5   **PROJECT SCHEDULE MANAGEMENT**

Instructor : Dr. Ali Rammal

- Project schedule management is the process to ensure timely completion of the project.
- Schedule of project activities is the responsibility of the project manager.
- Unrealistic schedule is the fault of the project manager.
- Schedule should be done before project activities start
- WBS is required to do the schedule plan
- Teams who will implement the project should be involved in preparing the schedule.

❑ **The Schedule Management Process**

- Plan Schedule Management
- Define Activities
- Sequence Activities
- Estimate Activity Durations
- Develop Schedule
- Control Schedule

PROJECT SCHEDULE MANAGEMENT

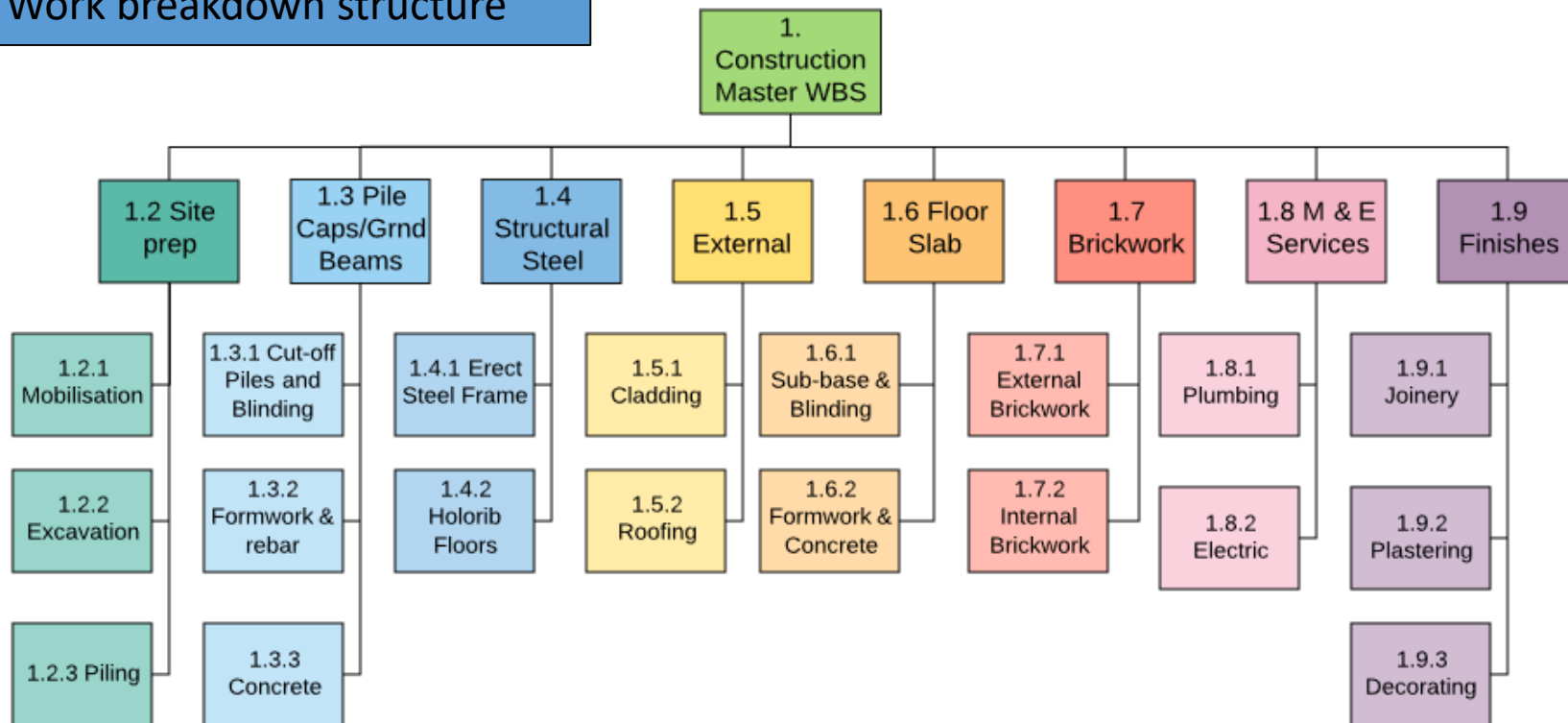| Knowledge Area	INTIATING	PLANNING	EXECTUING	MONITORING & CONTROLING	CLOSE OUT
SCHEDULE MANAGEMENT		- Plan schedule Management - Define activity - Sequence activity - Estimate activity duration - Develop Schedule		Control Schedule	

5.1 PLAN SCHEDULE MANAGEMENT

The project manager should plan, manage and control the project to the schedule baseline. The schedule plan should be managed along the way of the project. So the schedule management plan is a document where the project manager illustrates how he will plan and control and track the schedule and what will do in case if variances occur. The key output of this process is the schedule management plan.

5.2 DEFINE ACTIVITIES

This process involves taking the work packages created in the WBS and decomposing them into the activities that are required to produce the work package deliverables and thus achieve the project objectives.

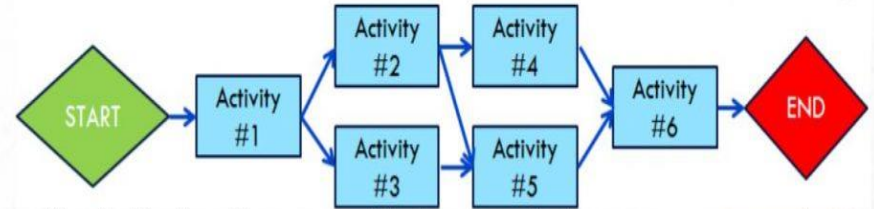Work breakdown structure

5.3 SEQUENCE ACTIVTIES

Sequence activities is the process of identifying and documenting relationships among the project activities. In the project management, the key benefit of this type of process is that it defines the logical sequence of work to obtain the greatest efficiency given all project constraints.

