Module 3: Project Time Management

This module, we will discuss Gantt Charts, Critical Path Methods, use of automation tools, as well as many other topics relating to time management.

Think about how you use to manage time in your personal life, what causes you to successfully manage your time? Do you use any tricks or tools? Do you often mismanage your time? If so, what things cause these delays or setbacks?

Module 3

Learning Objectives

- Describe a Gantt Chart
- Create a Gantt Chart
- Define Critical Path Method, Arcs, and Nodes
- Create a critical path diagram
- Identify and calculate slack time
- Identify Automation Tools
- Schedule Controls

Do you recall the concepts from last module on Work Breakdown Structure? Write your thoughts on how it can help in Project Schedule Management.

In last module we discussed:

- Defining a work breakdown structure
- Creating a work breakdown structure
- Defining work packages
- Creating a work breakdown structure with work packages
- Defining a WBS dictionary
- Defining a control account and how to use it to track your progress.

Module 3

Time Management

What is Gantt chart?

- One of the easiest and most used tools to manage a project is a Gantt chart
  - It was created in 1917 by Henry Gantt
  - It is widely recognized as the oldest form of scheduling tool
  - It was first used in building ships and aircrafts during World War I
- Graphical way of showing task durations and project schedule
- Does not explicitly show relationships between tasks
- Strengths: Easy to understand and easy to use
- Weaknesses: Limited use for complicated project tracking and lacks detail

Your Notes:

Sample WBS and Schedule

- Two Parts X and Y: Manufacture and Assembly

Job #	Description	Immediate Predecessors	Time [min]
A	Start		0
B	Get materials for X	A	5
C	Get materials for Y	A	30
D	Mold X in form	B,C	15
E	Mold Y in form	B,C	30
F	Turn Y on lathe	E	40
G	Assemble X and Y	D,F	10
H	Finish	G	0

Module 3

Time Management *Continued*

In the previous WBS and Schedule example:

1. Each task is assigned a job number or a letter
2. Each task has a description
3. Each task has a precedent (i.e the tasks that need to be completed before starting the particular task)
4. Each task is assigned an amount of time for its completion

Building a Gantt Chart

- Two Parts X and Y: Manufacture and Assembly

Task	Description	Preceding Tasks	Time in minutes
			0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115
A	Start		
B	Get Materials for X	A	
C	Get Materials for Y	A	
D	Mold X in Form	B,C	
E	Mold Y in Form	B,C	
F	Turn Y on Lathe	E	
G	Assemble X and Y	D,F	
H	Finish	G	

Your notes:

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Critical Path Method Overview

Critical Path Method (CPM)

The Critical Path is the longest path through a project that completes all the required components.

First Step:

- Determine the level of detail and identify tasks based on WBS
- List all tasks in a table with
  - A number or letter combination used to identify tasks and subtasks
  - A brief description of the task
  - Ensure that predecessors appear before each task and show relationship
  - Task duration (must remain consistent throughout the project)
- Group tasks in "technological order"
  - Ensure that all preceding tasks are listed BEFORE adding a new task
  - Do not iterate
  - Job **a** precedes **b** precedes **c** precedes **a**

Sample WBS and Schedule

- Two Parts X and Y: Manufacture and Assembly

Job #	Description	Immediate Predecessors	Time [min]
A	**Start**		**0**
B	**Get materials for X**	**A**	**5**
C	**Get materials for Y**	**A**	**30**
D	**Mold X in form**	**B,C**	**15**
E	**Mold Y in form**	**B,C**	**30**
F	**Turn Y on lathe**	**E**	**40**
G	**Assemble X and Y**	**D,F**	**10**
H	**Finish**	**G**	**0**

