interfering float (IF)- Also called head event slack. It is the difference between total float and free float

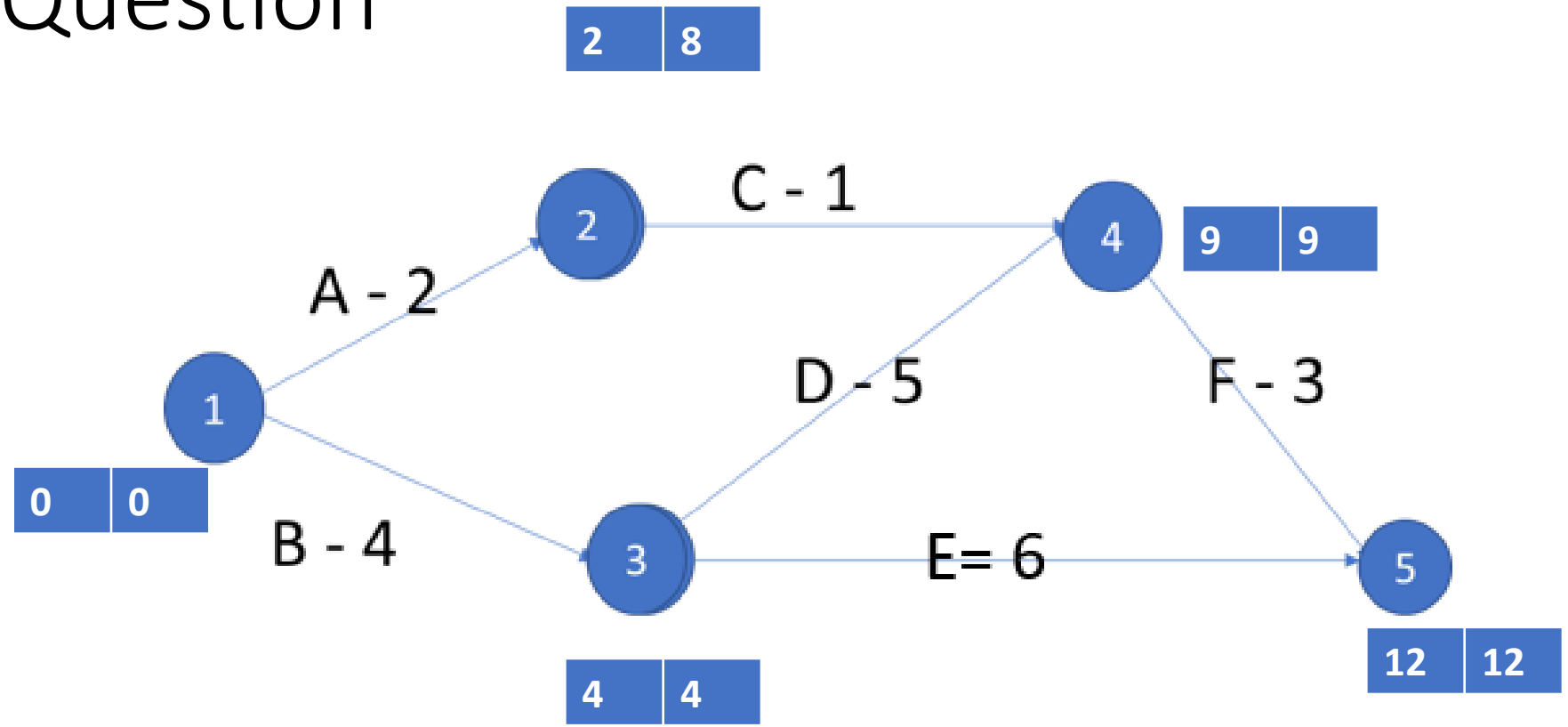
PANA ACADEMY

Float/Slack Calculation



Total float (TF) = LFj-ESi-D (LFT-EFT or LST-EST)
Free float (FF) = EFj-ESi-D <TF (TF – Head event Slack)
Independent Float = EFj-LSi-D < FF-tail event slack (may be negative put 0)
Interfering float = TF-FF (slack of head event)

Question



Critical Path = 1-3-4-5
Critical activities = B, D and F
Project duration = 12 days

PANA ACADEMY

Some definitions

. Float
- It indicates the range within which an activity start time or its finish time may fluctuate without affecting completion of the project.