Time Management

Master of Project Academy

Sequence Activities

- Process of identifying and documenting relationships among the project activities.
- Key result of this process is Network Diagram.
- If activity durations are added, network diagram also shows critical path.

NETWORK DIAGRAM
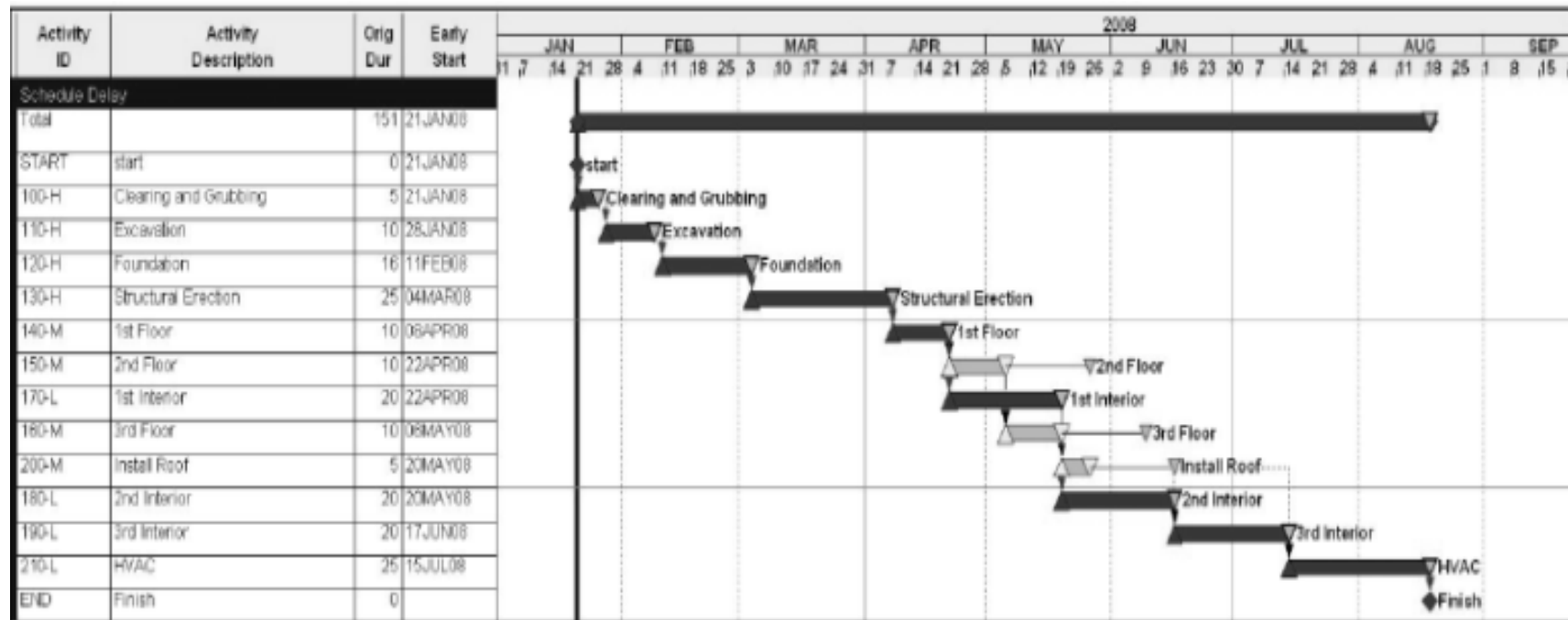
5.4 ESTIMATE ACTIVITY DURATION

When the activities have been defined and sequenced, the next step is to estimate how long each activity will take. This is the Estimate Activity Durations process. When possible, the estimators should be those who will be doing the work. On large projects, however, the estimators are more often the members of the project management team, as it is known during planning, who are most familiar with the work that needs to be done.

Task ID	Name	Durations	Cost
110	Excavation	6 days	$5,850
120	Pour Foundation	10 days	$4,700
210	Wood work	20 days	$60,850
310	Electrical & Plumbing	10 days	$20,260
320	Flooring	8 days	$18,760
330	Finishing	12 days	$16,760
410	Landscaping	14 days	$7,620
Total		**80 days**	**$134,800**

5.4 DEVELOP SCHEDULE

Develop Schedule is the process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model.

Activity ID	Activity Description	Orig Dur	Early Start	2008								
				JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Schedule Delay												
Total		151	21JAN08									
START	start	0	21JAN08	start								
100-H	Clearing and Grubbing	5	21JAN08	Clearing and Grubbing								
110-H	Excavation	10	28JAN08	Excavation								
120-H	Foundation	16	11FEB08		Foundation							
130-H	Structural Erection	25	04MAR08			Structural Erection						
140-M	1st Floor	10	06APR08				1st Floor					
150-M	2nd Floor	10	22APR08					2nd Floor				
170-L	1st Interior	20	22APR08					1st Interior				
160-M	3rd Floor	10	08MAY08						3rd Floor			
200-M	Install Roof	5	20MAY08						Install Roof			
180-L	2nd Interior	20	20MAY08						2nd Interior			
190-L	3rd Interior	20	17JUN08							3rd Interior		
210-L	HVAC	25	15JUL08								HVAC	
END	Finish	0										Finish

5.4 CONTROL SCHEDULE

Control schedule is a process in project management that involves monitoring the status of activities related to a particular project. Aside from monitoring the status, it also involves updating of the project process as well as managing the changes to the schedule in order to achieve the plan.

❖ MILESTONES ACTIVITIES

A milestone represents the completion of a series of activities or work packages. Milestones represent significant events within the project schedule. They are not work activities, and they have no duration. The project manager can also insert milestones as checkpoints to help control the project. If a milestone in the schedule is reached and any of the planned work has not been completed. it indicates the project is not progressing as planned.