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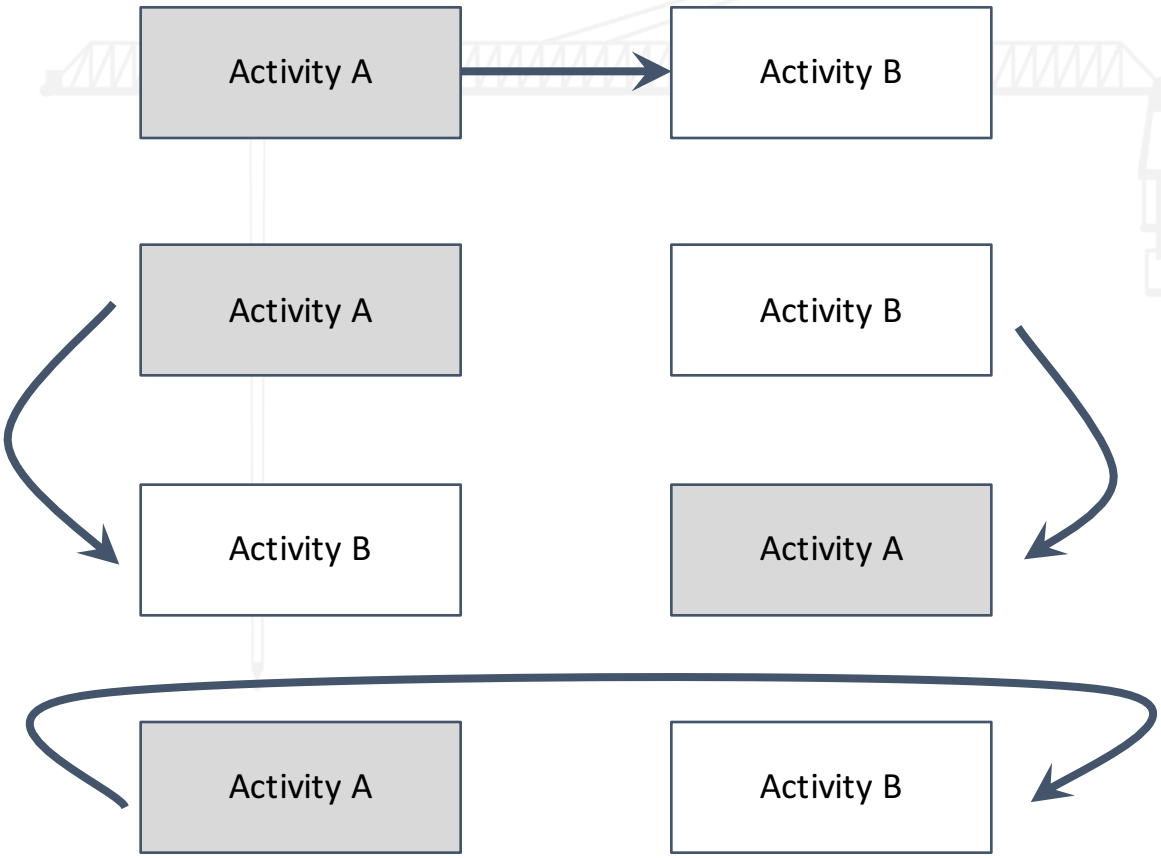
Critical Path Method Overview *Continued*

How do you show the relationship of the tasks?



Notes:

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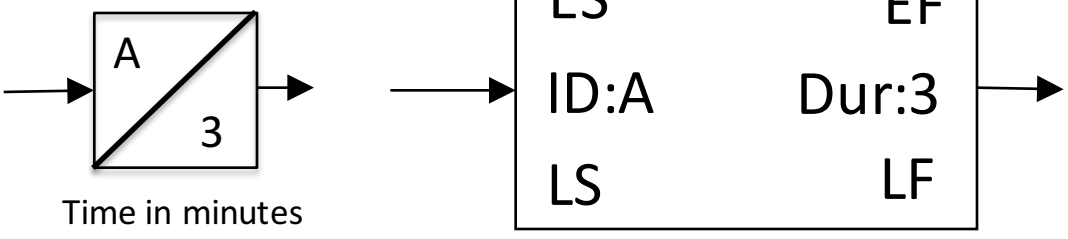
Types of Diagrams

Next Steps

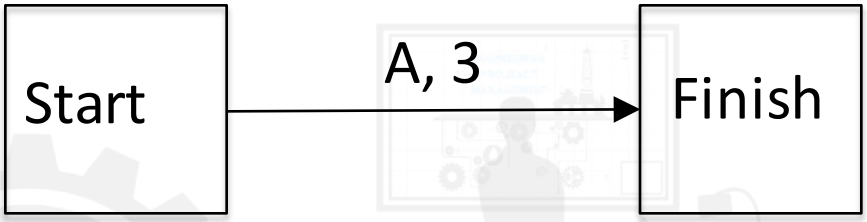
- Chose the type of diagram you want to use
  - Activity on the Node or
  - Activity on the Arc
- Each has it's advantages, but represent the same thing
- The tasks are represented using different shapes.

Your Notes:

Activity on Node: AON-Tasks are indicated by Circles or Boxes inside the diagram and represent a **Node**



Activity on Arrow: AOA-Tasks are indicated by Arcs or uni-directional arrows on a diagram and the **NODES** represent "states" of a project



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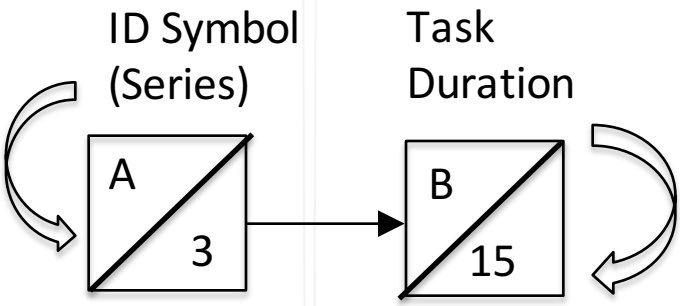
Types of Diagrams *Continued*