. Crashing
- The process for reducing the duration of critical path activities by locating maximum resources to those activities.

. Crashing Cost
- This is the Direct cost corresponding to the completion of activity within crash time

. Crash Time
- It is the minimum time which an activity will take to complete after Crashing.

Sub-Critical Path

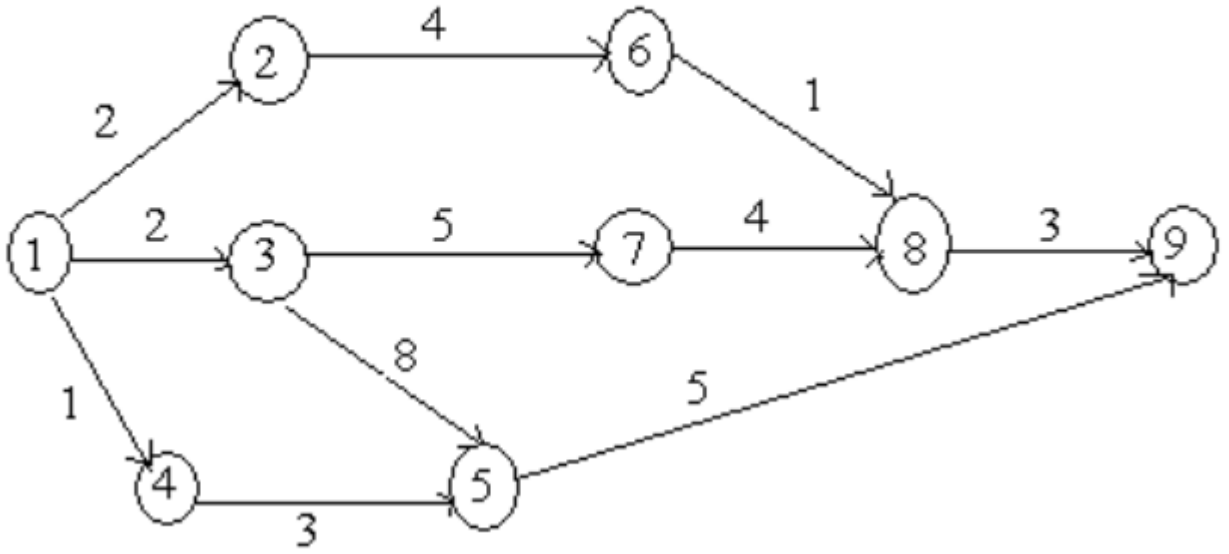
- Sub critical path means the second longest path in the network. It is shorter than the critical path but longer than all other paths in the network. They have Float positive.
  Also known as semi- critical path

Super critical activity

- Activity having negative floats. It results when activity duration is more than time available