Data Date

Event	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Subcontracts Signed			△▼					
Specifications Finalized				△▽				
Design Reviewed					△			
Subsystem Tested						△		
First Unit Delivered							△	
Production Plan Completed								△

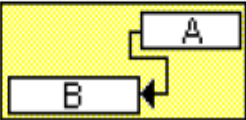There are many other acceptable ways to display project information on a milestone chart.
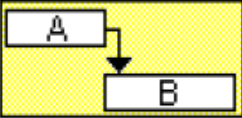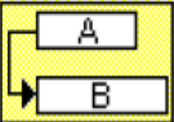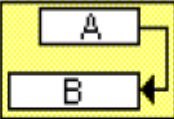
❖ Precedence Diagram Method (PDM)/ SEQUENCE ACTIVITY PROCESS

It is a method used in Critical Path Methodology(CPM) for constructing a project schedule network diagram that uses boxes or rectangles, referred to as nodes, to represent activities, and connects them with arrows that show the logical relationships that exist between them.
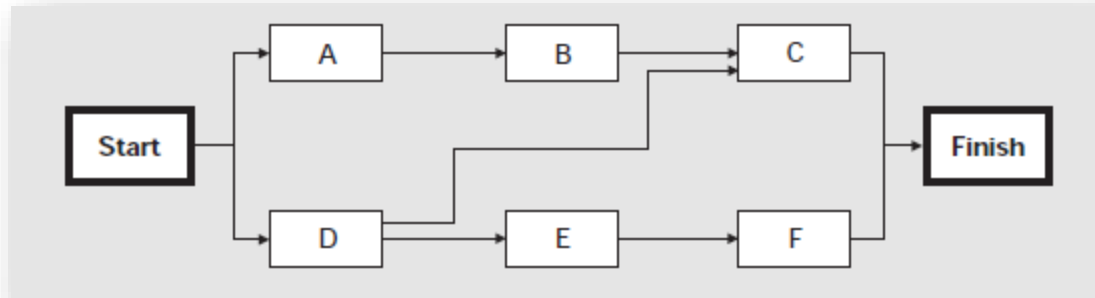
Task dependency	Example	Description
Finish-to-start (FS)	A → B	Task (B) cannot start until task (A) finishes.
Start-to-start (SS)	A → B	Task (B) cannot start until task (A) starts.
Finish-to-finish (FF)	A → B	Task (B) cannot finish until task (A) finishes.
Start-to-finish (SF)	A → B	Task (B) cannot finish until task (A) starts.

A

B

C

D

A: you should finish excavating so you can start the foundation work

B: you should start trenching so you can pull the cables.

C: Documentation work cannot finish until the test work is finished

D: Transportation of Materials cannot finish until Overnight Security starts

A → B
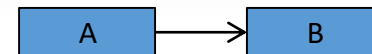
Predecessor   Successor

❖ **TYPE OF DEPENDENCIES**

❖ **LEADS & LAGS:**

A Lead means that an activity B can start before the predecessor activity A is completed.
Example: you can start laying the cable before completing the trenching work.

A LAGS: it is the waiting time between activities. Such you wait 5 to 6 for curing time when you finish casting and before you start backfilling work.

CRITICAL PATH :

❑ The longest path from the beginning to the end of the project. Activities on the critical path cannot be delayed without delaying the project.

❑ Any path close in duration to the critical path is called Near-critical path
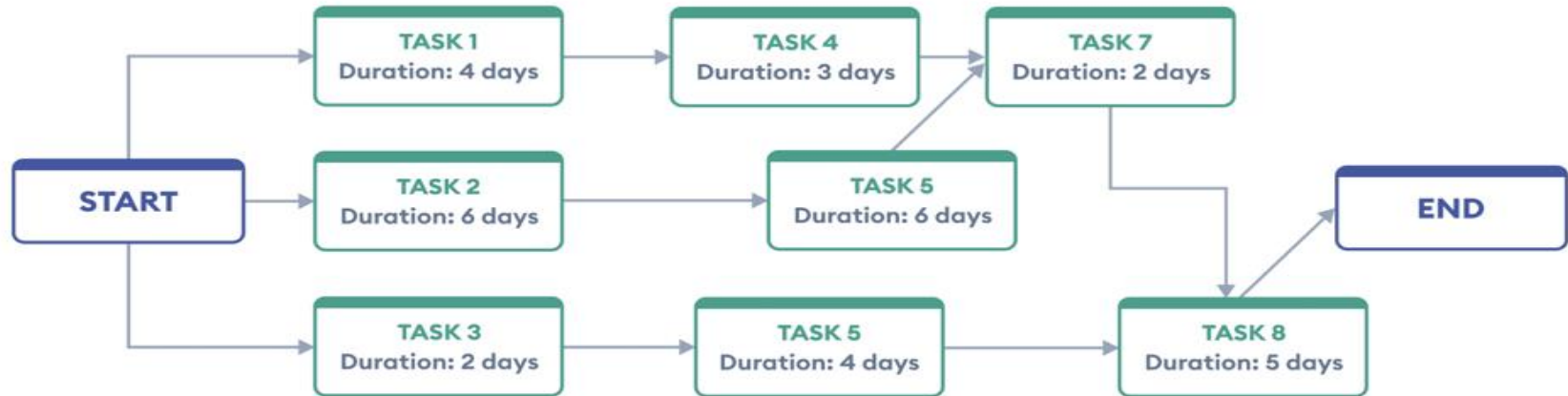
❖ **PROJECT SCHEDULE NETWORK DIAGRAM**

It is a graphical representation of the logical relationships, also referred to as dependencies, among the project schedule activities.

- Help justify your time estimate for the project.