Next Steps

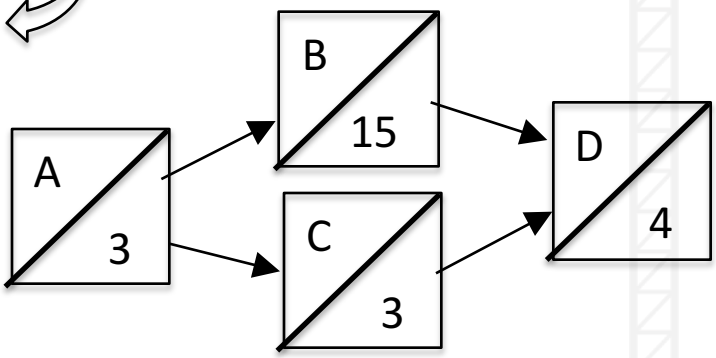
After you have determined which type of graph AON or AOA and the precedence, label the nodes and show durations according to precedence

What is the shortest time for completion for the Parallel tasks example below?

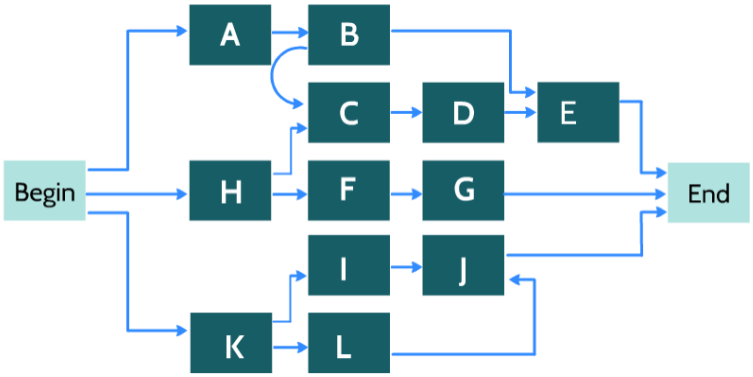


"B can only start after A is completed"

(Parallel)



"B and C do not depend on each other"



Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – 5th edition, Project Management Institute Inc., 2013, Page 160. Figure 6-11

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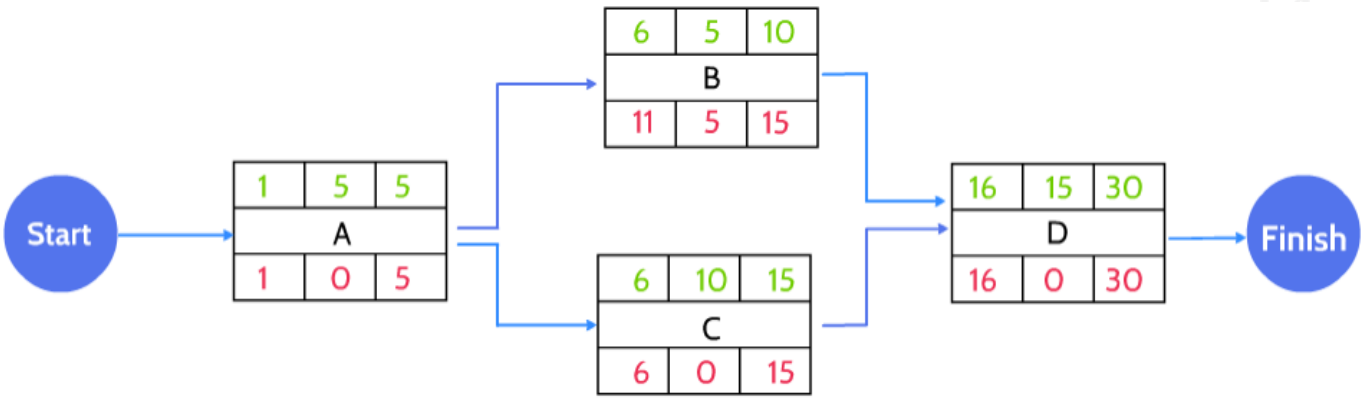
Activity on Node Example

Project Graph - AON

- Draw each task as a rectangle
- Connect each job with immediate predecessor(s) using unidirectional arrows "→"
- " Start" is the only task without a precedent
- "Finish" is the last task of the project
- "Start" and "Finish" both have a duration of "0"
- Connect all tasks with arrows following precedence
- Calculate the total time of each path
- The Path with the longest total time is the **"critical path"**
- There can be multiple critical paths in a project. The critical path is **the minimum time to complete project**.