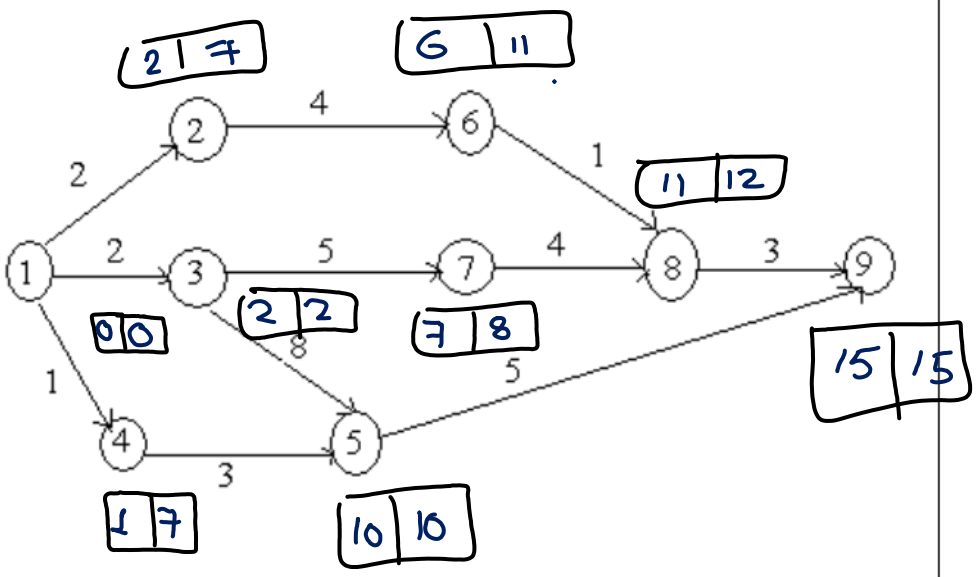
PANA ACADEMY

Find the critical path and calculate the slack time for the following network



PANA ACADEMY

Find the critical path and calculate the slack time for the following network



Activity(i, j)	Normal Time (D_{ij})	Earliest Time		Latest Time		Float Time ($L_i - D_{ij}$) - E_i
		Start (E_i)	Finish ($E_i + D_{ij}$)	Start ($L_i - D_{ij}$)	Finish (L_i)	
(1, 2)	2	0	2	5	7	5
(1, 3)	2	0	2	0	2	0
(1, 4)	1	0	1	6	7	6
(2, 6)	4	2	6	7	11	5
(3, 7)	5	2	7	3	8	1
(3, 5)	8	2	10	2	10	0
(4, 5)	3	1	4	7	10	6
(5, 9)	5	10	15	10	15	0
(6, 8)	1	6	7	11	12	5
(7, 8)	4	7	11	8	12	1
(8, 9)	3	11	14	12	15	1

PANA ACADEMY

PROGRAM EVALUATION REVIEW TECHNIQUE (PERT)

PROGRAM EVALUATION REVIEW TECHNIQUE (PERT)

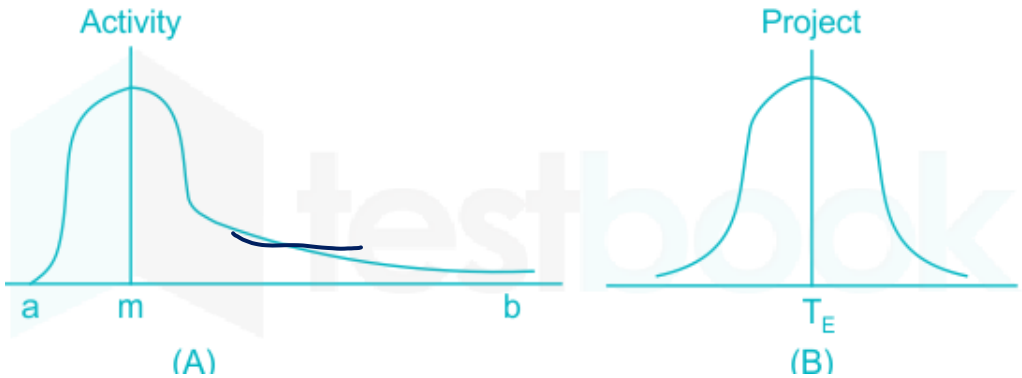
PANA ACADEMY

- PERT was devised in 1958 for Polaris Missile Program
- PERT is a technique that uses Optimistic time (o), Pessimistic time (p) and Realistic Time (r) (most likely time) estimates to calculate the EXPECTED TIME (ET) of a particular task.
- The Optimistic time (o) and Pessimistic time (p) reflects the minimum and maximum possible periods of time for an activity to be completed.
- The Realistic time (r) or the Most likely time , reflects the Project manager's "Best Guess" of the amount of time required for a task completion.