- Aid in effectively planning, organizing, and controlling the project

- Show interdependencies of all activities, and thereby identify riskier activities

- Show project progress
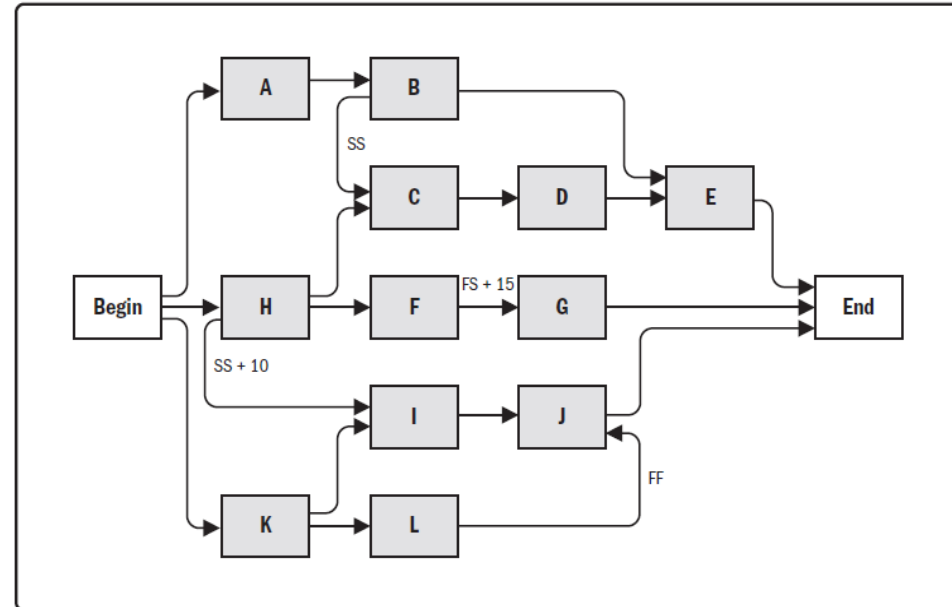
❖ **Estimate Activity resources/ Estimate activity duration process**

It is the process of estimating the type and quantities of material, people, equipment, or supplies required to perform each activity.

❖ **Padding:**

Padding is an extra time and cost added to an estimate because the estimator does not have enough information. Padding is a sign of poor project management and that it can damage your reputation and the credibility of the project management profession as a whole. Padding is totally different of creating reserve.

❑ **ESTIMATION TECHNIQUES TO CALCULATE THE EXPECTED ACTIVIT DURATION.**

01 **One Point estimate**

- Used for one time estimation
- Estimator submit one estimate per activity
- Depends on Experience, Expert Judgement, & Historical Information

02 **Analogous Estimating**

- Depends Expert Judgement & Historical Information
- Used to create the overall project duration
- When more info are available. Estimation will be reviewed

03 **Parametric estimating**

- Use statistical relationship between historical data and other Variable
- It is an accurate estimation

04 **Bottom up estimating**

- Used to estimate the duration of the project by estimating the lower component of WBS

❑ Three Point Estimates (PERT)

A three-point estimate uses average of optimistic, most likely, and pessimistic estimates and hence improving the accuracy to calculate the activity duration.

- ✓ **Most likely estimate (M) –** The realistic and most likely estimate. The most probable amount of time

- ✓ **Optimistic estimate (O)** is the best case scenario. The shortest possible amount of time each task will take

- ✓ **Pessimistic estimate (P)** assumes the worst case scenario. The longest amount of time tasks might take if things don't go

- **Beta Distribution (Weighted Average) :** It gives stronger consideration to the most likely estimate. **PERT: (P + 4M +0)/6**

- **Standard Deviation of an activity:** It is the possible range of estimate. **(P- O)/6**

. **Range of the estimate: it is the estimated duration of activities plus minus SD.**

Activity	O	M	P	PERT	SD	Range
A	14	27	47			
B	41	60	89			
C	39	44	48			
D	29	37	42			

Activity	O	M	P	PERT	SD	Range
A	14	27	47	28.167	5.5	22.667 to 33.667
B	41	60	89	61.667	8	53.667 to 69.667
C	39	44	48	43.833	1.5	42.333 to 45.333
D	29	37	42	36.500	2.167	34.333 to 38.667

❖ **DATA ANALYSIS/ SIMULATION**

1- Alternative Analysis:

It is the process of find alternative solution if the activity estimation is not within the project constraints such

adding more resources or maybe subcontract the work instead to do it internally, or adding different tools or

resources to the project such machines, equipment etc...

2 - Reserve Analysis:

Used to determine the amount of contingency and management reserve needed for the project.

❖ **Contingency reserve:**

It is a reserve of time or cost that project manager consider for the identified risks. The project manager has authority to use the contingency reserve when the identified occurs.

❖ **Management reserve:**

It is a reserve of time or cost that project manager consider for the unidentified risks. The project manager has authority to use the contingency reserve when the identified occurs.