Notes:

Critical Path Method Example



Thinking ahead: *What stipulations should exist that will make a Critical Path Method work?*

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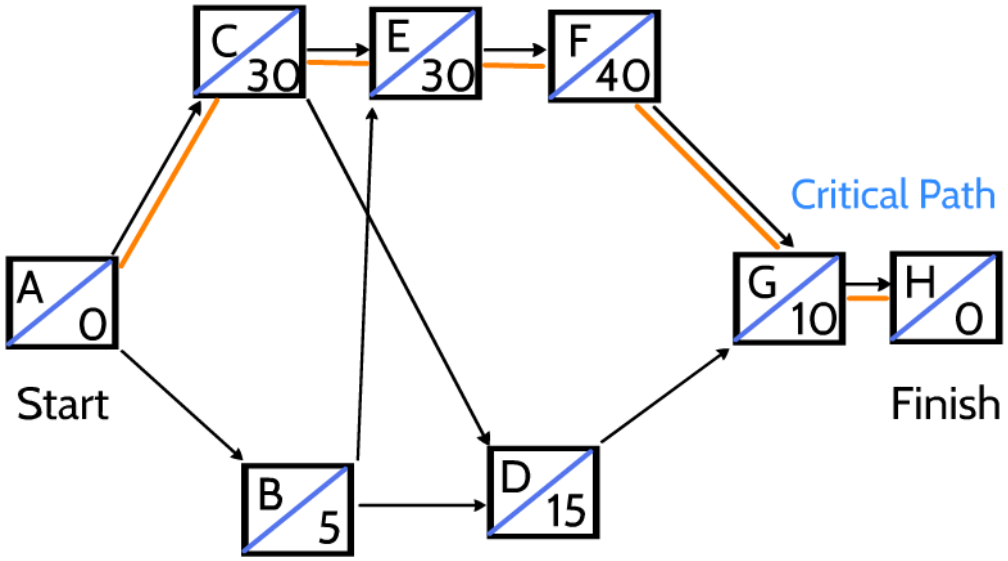
Finding Critical Path

Project Diagram



4 unique paths: A,C,E,F,G,H; A,C,D,G,H; A,B,D,G,H; A,B,E,F,G,H

110 55 25 85

Sample WBS and Schedule

- Two Parts X and Y: Manufacture and Assembly

Job #	Description	Immediate Predecessors	Time [min]
A	Start		0
B	Get materials for X	A	5
C	Get materials for Y	A	30
D	Mold X in form	B,C	15
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F	Turn Y on lathe	E	40
G	Assemble X and Y	D,F	10
H	Finish	G	0

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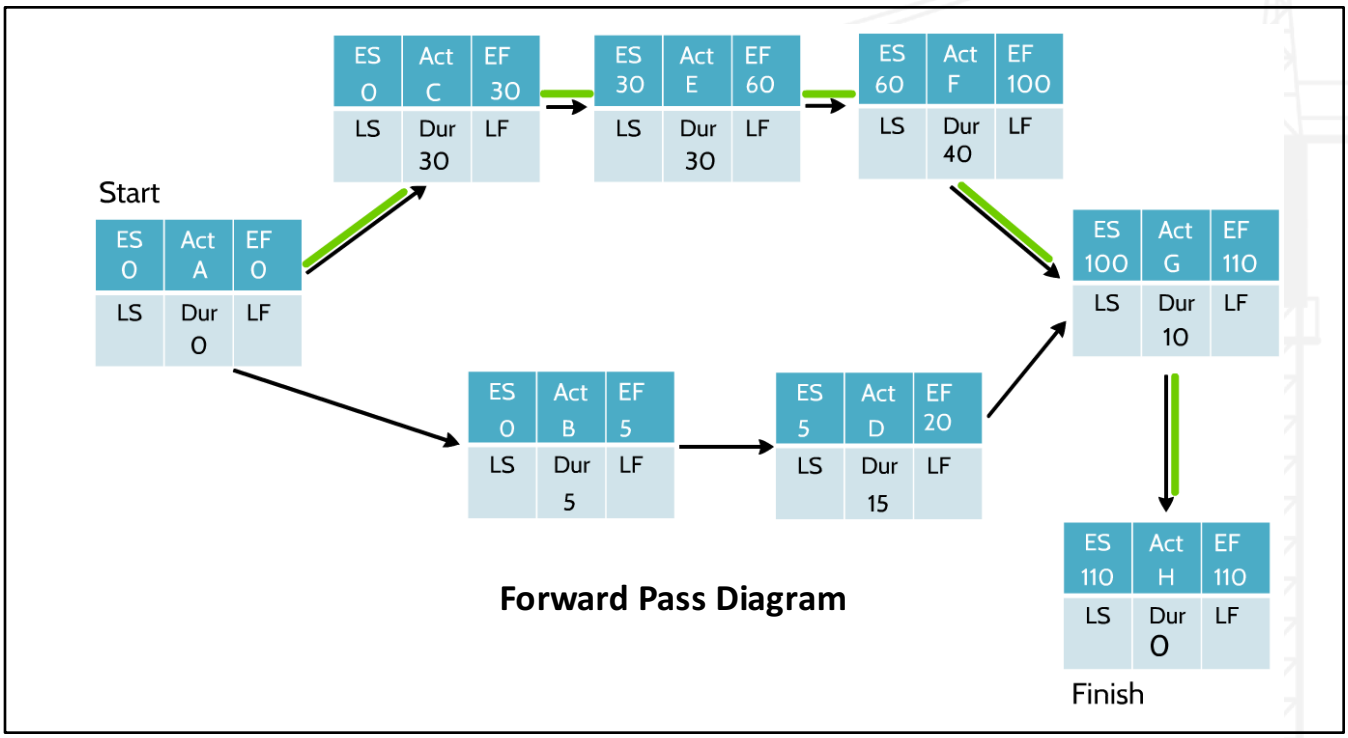
Forward and Backward Pass Diagram