CALCULATING EXPECTED COMPLETION TIME (ET)

$$ET = \frac{t_o + 4t_m + t_p}{6}$$

- **Time estimates follow ß- distribution.**
- **Activity follows ß- distribution.**
- **Project follows normal distribution. (Central Limit Theorm**



Remember: In pert individual activities follows Beta Distribution whereas whole project follows Normal Distribution

PANA ACADEMY

Some useful terms

Activity Expected Time

$$t_e = \frac{t_o + 4t_m + t_p}{6}$$

$$\textit{Activity Variance } \sigma^2 = \left(\frac{t_p - t_o}{6}\right)^2$$

$\sigma^2 = \sigma_1^2 + \sigma_2^2 + \sigma_3^2 + \cdots$

$Var = Var_1 + Var_2 + Var_3 \cdots$

- Pert is used in complex and un-certain projects like research and developments

Standard Deviation along Critical Path

$$\sigma = \sqrt{\sum (\sigma_{ij})^2}$$

PANA ACADEMY

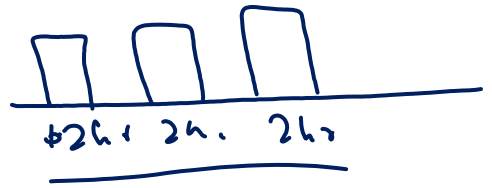
Difference Between CPM and PERT

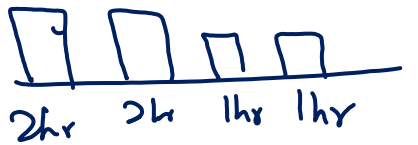
PERT	CPM
PERT is used for non-repetitive jobs like planning the assembly of the space.	CPM is used for repetitive job like building a house
it is a probabilistic model.	It is a deterministic model
It is applied mainly for planning and scheduling research programmes.	It is applied mainly for construction and business problems
PERT incorporates statistical analysis and thereby determines the probabilities concerning the time by which each activity or entire project would be completed.	CPM does not incorporate statistical analysis in determining time estimates, because time is precise and known.
It is event-oriented as the results of analysis are expressed in terms of events or distinct points in time indicative of progress.	It is activity-oriented as the result or calculations are considered in terms of activities or operations of the project.

Resource Levelling and Smoothing

PANA ACADEMY

	Resource leveling	Resource smoothing
1	Resource limited scheduling technique; Importance is given to the limited resources	Time limited scheduling technique; Importance is given to the duration of the project
2	Removes all resource conflicts	Removes as much resource conflicts as possible; but, may not remove all resource conflicts
3	May not require additional resources	May require additional resources to address left over resource conflicts
4	Activities may be shifted beyond the float available while rescheduling the activities	Activities are shifted only to the extent of the float available
5	Generally, the project duration gets extended	The project duration remains the same
6	May change the critical path	No change in critical path
7	Resource is constraint	Time is constraint





Monitoring, Evaluation and Controlling

Monitoring:

Monitoring is collecting, recording and reporting information concerning all aspects of project performances.

Evaluation:

Evaluation is an objective and systematic judgmental process for determining relevance, efficiency, effectiveness and relevancy of the project performance.

- Monitoring is an ongoing activity whereas evaluation is periodic activity.

Controlling:

It is the management function of comparing the actual achievements with the planned ones at every stage and taking necessary actions.