❖ **CRITICAL PATH:**

The critical path is the longest duration path through a network diagram

CP=18 days
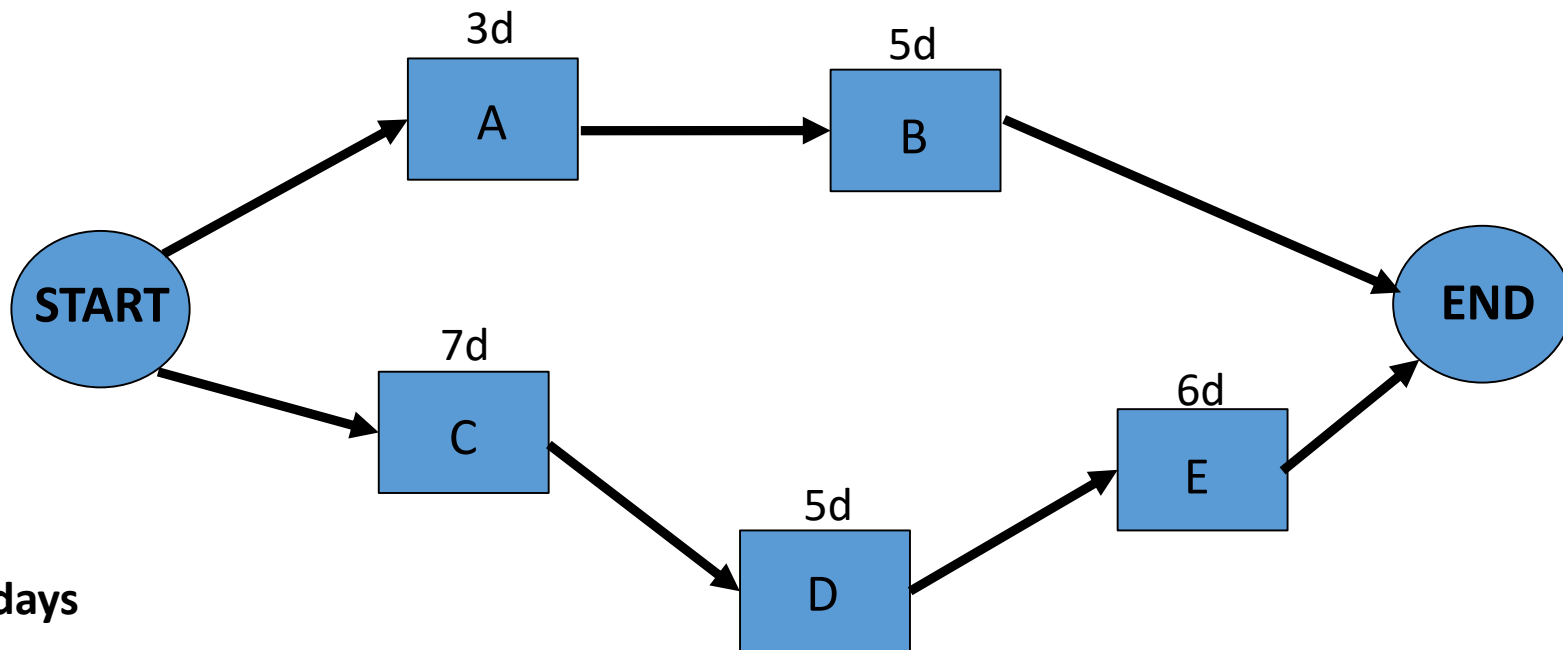
❖ **NEAR- CRITICAL PATH:**

Near critical path: the close in duration to the critical path, Project Manager should take care of the point where the near critical path becomes critical.

❖ **FLOAT: (SLACK)**

➢ **TOTAL FLOAT :** It is the amount of time an activity can be delayed without delaying the project end date or an intermediary milestone. Total float of critical path is zero.

START FORMULA
FLOAT= LS-ES

FINSIH FORMULA
FLOAT= LF-EF

- Early Start represents the earliest date an activity can possibly begin, based on all its predecessors and successors.
- Early Finish represents the earliest date an activity can possibly finish, if all predecessors and successors also finish on their respective early finish dates

Late Start (LS): This is the latest time that an activity can be started on your project. If you start the activity beyond this time, it will affect your critical path.