Key

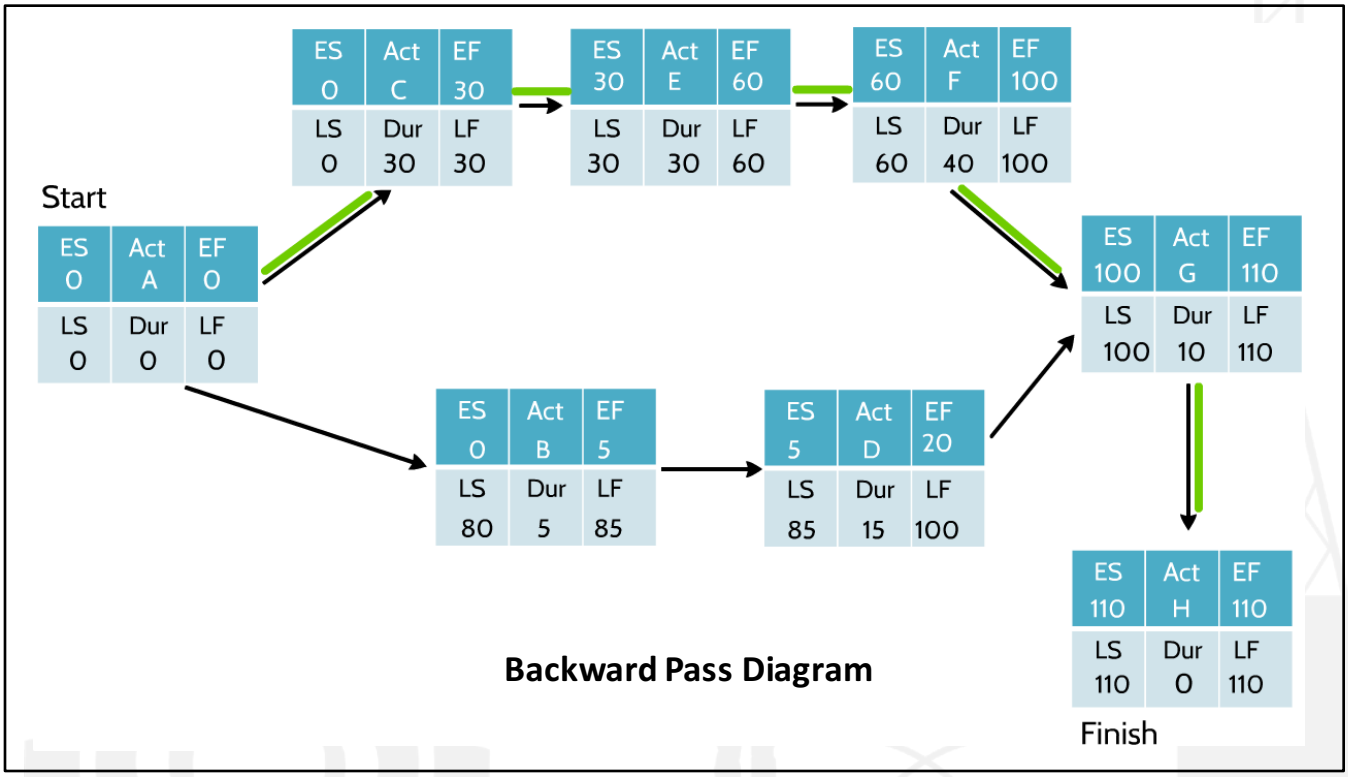
Early Start	Act	Early Finish
Late Start	Dur	Late Finish