- It consists of following 3 steps:
  - Measuring
  - Evaluating
  - Correcting

PANA ACADEMY

Process of controlling

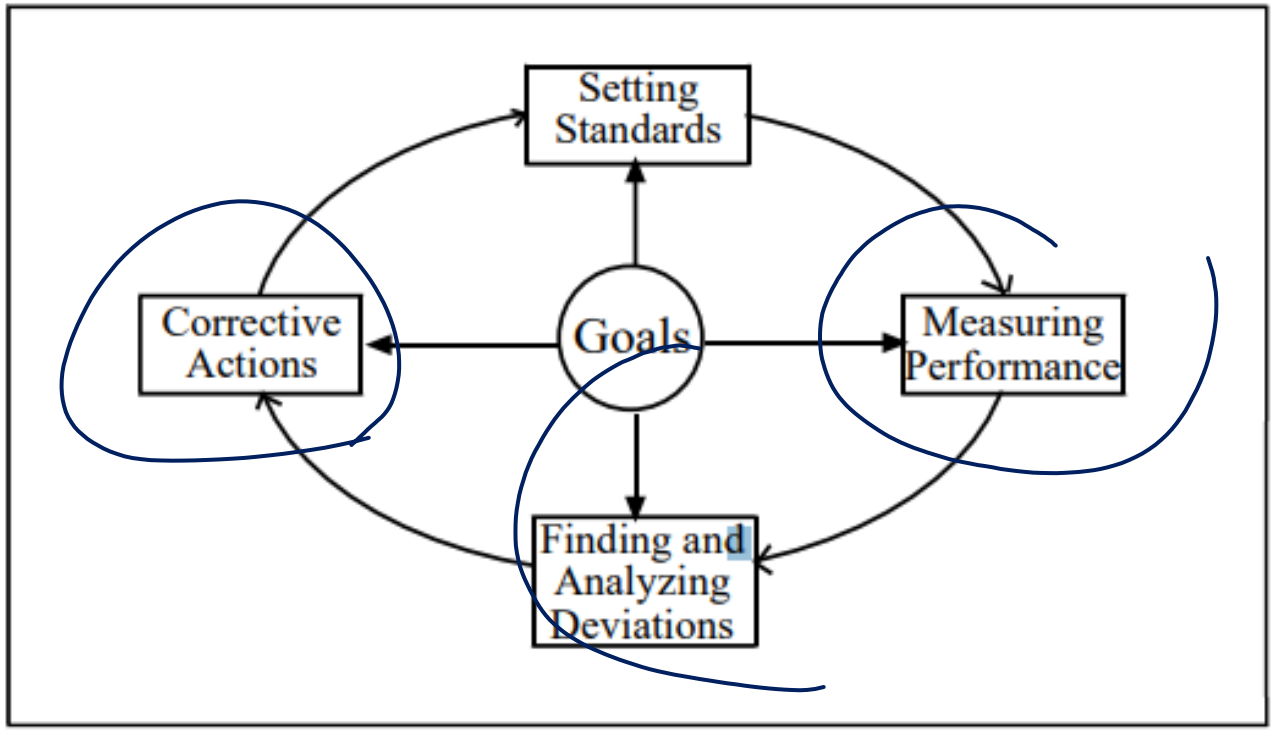
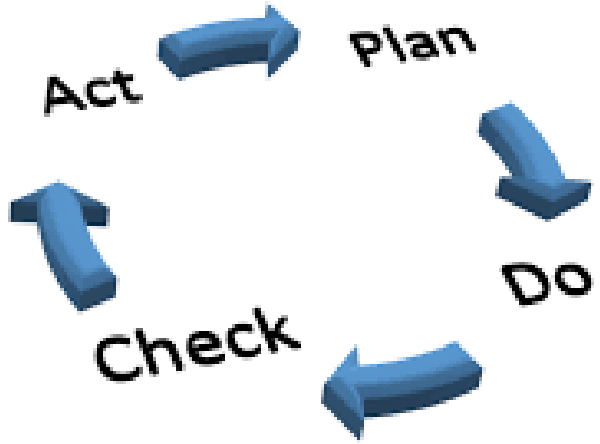


Fig: The Process of Control



PDCA Cycle

PANA ACADEMY

Areas of control

1. Quality control / Performance control
2. Cost control
3. Progress control/ Time control

1. Quality control:

- Measuring, evaluating and correcting the quality of the work whether things are being done right or not
- Tools for quality control

➢Well written specification

➢National and international standards

➢Procedural guidelines

➢Training

PANA ACADEMY

Cost of quality

- Cost of the quality is combination of following two costs:

A. Cost to control quality (a. Prevention and b. Appraisal)

B. Cost of failure to control (c. internal failure and b. external failure)

a. Prevention cost :

- Cost of preventing defective works before the product is made or service is rendered

Includes :

- Design reviews
- Trainings
- Process control, etc.

b. Appraisal cost

- Cost of auditing/checking service procedures to make sure that work is performed as prescribed
- Eg: Prototype inspection and tests

Cost of quality

c. Internal failure costs:

- The failure cost incurred when the product is in factory/place of origin and not been sold

Includes

- Redesign
- Cost of delays
- Retesting defective items
- Scrap

d. External failure costs:

- These costs are applicable to goods that have been sold

Includes

- Warranty cost
- Insurance and settlement
- Product returns
- Field service, etc.