Late finish (LF): Latest date that the activity can finish without causing a delay to the project completion date.
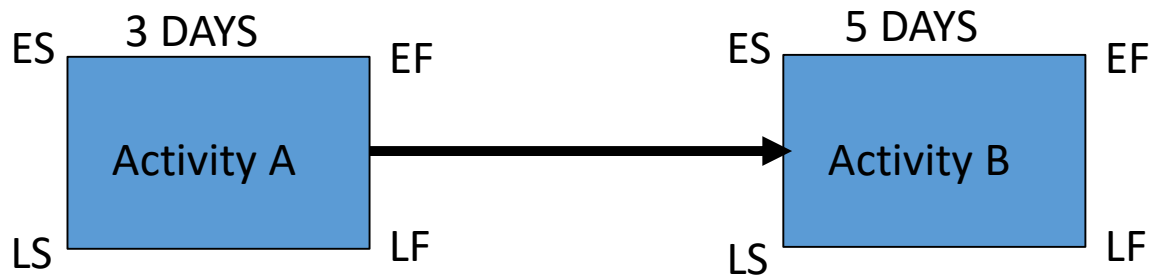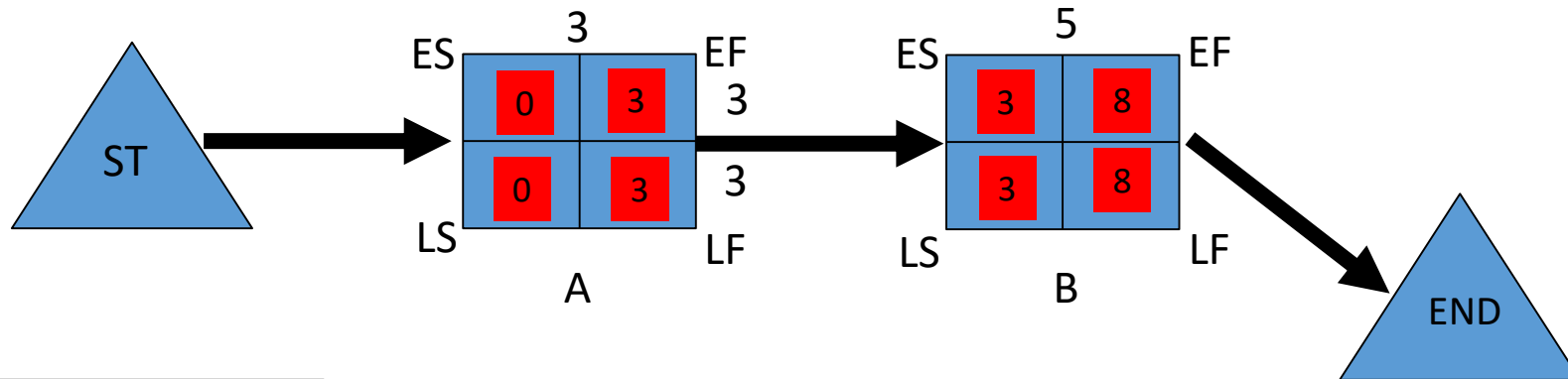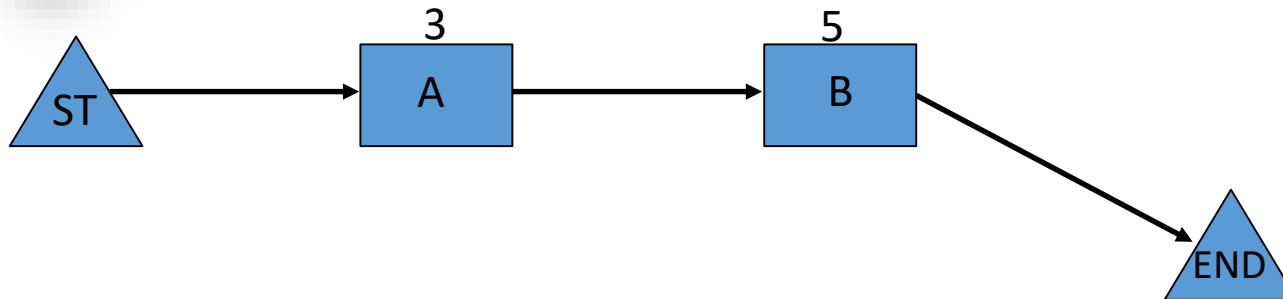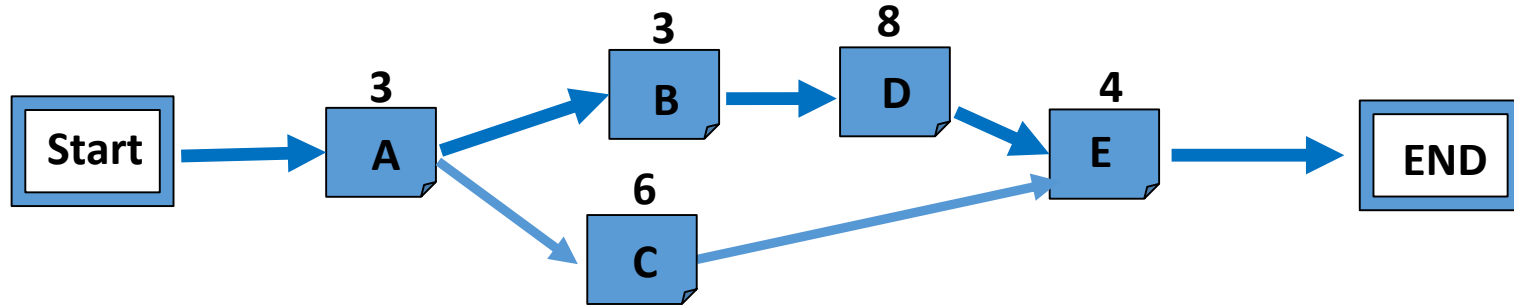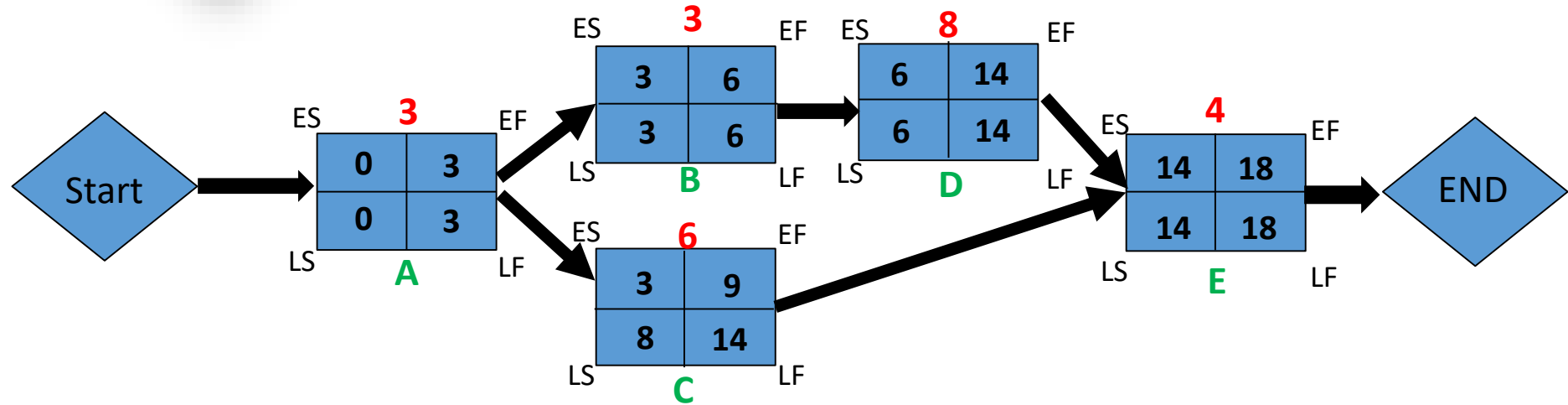
Float of Activity B:
LF-EF= 8-8= 0
LS-ES= 3-3=0

Float of Activity A:
LF-EF= 3-3 = 0
LS-ES= 0-0 = 0

Exercise

1- What is the length of the critical path?

2- what is the float of the activity # B ?

3- What is the float of activity# C ?