All numbers in minutes

For Two Parts X and Y: Manufacture and Assembly Example



Forward Pass Diagram



Backward Pass Diagram

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Total Slack

Some tasks have **ES=LS** --> no slack

- Total Slack of a task **TS=LS-ES**
- **Maximum amount of time a task may be delayed beyond its early start without delaying project completion**
- Activities in the critical path do not have slack
  - If you delay any task in the critical path it will delay the project
  - Total Slack in critical path = 0
- Slack time is a useful tool and allows the project manager to shift resources as necessary
- Total Slack of a task: TS = LF - EF or TS = LS - ES

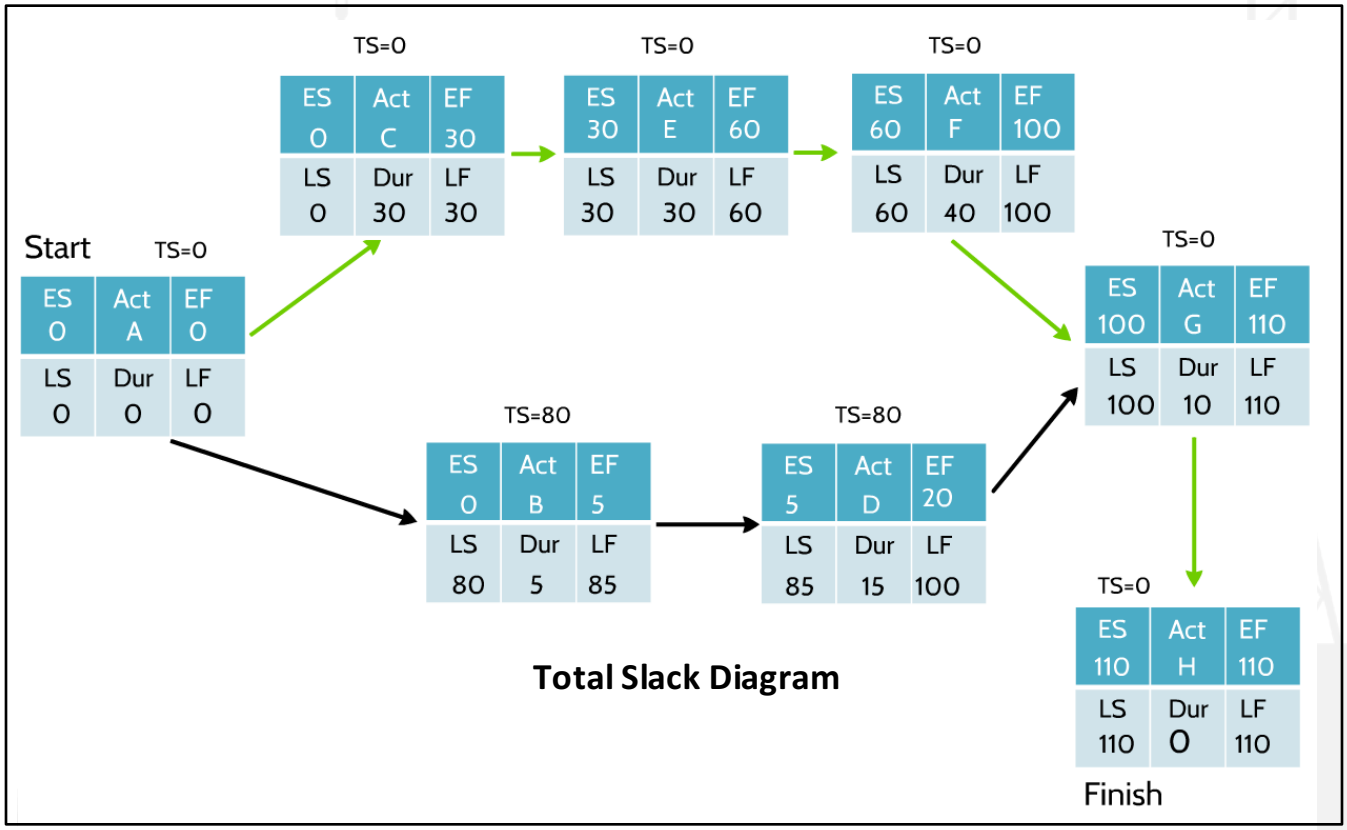
Notes:

Key

Early Start	Act	Early Finish
Late Start	Dur	Late Finish

All numbers in minutes

For Two Parts X and Y: Manufacture and Assembly Example



Total Slack Diagram

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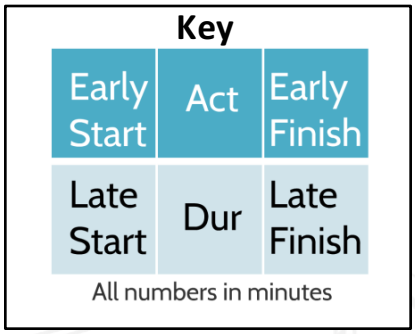
Free Slack