Areas of control

2. Cost Control

- It means controlling changes to project budget

Methods of cost control:

a. **Short term planning and control**

b. **Accounting method of control**

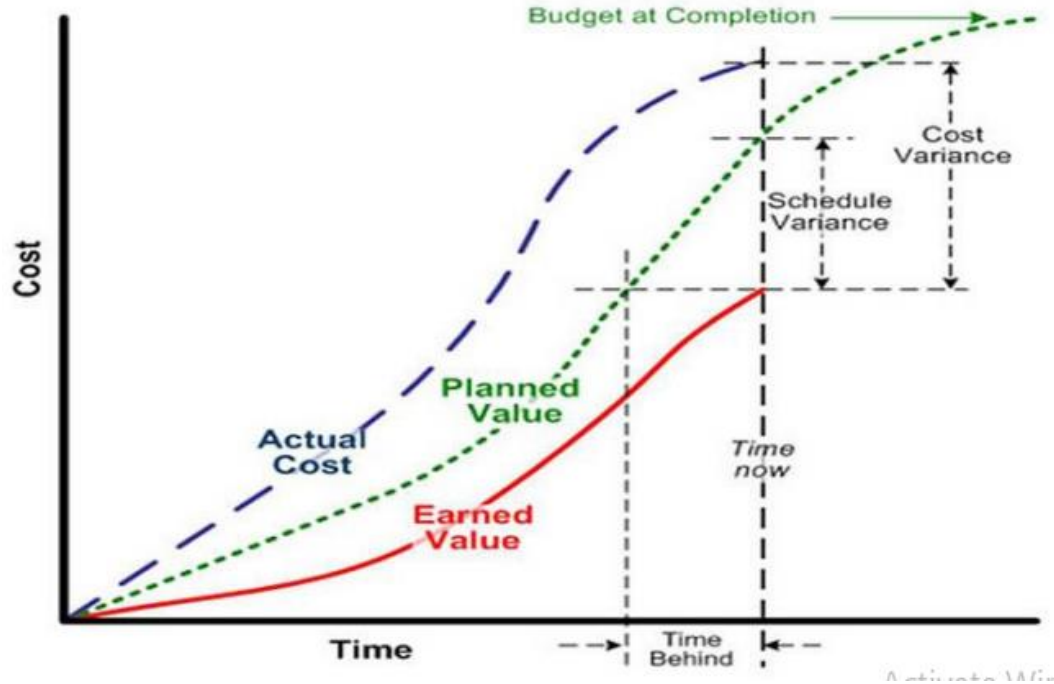
- Overall profit and loss account: Profit and loss checked at the end of project
- Profit-loss on valuation date: profit and loss checked on pre-scheduled date
- Unit costing: Comparing actual cost of unit item with the budgeted cost

c. **Project cost model- S curve and Earned Value Analysis (EVA)**

PANA ACADEMY

Earned Value Analysis (EVA)

- Earned value is the value of work done at a given point of time
- EVA is a tool that compares the value of work done with the value of work that should have been done
- Presented in the form of S-curve diagrams



The 3 fundamental metrics

- Budgeted Cost of Work Performed (BCWP)
- Budgeted Cost of Work Scheduled (BCWS)
- Actual Cost of Work Performed (ACWP)

PANA ACADEMY

PANA ACADEMY

Budgeted Cost of Work Performed

- **This is the "Earned Value."**
- Abbreviated as **BCWP**.
- For completed work, it is the cost originally budgeted to accomplish that work.
- "How much work was actually done?"

Budgeted Cost of Work Scheduled

- Abbreviated **BCWS**.
- It is the total budgeted cost up to the analysis date.
- Approximated by the total budget multiplied by the fraction of total project duration at the analysis date.
- "How much work should have been done?"

PANA ACADEMY

Actual Cost of Work Performed

- Abbreviated **ACWP**.
- What it actually cost to accomplish all the work completed as of the analysis date.
- "What did the work that was actually done actually cost?"

Derived Metrics

- Schedule Variance (**SV**)
- Schedule Performance Index (**SPI**)
- Cost Variance (**CV**)
- Cost Performance Index (**CPI**)

- SV = BCWP - BCWS
  - Negative means Behind Schedule
- SPI = BCWP / BCWS
  - Less than 1.00 means Behind Schedule
- CV = BCWP - ACWP
  - Negative means Over Budget
- CPI = BCWP / ACWP
  - Less than 1.00 means Over Budget

PANA ACADEMY

Calculation

Example

	Days	Unit	Price	Total
Original	**50**	**100**	**400**	**40000**
After 25 days:				
Scheduled	25	50	400	20000
Performed	25	40	450	18000

After 25 days:
BCWP = 16000
BCWS = 20000
ACWP = 18000

- SV = BCWP - BCWS
  - Negative means Behind Schedule

-4000

- SPI = BCWP / BCWS
  - Less than 1.00 means Behind Schedule

0.8

- CV = BCWP - ACWP
  - Negative means Over Budget

-2000

- CPI = BCWP / ACWP
  - Less than 1.00 means Over Budget

0.88

PANA ACADEMY

Earned Value Analysis (EVA)

Performance Measures		Schedule		
		SV > 0 & SPI > 1.0	SV = 0 & SPI = 1.0	SV < 0 & SPI < 1.0
Cost	CV > 0 & CPI > 1.0	Ahead of Schedule Under Budget	On Schedule Under Budget	Behind Schedule Under Budget
	CV = 0 & CPI = 1.0	Ahead of Schedule On Budget	On Schedule On Budget	Behind Schedule On Budget
	CV < 0 & CPI < 1.0	Ahead of Schedule Over Budget	On Schedule Over Budget	Behind Schedule Over Budget

PANA ACADEMY

MCQs

1. The following statements relate to project network. Choose the correct code for the statements being correct or incorrect.

Statement I: An activity cannot be represented by more than one arrow, but an arrow can represent one or more activities.

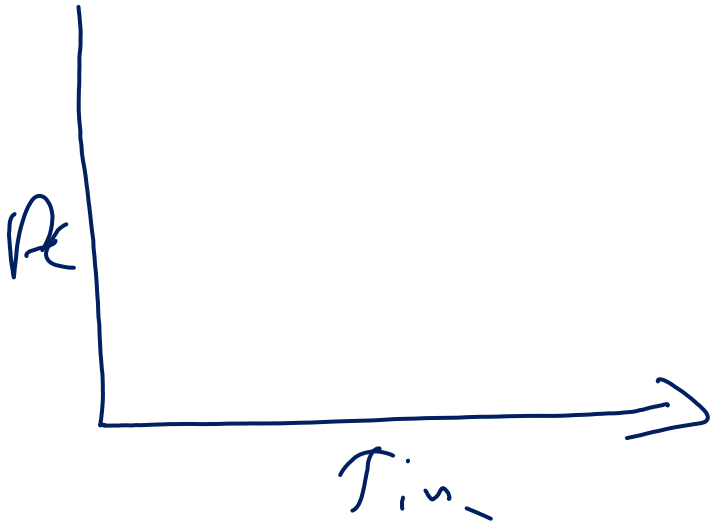
Statement II : The activities in a critical path can be preponed or postponed.

a. Both the statements I and II are correct.
b. Both the statements I and II are incorrect.
c. Statement II is correct, but I is incorrect.
d. Statement I is correct, but II is incorrect.