4- The resource working on activity C is replaced with another resource who is less experienced. The activity will now take 10 weeks. How will this affect the project?
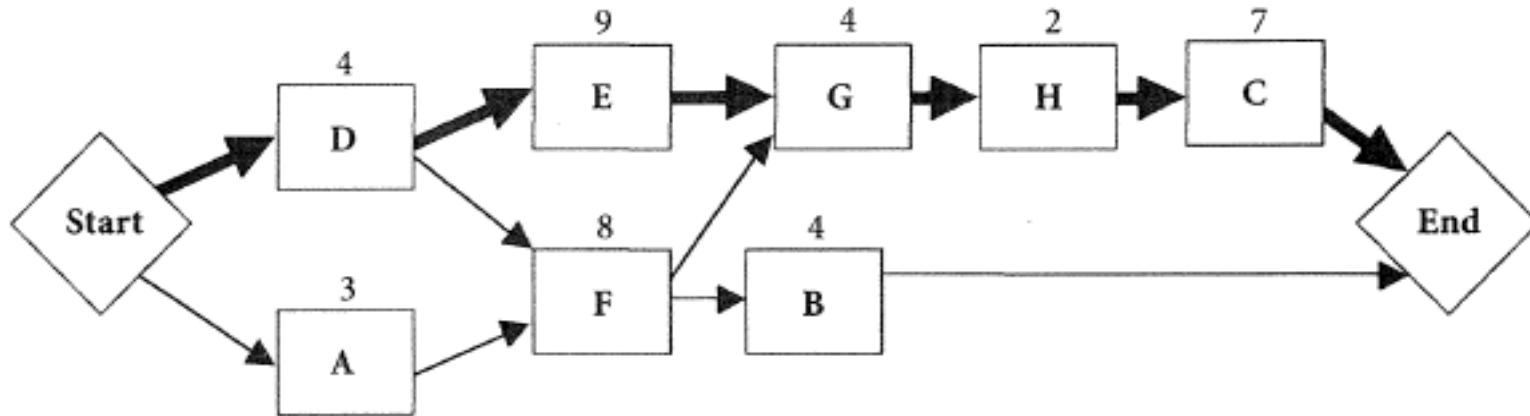
ANSWER

1- What is the length of the critical path: 18 weeks
2- what is the float of the activity B : ZERO
3- What is the float of activity C 5 weeks

Project will not be effected because the activity # C is not on the critical path and length of the path 1,3,5 is 13 weeks and adding 4 weeks that's will make the path duration 17 weeks while the critical path duration is 18
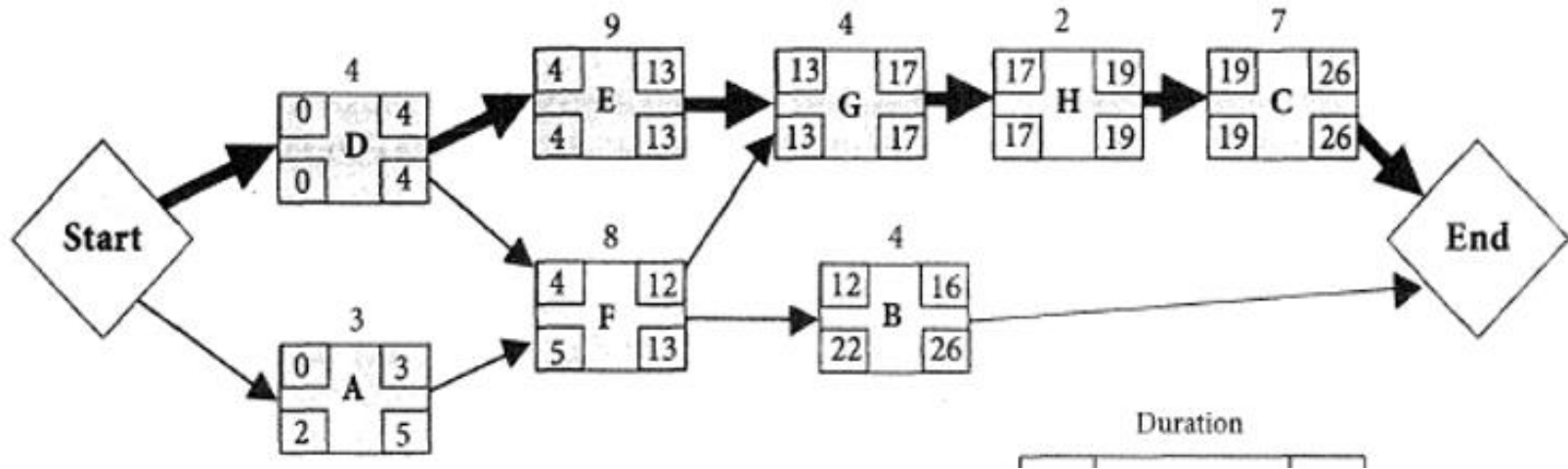
EXERCICE

1- What is the duration of the critical path ?

2- What is the float of activity A?

3- What is the float of activity F?

4- What is the float of activity B?

ANSWER

1- What is the duration of the critical path ?26

2- What is the float of activity A? 2

3- What is the float of activity F?1

4- What is the float of activity B?10

EXERCICE:

Draw a network diagram, and then answer the following questions.

You are the project manager for a new project and have figured out the following dependencies:

- Activity 1 can start immediately and has an estimated duration of 3 weeks.
- Activity 2 can start after activity 1 is completed and has an estimated duration of 3 weeks.
- Activity 3 can start after activity 1 is completed and has an estimated duration of 6 weeks.
- Activity 4 can start after activity 2 is completed and has an estimated duration of 8 weeks.
- Activity 5 can start after activity 4 is completed and after activity 3 is completed. This activity takes 4 weeks.

1- What is the duration of the critical path?
2- What is the float of activity 3 ?
3- What is the float of activity 2?
4- The resource working on activity 3 is replaced with another resource who is less experienced. The activity will now take 10 weeks. How will this affect the project?

❑ **SCHEDULE COMPRESSION**

• **FAST TRACKING:**

This technique involves taking critical path activities that were originally planned in series and doing them instead in parallel for some or all of their duration

• **CRASHING:**

This technique involves adding or adjusting resources in order to compress the schedule while maintaining the original project scope.

• **REDUCE SCOPE:** can save cost and resources but it may affect the customer satisfaction and increase risk.

• **CUT QUALITY :** May negatively impact customer satisfaction

❖ **Resource Optimization**

Resource leveling.

Resource Smoothing
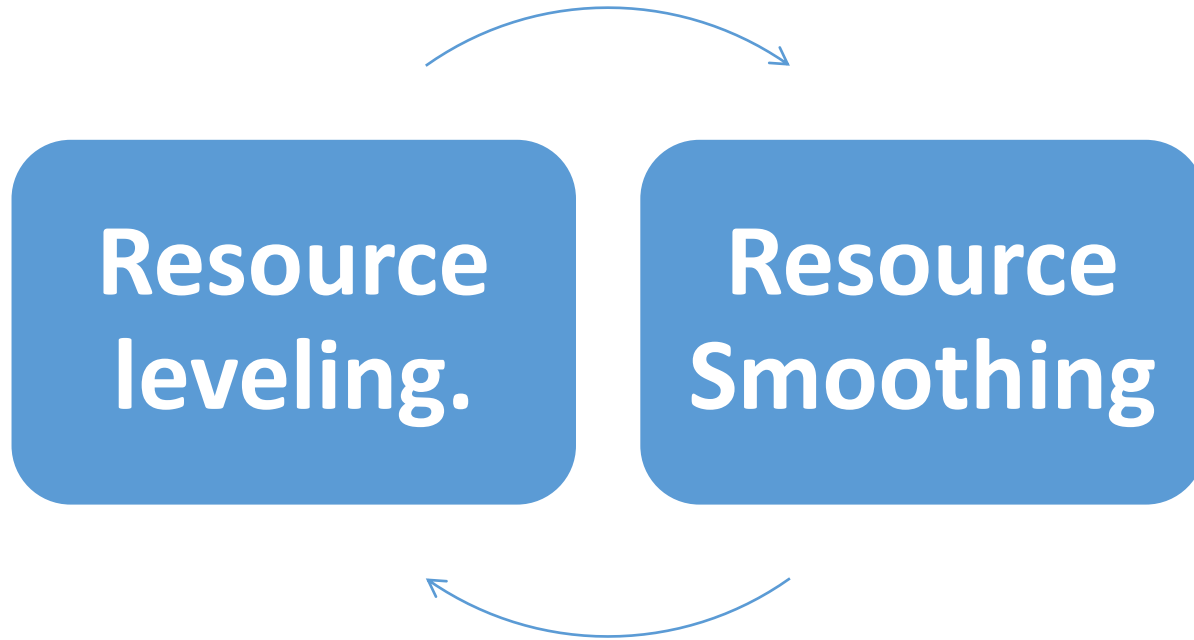
1- Resource leveling

Resource leveling is a project management technique that involves resolving overallocation or scheduling conflicts to ensure a project can be completed with the available resources. Resources include the money, materials, machines, manpower etc...

Sometimes projects don't always go as planned. You may encounter resource shortages and have to find ways to adapt to ensure project deliverables aren't affected. That's where resource leveling comes in. It allows you to readjust timelines so that a project can be finished with the available resources. With this technique, you can allocate resources accordingly to ensure goals and objectives are met.
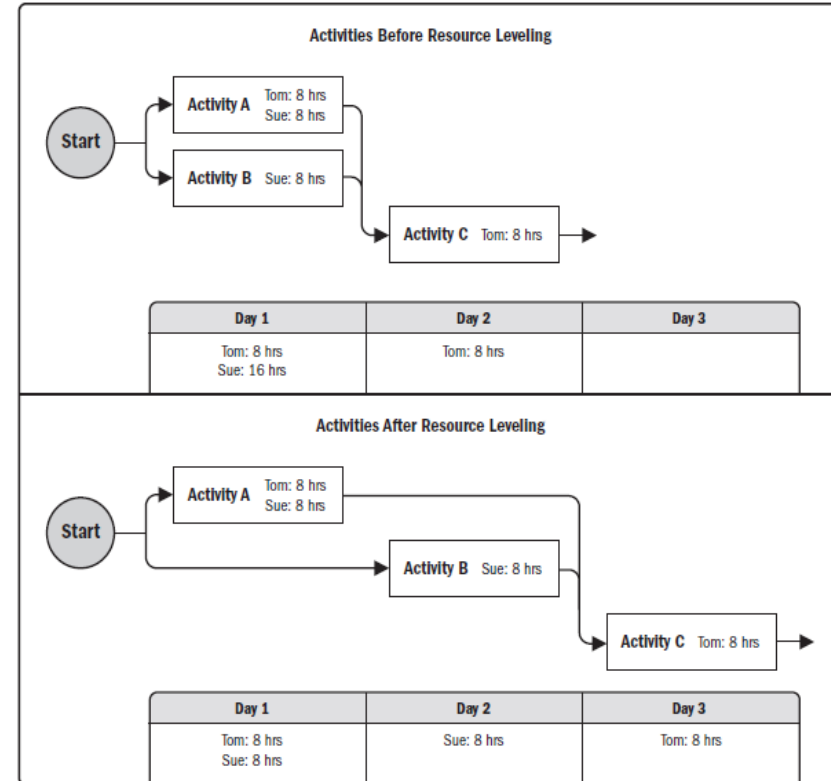
2- Resource Smoothing :

Resource smoothing is used when the time constraint takes priority. The objective is to complete the work by the required date while avoiding peaks and troughs of resource demand. A smoothed resource profile will be achieved by delaying some work

Resource Leveling	Resource Smoothing
• Main constraint is resource availability. You extend the project duration as required.	• Main constraint is time. Project Duration is fixed.
• Project End date may change.	• Project End date will not change.
• Overall Project can be delayed. Consequently, costs may be increased.	• Overall project will not be delayed, but Activities may only be delayed with in their free or total float.
• Can be done to activities on the critical path.	• Cannot be done to activities on the critical path.
• Changes are allowed to critical path.	• changes are not allowed to critical path.
• Used when resources are over-allocated.	• Used when resources are unevenly allocated.
• Resource Constrained Scheduling (RCS)	• Time Constrained Scheduling (TCS)

RL VS RS