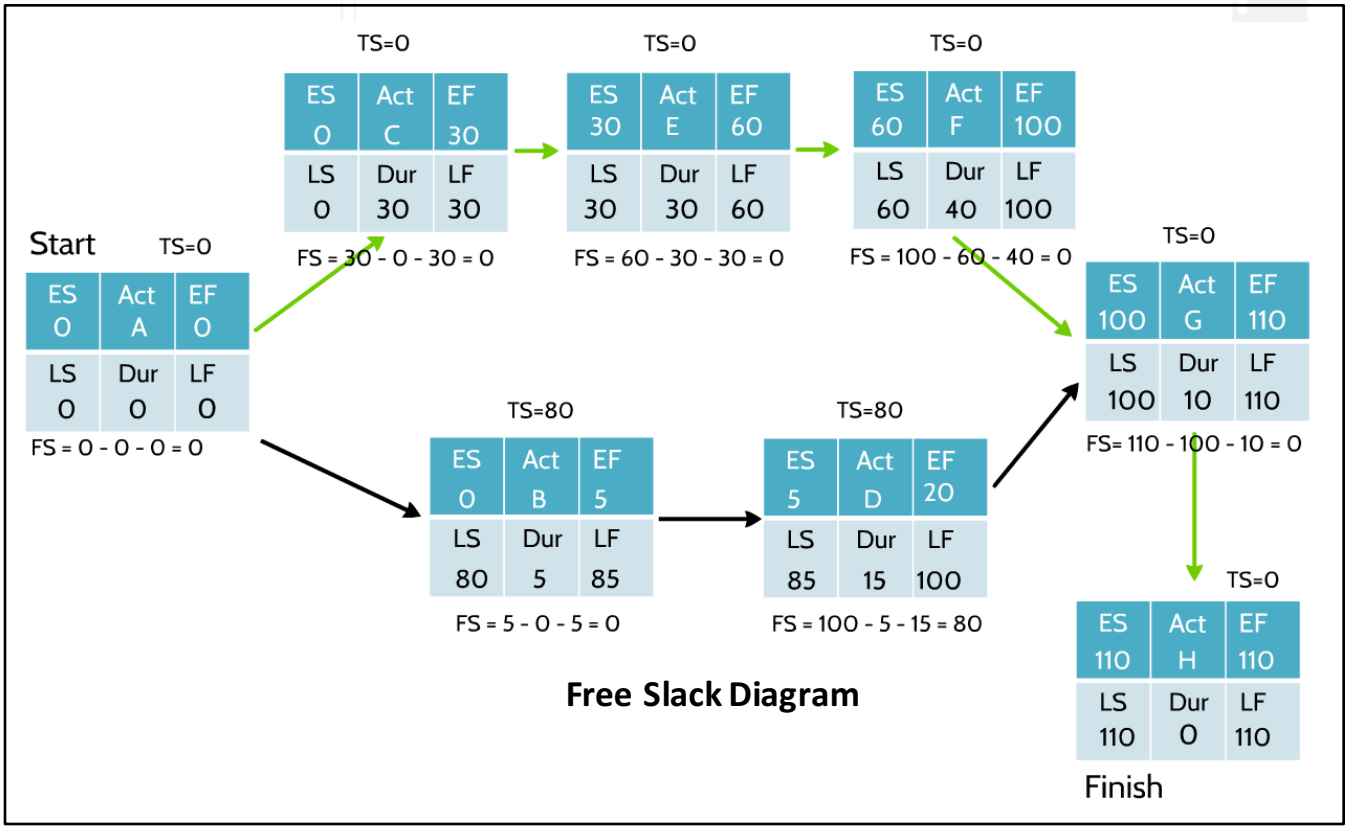
Free Slack

Free Slack (FS) is the amount a task can be delayed without delaying the early start (ES) of any other task.

Calculate Free Slack

Free Slack (FS) = Minimum value of ES of all successors - ES of current activity - Duration of current activity

For Two Parts X and Y: Manufacture and Assembly Example



Free Slack Diagram

Notes:

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Things that can go wrong

Main CPM Errors that people make -

- Estimated job times are wrong
- Predecessor relationships may contain cycles → "cycle error"
- List of prerequisites contains more than the immediate predecessors
- You may have overlooked some predecessor relationships
- Some predecessor relationships may be listed that are spurious
- Some tasks may be missing

Gradual Refinement of CPM -

- **Task Times**
  - Given rough time estimates construct CPM chart
  - Re-estimate times for **CP** and those with very small **TS**
  - Iterate until the critical path is stable
  - Focus attention on a subset of tasks
- **Predecessor Relationships**
  - Check algorithmically for cycle errors and pre-predecessor errors
  - Cancel all except immediate predecessor relationships
- **Wrong or Missing Facts**
  - Cannot be detected by computers!