PANA ACADEMY

MCQs

2. Bar chart is drawn for
A) Time versus Activity
B) Activity Vs Resources
C) Resources Vs Progress
D) Progress Vs Time



3. Henry Gantt Developed Bar Charts for Planning and Scheduling of projects in
a) 1880
b)1900
c) 1920
d)1940

4. Bar Charts Are Suitable for
A) Major Projects
B) Minor Projects
C)Large Projects
D) All of the above

PANA ACADEMY

MCQs

5. The project in which the government receives the investment from the international donors and doesn't repay the investment is called

a. Loan projects
b. Grant projects
c. Private sector projects
d. Process oriented projects

6. The process of reducing the project's duration by using additional resources for the critical activities is called

a. Project reducing
b. Project maintenance
c. Scheduling
d. Crashing

MCQs

7. The critical path represents
   a. The maximum duration in which the project can be completed
   b. The minimum duration in which the project can be completed
   c. Does not signify about project completion
   d. The mean time in which the project can be completed

8. Which of the following is correct ?
   a. Pert is commonly used in construction work
   b. Pert is suitable for the estimation of activity duration where high levels of uncertainty is there
   c. Pert does not provide time duration
   d. Pert is a deterministic Approach for estimating the time duration of an activity.

PANA ACADEMY

MCQs

9. Which of the following is PERT event ?

a. Transport of sand
b. Transport of cement
c. Concreting of roof completed
d. Making of formwork

10 .The estimates of activities in PERT follows

a. Normal distribution curve
b. Poisson's distribution curve
c. Beta distribution curve
d. None of the above

PANA ACADEMY

MCQs

11. If SPI > 1, then which of the following is true ?
    a. Project is ahead of schedule
    b. Project is behind the schedule
    c. Project is on time
    d. None of the above

12. Training of the employees increases which of the quality cost?
    a. Prevention cost
    b. Appraisal cost
    c. Internal failure cost
    d. External failure cost

PANA ACADEMY

MCQs

13 By considering following activities of a project, the project duration will be

Activity	A	B	C	D	E
Immediate predecessors	-	-	-	C	A, B, D
Duration (days)	4	5	3	7	5

a) 9 days

b) 10 days

c) 15 days

d) 24 days

t_o t_m t_p

14. The optimistic, most likely and pessimistic time estimates of an activity are 5, 10, 21 days, what are the expected time and standard deviation?

a. 12,3

b. 11,4

c. 11,2.67

d. 10,16

$$t_e = \frac{5 + 4\times 10 + 21}{6} = 11$$ #

$$\sigma = \frac{t_p - t_o}{6} = \frac{21-5}{6} = 2.67$$

PANA ACADEMY

MCQs

$\sigma_1 = 5$

$\sigma_2 = 5$ $\quad \sigma_3 = 5$ $\quad \sigma_4 = 5$ $\quad \sigma_5 = 5$

15. If PERT network consists of 5 activities with standard deviation of each event being 5. Then, the standard deviation of the entire project is

a. 25
b. 5
c. $5\sqrt{5}$
d. 125

$\sigma^2 = \sigma_1^2 + \sigma_2^2 + \sigma_3^2 + \sigma_4^2 + \sigma_5^2$

$\sigma^2 = 5 \times 5^2$

$\sigma = 5\sqrt{5}$ #

16. The company or project initiated through two or more parties is called [NEC 2079]

a. Bilateral Project
b. Multilateral project
c. Joint Venture project
d. PPP

PANA ACADEMY

17. Pick up the incorrect statement from the following:

a) An activity of a project is denoted by an arrow on the net work
b) The tail of the arrow indicates the start of the activity
c) The head of the arrow indicates the end of the activity
d) The arrows are drawn to scale from left to right
e) Each activity consumes a given time.

18. Mile Stone charts were invented in the year of

a) 1910
b) 1920
c) 1930
d) 1940
e) 1950

PANA ACADEMY

19. A dummy activity
    a. is artificially introduced
    b. is represented by a dotted line
    c. does not consume time
    d. all the above.

20. The time by which activity completion time can be delayed without affecting the start of succeeding activities, is known as
a. duration
b. total float
c. free float
d. interfering float.

PANA ACADEMY

21. A schedule performance index (SPI) of 0.76 means.
    a) You are over budget
    b) You are ahead of schedule
    c) You are only progressing at 76 percent of the rate originally planned
    d) You are only progressing at 24 percent of the rate originally planned

PANA ACADEMY

THANK YOU