Topic: The easiest way to calculate Critical Path, Total Float, Free Float, Early Start, Early Finish, Late Start, and Late Finish.

Presenter: Sohel Akhter, PMP, CCNA, ISMS
PMP and Six Sigma instructor, Netcom Learning Adjunct Professor, MBA program, CUNY
Agenda

- Network Diagram
- Critical Path, Near Critical Path
- Benefits of Critical Path
- Buffer/ Float Calculation
- Early Start, Early Finish, Late Start, and Late Finish calculation
- Total Float and Free Float Calculation
Network Diagram: Usually it just shows dependencies and if activity duration estimates are added then show the critical path or the duration of the project. This diagramming method is also referred to as Activity on Node (AON). Boxes are used to represent activities and arrows show dependencies.
Critical Path: The Critical Path is the longest duration path through a network diagram and determines the shortest time to complete the project.

Let's look at the Paths:

If the longest or Critical Path is 12 weeks long, the estimated duration of our project is also 12 weeks.

Few important points are listed below about critical path:

- It identifies how much individual activities can be delayed without delaying the project.
- It is the path with least (usually zero) float so none of the activities in the critical path can slip.
- Delays experienced with any activity on the critical path translate directly into delays of project completion date.

Near Critical Path: Path with very small float (slight delay can shift critical path).
**Float/Slack or Buffer Calculation:** Activities in the critical path have no float as any delay will increase the duration of the project. Now to calculate the float or buffer for activities not in the critical path we can use the following techniques

- Find out the largest path the activity is on
- Subtract the largest path duration of that activity from critical path duration

Start-A, A-B, B-C, C-Finish = 7 wks
Start-D, D-E, E-F, F-Finish = 12 wks = Critical Path!
Start-D, D-C, C-Finish = 10 wks
Buffer for A = 12 – 7 = 5 wks, buffer for B = 12 – 7 = 5 wk, buffer for C = 12 – 10 = 2 wks
Other values calculated in CPM include:

- **Early Start**: The soonest a task can begin.
- **Early Finish**: The soonest a task can end.
  
  \[ \text{Early Finish} = \text{Early Start} + \text{Duration} - 1 \]

- **Late Start**: The latest a task can begin without effecting the project duration.
  
  \[ \text{Late Start} = \text{Early Start} + \text{Float} \]

- **Late Finish**: The latest a task can end without effecting the project duration.
  
  \[ \text{Late Finish} = \text{Late Start} + \text{Duration} - 1 \]

- **A Forward Pass** is used to calculate Early Start and Early Finish.
- **A Backward Pass** is used to calculate Late Start and Late Finish.

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![Diagram of project network with nodes A, B, C, D, E, F, Start, and Finish, with arrows indicating the flow between tasks, and values ES, EF, LS, LF, and Float calculated.]

- **Buffer**: A, 5 wks
  - B, 5 wks
  - C, 2 wks

PMP Bootcamp, Sohel Akhter (PMP, ISMS, CCNA) - sohel_akhter_pm@yahoo.com, 347-536-2811
Types of Float/Slack

- **Free Float**: Amount of time an activity can be delayed without affecting the Early Start of its successor.
- **Total Float**: Amount of time an activity can be delayed without affecting the Project Completion date.

For E
Total Float: Critical path duration – Longest path of E = 38 – 19 = 19 wks
Free Float: 16,17,18,19 = 4 wks
Draw a network diagram and answer the questions.

- 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. It has an estimated duration of 4 weeks.

1. What is the duration of the critical path? Start, Act1, Act2, Act4, Act5, Finish = 18 wks
2. What is the float of activity 3? 18 – 13 = 5 wks
3. What is the float of activity 2? 0
4. What is the float of the path with the longest float? 5 wks
5. A new activity 6 is added to the project. It will take 11 weeks to complete and must be completed before activity 5 and after activity 3. Management is concerned that adding the activity will add 11 weeks to the project. How much longer the project will take?

New critical path is Start, Act1, Act3, Act6, Finish = 24 wks, Old critical path was 18 wks. We are adding 24 – 18 = 6 wks.
1. What is the duration of the critical path?
Start, D, E, G, H, C, Finish = 32 wks
Start, D, F, G, H, C, Finish = 31 wks
Start, D, F, B, Finish = 16 wks
Start, A, F, B, Finish = 18 wks
Start, A, F, G, H, C, Finish = 33 wks , critical path

1. To shorten the length of the project, the sponsor has offered to remove the work of activity E from the project, making activity D the predecessor to activities G and F. What will be the effect?
No impact

1. What is the float of activity B? 33 – 18 = 15 wks
2. What is the float of activity E? 33 – 32 = 1 wk
3. What is the float of activity D? 33 – 32 = 1 wk
Questions?