Your Notes:

Module 3

Strategies for Dealing

Control Schedule

- The process of monitoring the status of a project throughout the project and how to manage change if necessary.
    - Quickly identifies deviations from the schedule and plan
    - Typically, done by measuring the current work by the work estimates based on time.
    - May require reprioritization and change
- How do you measure performance against the schedule?
    - Compare progress along the CP
    - Critical chain (comparing built in buffers against the delivery date)
    - Earned Value Management
        - Looking at variances and their impacts on parts of the project
        - Some are more impactful than others
            - CP vs non-CP

What can you do if you find you're off schedule?

- Change request
- Update your schedule
- Choose an appropriate corrective action

Notes:

Automation Tools -

Automation helps with larger projects

- Use automation to help build you schedule and CP
- Helps track status of the project
- Commercially available
- Internal to the organization (Saves time and money)

Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK^{R} Guide) – 5th edition, Project Management Institute Inc., 2013, Page 185

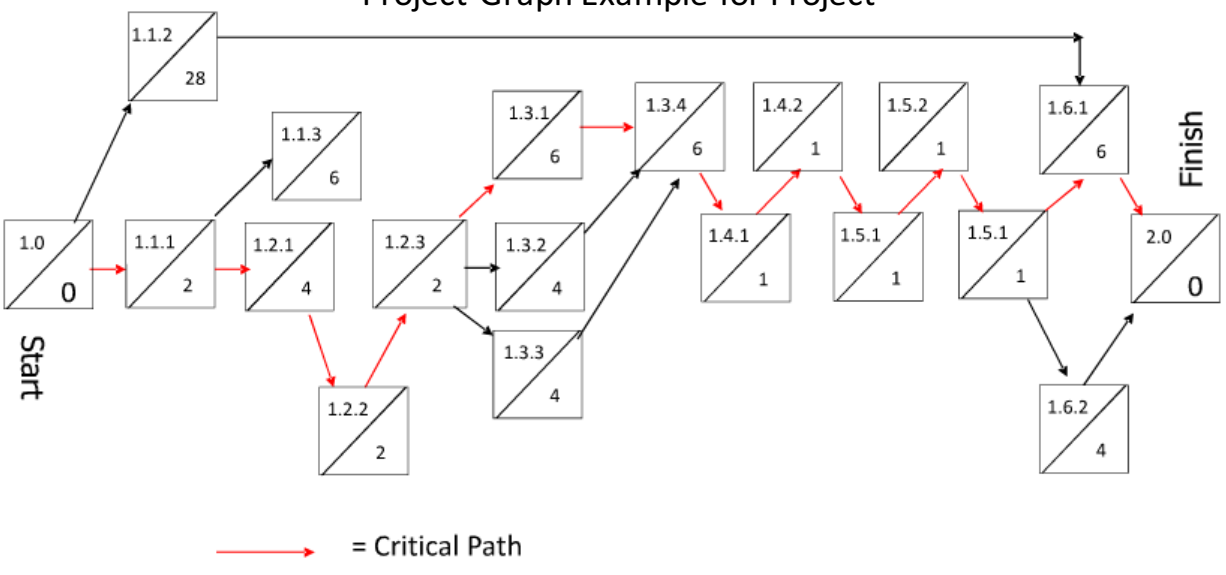
Module 3

Resources

WBS Buildup: Example - Develop an electric car

1.1. Initiating	1.3. Construction	1.5. Competition
1.1.1 Develop Scope and Plan	1.3.1 Purchase Material	1.5.1 Travel
1.1.2 Engage Stakeholders	1.3.2 Rent Equipment	1.5.2 Event
1.1.3 Raise Funds	1.3.3 Engagement Specialist	1.6. Close Out
1.2. Planning	1.3.4 Complete Assembly	1.6.1 Disassemble Car
1.2.1 System Design	1.4. Construction	1.6.2 Reconcile Accounts and Finalize Payments
1.2.2 Cost Estimate	1.4.1 Component Testing	
1.2.3 Approvals	1.4.2 Track Testing	

Project Graph Example for Project



Module 3 Conclusion

Modules objectives:

- ❑ Describe a Gantt Chart
- ❑ Create a Gantt Chart
- ❑ Define Critical Path Method, Arcs, and Nodes
- ❑ Create a critical path diagram
- ❑ Identify and calculate slack time
- ❑ Identify Automation Tools
- ❑ Schedule Controlst

Module Assignments:

- ❑ Peer Review: Project Schedule Assignment
- ❑ Discussion:Kaz and Tom weekly conclusion
- ❑ Quiz: End of Module 3 Quiz

Summarize this Module and jot down how you will personally use this material: